Chas Spell
Environmental Consultant
APS Gas-Oil Plants

Tel: 602-250-1383
Fax: 602-250-1416
Charles.Spell@aps.com

Mail Station 4120
PO Box 53999
Phoenix, Arizona 85072-3999

October 4, 2007

Certified Mail

Ms. Nancy Wrona
Arizona Dept. of Environmental Quality
Director, Air Quality Division
1110 W. Washington St.
Phoenix, AZ 85007

Re: Arizona Public Service West Phoenix Power Plant Potentially Subject to BART Determination Response

Dear Ms. Wrona:

Thank you for your correspondence dated July 13, 2007 that discussed ADEQ's determination that certain Arizona Public Service (APS) West Phoenix Power Plant (West Phoenix) emission units have been identified as being potentially subject to best available retrofit technology (BART). The correspondence indicated that ADEQ derived this conclusion by first identifying which West Phoenix emission units are eligible to be potentially subject to BART based on categorical sources, constructions dates, and potential to emit. ADEQ determined that the only West Phoenix emissions units that are eligible to be potentially subject to BART are the combined cycle units CC1, CC2, and CC3. Based on the air impact modeling results of these emission units, ADEQ then determined the units to be potentially subject to BART because they either caused or contributed to visibility impairment on a Class I area. For this assessment, your correspondence indicated that Arizona considers a change of 1.0 deciview (dV) or greater as causing visibility impairment, and a change of 0.5 dV or greater as contributing to a visibility impairment.

After a thorough review of your correspondence, APS concurs with ADEQ's designation of the West Phoenix combined cycles CC1, CC2, and CC3 as being potentially subject to BART eligible; however, APS does not concur with ADEQ's position that these emission units are potentially subject to BART. ADEQ designated the identified emission units as being potentially subject to BART because the air impact modeling results indicated a 0.69dV impact on the Superstition Wilderness area and a 0.64 dV impact on the Mazatzal Wilderness area, both due to NOx emissions. APS believes, however, that these results are inaccurate because the air impact modeling is based on erroneous input data. Specifically, APS identified the following errors.

- The data used as the CC3 pound per hour emission rates are actually ton per year emission caps for multiple West Phoenix units. CC3 is equipped with an SCR and the actual emission rates are substantially lower than the values used in the modeling.

- The CC3 stack height was assumed to 54 feet; however, the actual stack height is 82 feet.

- The air impact modeling used West Phoenix emission rates associated with fuel oil combustion. While the West Phoenix units do have the capability to combust fuel oil, it is not a normal operating scenario for these units. The normal operating scenario for the West Phoenix units is combustion of pipeline quality natural gas, as Maricopa County prohibits the combustion of fuel oil except during periods of natural gas curtailments. Accordingly, the WRAP modeling should have used emission rates associated with natural gas combustion rather than fuel oil combustion.

For sources who do not concur with ADEQ's determination, your correspondence provides an option for a source to demonstrate that the designated emission units are not potentially subject to BART. Pursuant to this option, APS contracted ENVIRON to repeat the West Phoenix air impact modeling using the exact same modeling protocol that was used for the initial WRAP Regional Modeling, but with the correct West Phoenix emission rate data. The results of this modeling indicate the maximum three-year average 98th percentile visibility impact from the designated West Phoenix units is not 0.69dV, but rather is only 0.24 dV. A complete copy of the modeling report is enclosed.

Accordingly, because the actual visibility impact is far below the thresholds for causing or contributing to visibility impairment, APS believes the designated West Phoenix emission units are not potentially subject to BART. APS therefore respectfully requests ADEQ to reconsider their determination based on the enclosed information that the West Phoenix emission units are potentially subject to BART, and that the summary document describing visibility impacts of Arizona BART eligible sources and WRAP BART modeling results be updated with the correct modeling input data and results.

Sincerely,

Chas Spell

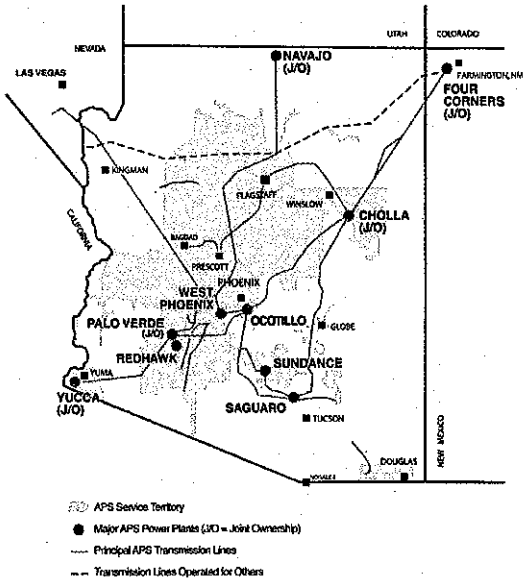
Chas Spell

Enclosure: Revised CALPUFF Best Available Retrofit Technology (BART) Modeling of the Arizona Public Service West Phoenix Generating Station

cc: Mr. Eric Massey
ADEQ - Manager, Air Quality Compliance

Final Report

Revised CALPUFF Best Available Retrofit Technology (BART) Modeling of the Arizona Public Service West Phoenix Generation Station



Prepared for:

Arizona Public Service

Prepared by:

Ralph Morris

ENVIRON International Corporation
773 San Marin Drive, Suite 2115
Novato, California 94998

Zion Wang

University of California at Riverside

October 3, 2007

EXECUTIVE SUMMARY

Revised CALPUFF modeling was conducted to estimate whether emissions from the Arizona Public Service (APS) West Phoenix Generating Station (WPGS) are reasonably anticipated to cause or contribute to visibility impairment at a Class I area and would therefore be subject to Best Available Retrofit Technology (BART) control requirements. The Western Regional Air Partnership (WRAP) Regional Modeling Center (RMC) performed CALPUFF subject-to-BART modeling of BART-eligible sources in Arizona for the Arizona Department of Environmental Quality (ADEQ). The ADEQ provided the WRAP RMC with emissions for the WPGS assuming that it was using natural gas and fuel oil in its combustion turbines. Since BART modeling guidance requires the use of the maximum actual 24 –hour emissions, then the emissions corresponding to the combustion turbines operating on fuel oil were used in the WRAP RMC subject-to-BART modeling. However, Maricopa County only allows the combustion of fuel oil in the WPGS turbines during natural gas curtailment conditions. In fact, the WPGS has only used natural gas for its electricity generation since 1999. According to BART modeling guidelines, subject-to-BART modeling should be conducted using the maximum actual 24-hour average emissions during 2001-2002, which would correspond to WPGS using natural gas not fuel oil. Thus, revised CALPUFF BART modeling was performed using all of the same assumptions as used in the WRAP RMC analysis only assuming WPGS was fired by natural gas instead of fuel oil. Assuming WPGS is using natural gas reduces SO2, NOx and PM 2.5 emissions by approximately 99%, 60% and 88%, respectively, over using fuel oil.

The BART guidance suggests that a significant contribution to visibility impairment occurs when the 98th percentile change in deciview (del-dv) impact is greater than 0.5 del-dv. The WRAP CALPUFF BART modeling assuming WPGS was using fuel oil estimated a maximum three-year average (2001-2003) 98th percentile visibility impact of 0.76 del-dv, which is greater than the 0.5 del-dv significant contribution to visibility impairment threshold. CALPUFF estimates a maximum three-year average (2001-2003) 98th percentile visibility impact of 0.24 del-dv when WPGS is assumed to be powered by natural gas, which is substantially lower than the 0.5 significance threshold.

In conclusion, when WPGS is assumed to be using natural gas the CALPUFF estimated visibility impacts at all Class I areas are well below the 0.5 del-dv significant contribution threshold.

1.0 INTRODUCTION

BACKGROUND

Federal law requires Best Available Retrofit Technology (BART) for any BART-eligible source that "emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility" in any mandatory Class I federal area. Pursuant to federal regulations, states have the option of exempting a BART-eligible source from the BART requirements based on dispersion modeling by demonstrating that the source cannot reasonably be anticipated to cause or contribute to visibility impairment in a Class I area.

According to 40 CFR Part 51, Appendix Y (EPA BART Guidelines; EPA, 2005), a BART-eligible source is considered to "contribute" to visibility impairment in a Class I area if the modeled 98th percentile change in deciviews (del-dv) is equal to or greater than the "contribution threshold" that has been defined as 0.5 del-dv. Any BART-eligible source determined to cause or contribute to visibility impairment in any Class I area is subject to BART.

Once a source has been determined to be subject-to-BART, an engineering analysis is performed to determine an appropriate level of control, or whether no additional control is appropriate.

WRAP SUBECT-TO-BART MODELING

The Western Regional Air Partnership (WRAP) Regional Modeling Center (RMC) performed subject-to-BART visibility modeling using the CALMET/CALPUFF modeling system. CALPUFF was set up for the three years of 2001-2003 and used to estimate the visibility impacts of BART-eligible sources in seven states in the WRAP region: Alaska, Arizona, Montana, Nevada, New Mexico, South Dakota and Utah. The WRAP RMC subject-to-BART CALPUFF modeling is available on the RMC BART modeling webpage:

http://pah.cert.ucr.edu/aqm/308/bart.shtml

Prior to conducting the subject-to-BART CALPUFF modeling, the RMC prepared and distributed a Modeling Protocol:

http://pah.cert.ucr.edu/aqm/308/bart/WRAP_RMC_BART_Protocol_Aug15_2006.pdf

The reader is referred to the WRAP RMC BART webpage for more details on the WRAP BART CALPUFF modeling.

WRAP APS WPGS CALPUFF BART Modeling

When Arizona Public Service (APS) reviewed the WRAP RMC BART CALPUFF modeling for their West Phoenix Generating Station (WPGS) they noted that higher SO2 and NOx emissions were assumed than actually emitted by the plant. The three units at the WPGS are designed to combust both natural gas and fuel oil. The Arizona Department of Environmental Quality (ADEQ) provided the WRAP RMC with emissions for the WPGS corresponding to using both

natural gas and fuel oil. For BART modeling, the maximum 24-hour actual emissions during the evaluation period (2001-2003) should be used. Thus, for the subject-to-BART modeling the higher SO2 and NOx emissions associated with the WPGS combusting fuel oil were used. However, Maricopa County only allows the combustion of fuel oil in the WPGS during natural gas curtailments. In fact, outside of a few hours of testing to assure the WPGS units could still operate on fuel oil, the WPGS hasn't used fuel oil since 1999. In addition, in 2001 WPGS installed Selective Catalytic Reduction (SCR) NOx control technology on Unit 3 that reduced NOx emissions from WPGS unit 3 by approximately 87%.

WPGS also noted another discrepancy with the modeling input information that ADEQ provided the WRAP RMC. ADEQ erroneously listed ton per year emission caps as the Unit 3 natural gas combustion pound per hour emissions rates for SO2, NOx, and PM-10. The actual pound per hour emission rates for Unit 3 should be the same as Units 1 and 2 for 2001, and for 2002 and the 2003 NOx emission rate for Unit 3 should be reduced from 255.8 pounds per hour to 34.3 pounds per hour as a result of installing the SCR.

PURPOSE

The purpose of this work is to rerun the WRAP RMC subject-to-BART CALPUFF modeling database using corrected emissions for the three units of the WPGS assuming they are operating using natural gas.

2.0 CALPUFF MODELING RESULTS

Below we discuss the revised subject-to-BART CALPUFF modeling results assuming the three units at WPGS are operating on natural gas and compare them to the results generated by the WRAP RMC that assumed the WPGS units were burning fuel oil.

WRAP CALPUFF MODELING

The WRAP RMC CALPUFF modeling of the WPGS is documented on the RMC BART modeling webpage (http://pah.cert.ucr.edu/aqm/308/bart.shtml). Figure 2-1 displays the WRAP Arizona CALPUFF BART modeling domain that includes the WPGS. The WPGS location is the furthest west of the two red dots in Figure 2-1 immediately west of the Superstitious Wilderness Area (supe). Outside of changing the emissions, and for 2002-2003 some stack parameters that is discussed below, the modeling methodology for the revised CALPUFF BART modeling used the same assumptions as used in the WRAP BART CALPUFF modeling.

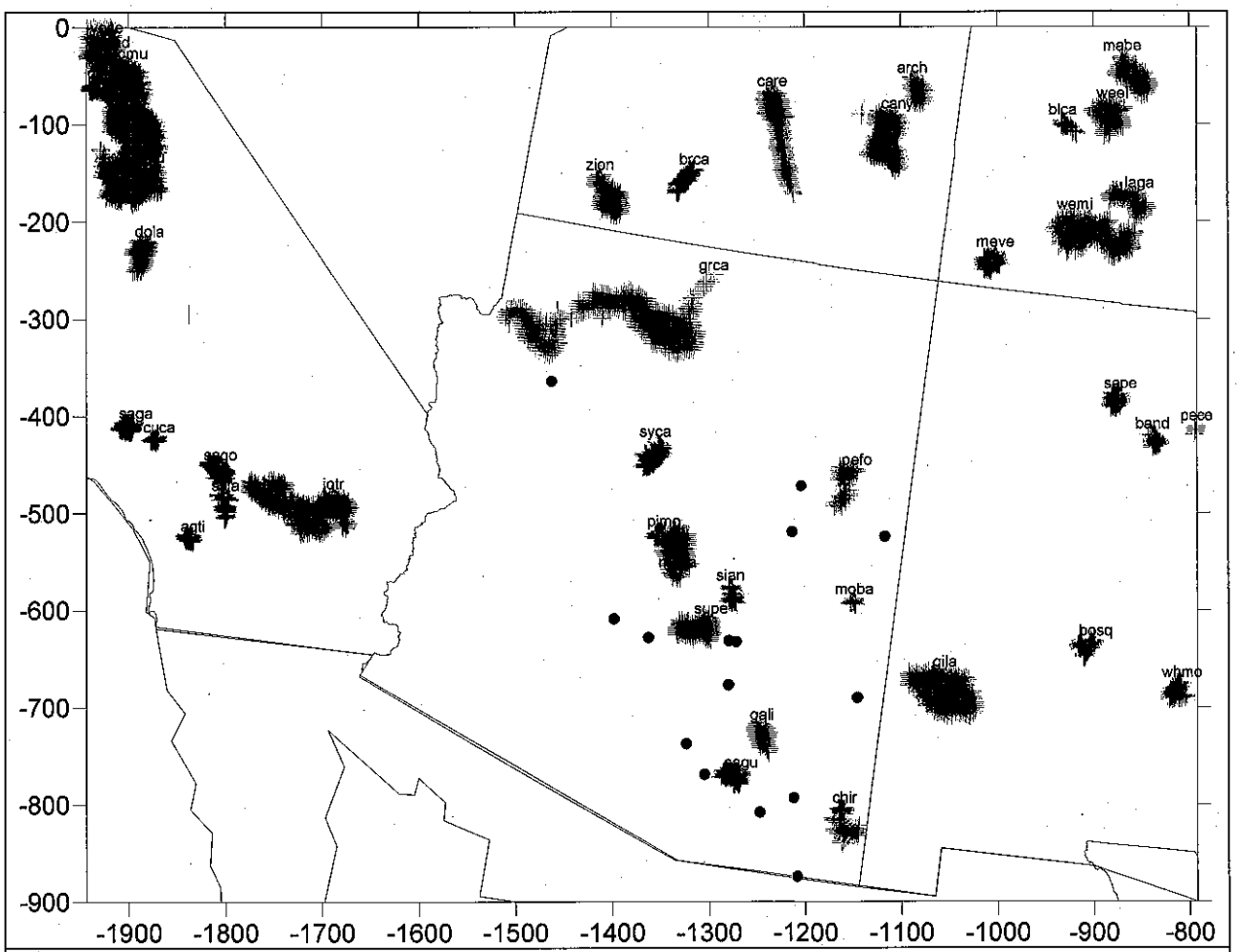


Figure 2-1. Arizona CALMET/CALPUFF modeling domain and relationship between Arizona potential BART-eligible sources and Class I areas (WPGS location is the furthest west of the two red dots immediate west of supe).

EMISSIONS

Table 2-1 presents the source locations and stack parameters used in the WRAP RMC subject-to-BART CALPUFF modeling. The exact same locations were used in the revised CALPUFF modeling for APS. The revised CALPUFF modeling also used the exact same stack parameters for 2001 as used in the WRAP CALPUFF modeling. In late 2001, APS installed a Selective Catalytic Reduction (SCR) NOx control device on Unit#3 of the WPGS that reduced the NOx emissions by 87%. To do this APS needed to make some design changes to WPGS Unit#3 that included increasing the stack height as well as changing the exit velocity and temperature (see Table 2-1). Thus, the revised WPGS CALPUFF BART modeling of 2002 and 2003 used the updated NOx emissions and stack parameters reflecting the presence of the SCR control device on Unit#3.

Table 2-1. Stack location and parameters for the West Phoenix Generating Station used in the WRAP and revised CALPUFF BART modeling.

WPGS Unit	Lambert Coordinated		Stack Height (m)	Elevation (m)	Stack Diameter (m)	Exit Velocity (m/s)	Exit Temperature (K)
	LCC X (km)	LCC Y (km)					
Unit#1	-1398.68	-608.93	16.459	320.040	4.694	21.458	449.817
Unit#2	-1398.68	-608.93	16.459	320.040	4.694	21.458	449.817
Unit#3*	-1398.68	-608.93	16.459*	320.040	4.694	21.458*	449.817*

* WPGS Unit#3 use stack height of 24.994 m, exit velocity of 26.518 ms and exit temperature of 442.444 F in 2002-2003 due to installation of an SCR control in 2001.

Table 2-2 compares the SO_2, NO_X and $PM_{2.5}$ emissions for the WPGS WRAP fuel oil and revised natural gas scenarios with (2002-2003) and without (2001) the SCR controls on WPGS Unit#3. The WPGSS fuel oil scenario (WRAP CALPUFF BART modeling) assumed almost 70 times more SO_2 emissions than the revised SO_2 emissions based on natural gas combustion (Table 2-2a). NO_X emissions from the WPGS under the fuel oil combustion assumption (WRAP CALPUFF BART modeling) at WPGS produces 2.5 and 3.5 times more NO_X emissions then when natural gas is combustion without and with Unit#3 having SCR, respectively (Table 2-2b). Finally, approximately 8 times more $PM_{2.5}$ emissions are assumed from WPGS using fuel oil versus natural gas (Table 2-2c).

Table 2-2a. Comparison of WPGS SO_2 emissions (g/s) used in the WRAP CALPUFF BART modeling assuming combustion using fuel oil versus those used in the revised CALPUFF BART modeling for 2001 (no SCR Unit#3) and 2002-2003 (SCR on Unit#3) that assumed WPGS was powered by natural gas.

WPGS Unit		2001		2002-2003	
	WRAP Fuel Oil (g/s)	Revised Nat Gas (g/s)	Percent Reduction* (%)	Revised Nat Gas (g/s)	Percent Reduction* (%)
Unit#1	5.569	0.063	98.9%	0.063	98.9%
Unit#2	5.569	0.063	98.9%	0.063	98.9%
Unit#3	2.054	0.063	96.9%	0.063	96.9%
Total	13.192	0.189	98.6%	0.189	98.6%

* Percent reduction from WRAP CALPUFF modeling under fuel oil combustion.

Table 2-2b. Comparison of WPGS NO_X emissions (g/s) used in the WRAP CALPUFF BART modeling assuming combustion using fuel oil versus those used in the revised CALPUFF BART modeling for 2001 (no SCR Unit#3) and 2002-2003 (SCR on Unit#3) that assumed WPGS was powered by natural gas.

WPGS Unit		2001		2002-2003	
	WRAP Fuel Oil (g/s)	Revised Nat Gas (g/s)	Percent Reduction (%)	Revised Nat Gas (g/s)	Percent Reduction (%)
Unit#1	96.138	32.130	66.6%	32.130	66.6%
Unit#2	96.138	32.130	66.6%	32.130	66.6%
Unit#3	51.043	32.130	37.1%	4.322	91.5%
Total	243.219	96.390	60.4%	68.582	71.8%

* Percent reduction from WRAP CALPUFF modeling under fuel oil combustion.

Table 2-2c. Comparison of WPGS $PM_{2.5}$ emissions (g/s) used in the WRAP CALPUFF BART modeling assuming combustion using fuel oil versus those used in the revised CALPUFF BART modeling for 2001 (no SCR Unit#3) and 2002-2003 (SCR on Unit#3) that assumed WPGS was powered by natural gas.

WPGS Unit		2001		2002-2003	
	WRAP Fuel Oil (g/s)	Revised Nat Gas (g/s)	Percent Reduction* (%)	Revised Nat Gas (g/s)	Percent Reduction* (%)
Unit#1	1.310	0.693	47.1%	0.693	47.1%
Unit#2	1.310	0.693	47.1%	0.693	47.1%
Unit#3	13.646	0.630	95.4%	0.630	95.4%
Total	16.266	2.016	87.6%	2.016	87.6%

* Percent reduction from WRAP CALPUFF modeling under fuel oil combustion.

CALPUFF MODELING RESULTS

CALPUFF was exercised using the revised emissions for WPGS reflecting the use of natural gas instead of fuel oil as assumed in the WRAP CALPUFF BART modeling. The CALPUFF estimated sulfate (SO4), nitrate (NO3) and fine particulate ($PM_{2.5}$) concentrations were converted to visibility impairment using the original IMPROVE equation and monthly average relative humidity adjustment factors as described in the WRAP RMC CALPUFF BART Modeling Protocol referenced earlier. The change in deciview over natural conditions was calculated and compared with the 0.5 change in deciview (del-dv) threshold of significance for contributing to visibility impairment at a Class I area. As in the WRAP CALPFF BART modeling, the annual average natural conditions were utilized.

The tables that follow present the CALPUFF estimated visibility impacts at Class I areas within 300 km of the WPGS. First the visibility impacts due to all pollutants (i.e., SO4, NO3 and $PM_{2.5}$) are presented (Table 2-3) followed by visibility impacts due to SO4 alone (Table 2-4), NO3 alone (Table 2-5), $PM_{2.5}$ alone (Table 2-6) and combined NO3 and $PM_{2.5}$ (Table 2-7). This is done for two main reasons. To help better understand the contributions of each of the visibility impairing pollutants due to the WPGS emissions to visibility impairment at the Class I areas. And because Arizona opted into the Section 309 visibility SIP, SO2 emissions (i.e. So4 impacts) from WPGS are already covered under the Section 309 SIP SO2 Annex Program. In the tables that follow we first present the CALPUFF-estimated visibility impacts due to WPGS from the WRAP fuel oil modeling (the "a" series) followed by the revised CALPUFF modeling results using the natural gas emissions assumptions (the "b" series).

Impacts due to All Emissions

The highest 98th percentile visibility impact for both the WRAP fuel oil and revised natural gas scenarios usually occurs at Superstition Wilderness Area (SUPE), which is not surprising given that it is the closest Class I area to the WPGS. Using fuel oil scenario with WPGS (Table 2-3a), the WRAP CALPUFF modeling estimates a 98th percentile visibility impact 0.75 del-dv using the three years of modeling (i.e., 22nd highest value). The 98th percentile value for the individual 2001, 2002 and 2003 years (8th highest day from each year) for the WRAP fuel oil scenario are 0.71, 0.75 and 0.82 del-dv for a three year average of 0.76 del-dv. The maximum 98th percentile visibility impact across all metrics and Class I areas is 0.81 del-dv for 2001 at the Mazatzal Wilderness area that is just a little further away (74 km) from the WPGA than the Superstition Wilderness Area (65 km). Thus, all of the CALPUFF estimated 98th percentile visibility impact metrics for the WRAP WPGS fuel oil scenario are above the 0.5 del-dv significant contribution threshold.

The revised CALPUFF modeling that assumed natural gas was powering the combustion turbines at WPGS estimated 98th percentile visibility impacts at Superstition Wilderness of from 0.21 to 0.28 del-dv for the various 98th percentile visibility metrics. The maximum 98th percentile visibility impact at any Class I area and across all the 98th percentile visibility metrics under the natural gas WPGS scenario is 0.31 del-dv that occurs in 2001 at Mazatzal Wilderness Area. Thus, CALPUFF estimates that all the 98th percentile visibility metrics are below the 0.5 del-dv significant contribution threshold when WPGS is powered by natural gas.

Individual PM Species Impacts

Tables 2-4 through 2-7 display the visibility impacts due to the SO4, NO3, $PM_{2.5}$ and NO3+$PM_{2.5}$ components of PM due to WPGS emissions at the Class I areas under the fuel oil and natural gas scenarios. The largest WPGS visibility impacts are due to NO3 (NOx emissions; Table 2-5) with the contributions to $PM_{2.5}$ being small (Table 2-6) and due to SO4 being negligible (Table 2-3). The combined contributions of NO3 plus PM 2.5 (Table 2-7) are nearly the same as due to all pollutants (Table 2-3).

SCR Sensitivity Analysis

WPGS installed an SCR on Unit#3 in 2001 and in the revised CALPUFF modeling assumed that the SCR was not operating for 2001 and was operating in 2002 and 2003. We can obtain a conservative estimate of the potential maximum visibility impacts in 2002-2003 through a simple sensitivity analysis by scaling the maximum 98th percentile del-dv impacts in 2002-2003 by the difference in NOx emissions of without and with the SCR which is approximately 1.41 (98.390/68.582, see Table 2-2b). The maximum 98th percentile visibility metric in 2002-2003 is 0.23 del-dv at Superstition Wilderness Area for 2003. Multiplying this value by 1.41 produces 0.32 del-dv, which is still below the 0.5 del-dv significant contribution threshold. This is a conservative estimate (i.e., overstatement) of the potential impacts of WPGS in 2002-2003 without the SCR on Unit#3 because the SCR only reduces the NOx emissions and the entire visibility impact due to SO2, NOx and PM 2.5 emissions was scaled in the sensitivity analysis. Thus, even without the SCR on Unit#3, when using natural gas the WPGS is estimated to have 98th percentile visibility impacts at all Class I areas that are well below the 0.5 del-dv significant contribution threshold.

Table 2-3a. CALPUFF-estimated visibility impacts from the WPGS for all pollutants (SO4, NO3 and $PM_{2.5}$) from the WRAP CALPUFF modeling that assumed WPGS was fired by fuel oil.

SRC12 APS – West Phoenix WRAP Fuel Oil Scenario: SO2 = 462 TPY; NOx = 8,454 TPY; PM = 567 TPY										
Class I Area		Minimum Distance (km)	Max Delta-dv (dv)	99th (dv)	98th (dv)	Days > 0.5 dv	98th Percentile for each Year			98th 3 Year Average
							2001	2002	2003	
supe	Superstition Wilderness	65	1.95	1.26	0.75	40	0.71	0.75	0.82	0.76
maza	Mazatzal Wilderness	74	3.33	1.02	0.71	35	0.81	0.57	0.65	0.68
pimo	Pine Mountain Wilderness	93	1.72	0.61	0.49	20	0.49	0.33	0.51	0.44
sian	Sierra Ancha Wilderness	119	1.36	0.59	0.41	14	0.45	0.39	0.38	0.41
syca	Sycamore Canyon WA	158	0.79	0.41	0.32	6	0.30	0.28	0.32	0.30
gali	Galiuro Wilderness	181	0.67	0.26	0.18	2	0.15	0.18	0.18	0.17
sagu	Saguaro NM	191	0.58	0.22	0.14	1	0.12	0.17	0.11	0.13
moba	Mount Baldy Wilderness	245	0.73	0.16	0.11	2	0.12	0.11	0.10	0.11
pefo	Petrified Forest NP	257	1.61	0.26	0.21	4	0.23	0.14	0.22	0.20
grca	Grand Canyon NP	280	1.14	0.57	0.29	11	0.44	0.25	0.23	0.30
jotr	Joshua Tree NM	291	1.16	0.23	0.13	4	0.21	0.11	0.11	0.14

Table 2-3b. CALPUFF-estimated visibility impacts from the WPGS for all pollutants (SO4, NO3 and $PM_{2.5}$) from the Revised CALPUFF modeling that assumed WPGS was fired by natural gas.

SRC12 APS – West Phoenix Revised Natural Gas Scenario: SO2 = TPY; NOx = TPY; PM = TPY										
Class I Area		Minimum Distance (km)	Max Delta-dv (dv)	99th (dv)	98th (dv)	Days > 0.5 dv	98th Percentile for each Year			98th 3 Year Average
							2001	2002	2003	
supe	Superstition Wilderness	65	0.68	0.38	0.25	5	0.28	0.21	0.23	0.24
maza	Mazatzal Wilderness	74	1.27	0.35	0.21	4	0.31	0.17	0.19	0.22
pimo	Pine Mountain Wilderness	93	0.61	0.22	0.14	3	0.18	0.09	0.14	0.14
sian	Sierra Ancha Wilderness	119	0.52	0.19	0.12	1	0.17	0.11	0.11	0.13
syca	Sycamore Canyon WA	158	0.29	0.13	0.10	0	0.12	0.08	0.09	0.09
gali	Galiuro Wilderness	181	0.20	0.08	0.05	0	0.05	0.05	0.05	0.05
sagu	Saguaro NM	191	0.16	0.06	0.04	0	0.04	0.04	0.03	0.04
moba	Mount Baldy Wilderness	245	0.27	0.05	0.04	0	0.04	0.03	0.03	0.03
pefo	Petrified Forest NP	257	0.58	0.09	0.06	1	0.09	0.04	0.06	0.06
grca	Grand Canyon NP	280	0.44	0.16	0.10	0	0.16	0.07	0.06	0.10
jotr	Joshua Tree NM	291	0.38	0.08	0.04	0	0.08	0.03	0.03	0.04

Table 2-4a. CALPUFF-estimated visibility impacts from the WPGS due to sulfate (SO4) only from the WRAP CALPUFF modeling that assumed WPGS was fired by fuel oil.

SRC12 APS – West Phoenix WRAP Fuel Oil Scenario: SO2 Only: SO2 = 462 TPY										
Class I Area		Minimum Distance (km)	Max Delta-dv (dv)	99th (dv)	98th (dv)	Days > 0.5 dv	98th Percentile for each Year			98th 3 Year Average
							2001	2002	2003	
supe	Superstition Wilderness	65	0.07	0.04	0.03	0	0.03	0.02	0.04	0.03
maza	Mazatzal Wilderness	74	0.16	0.03	0.02	0	0.02	0.02	0.02	0.02
pimo	Pine Mountain Wilderness	93	0.08	0.03	0.02	0	0.02	0.01	0.02	0.02
sian	Sierra Ancha Wilderness	119	0.05	0.02	0.02	0	0.01	0.01	0.02	0.01
syca	Sycamore Canyon WA	158	0.03	0.02	0.01	0	0.01	0.01	0.02	0.01
gali	Galiuro Wilderness	181	0.04	0.02	0.02	0	0.01	0.01	0.02	0.02
sagu	Saguaro NM	191	0.03	0.02	0.02	0	0.01	0.01	0.02	0.02
moba	Mount Baldy Wilderness	245	0.03	0.01	0.01	0	0.01	0.01	0.01	0.01
pefo	Petrified Forest NP	257	0.05	0.01	0.01	0	0.01	0.01	0.01	0.01
grca	Grand Canyon NP	280	0.05	0.02	0.01	0	0.02	0.01	0.01	0.01
jotr	Joshua Tree NM	291	0.06	0.02	0.02	0	0.02	0.01	0.02	0.01

Table 2-4b. CALPUFF-estimated visibility impacts from the WPGS due to sulfate (SO4) only from the Revised CALPUFF modeling that assumed WPGS was fired by natural gas.

SRC12 APS – West Phoenix Revised Natural Gas Scenario: SO2 Only: SO2 = TPY										
Class I Area		Minimum Distance (km)	Max Delta-dv (dv)	99th (dv)	98th (dv)	Days > 0.5 dv	98th Percentile for each Year			98th 3 Year Average
							2001	2002	2003	
supe	Superstition Wilderness	65	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
maza	Mazatzal Wilderness	74	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
pimo	Pine Mountain Wilderness	93	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
sian	Sierra Ancha Wilderness	119	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
syca	Sycamore Canyon WA	158	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
gali	Galiuro Wilderness	181	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
sagu	Saguaro NM	191	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
moba	Mount Baldy Wilderness	245	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
pefo	Petrified Forest NP	257	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
grca	Grand Canyon NP	280	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
jotr	Joshua Tree NM	291	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00

Table 2-5a. CALPUFF-estimated visibility impacts from the WPGS due to nitrate (NO3) only from the WRAP CALPUFF modeling that assumed WPGS was fired by fuel oil.

SRC12 APS – West Phoenix WRAP Fuel Oil Scenario: NOx Only: NOx = 8,454 TPY										
Class I Area		Minimum Distance (km)	Max Delta-dv (dv)	99th (dv)	98th (dv)	Days > 0.5 dv	98th Percentile for each Year			98th 3 Year Average
							2001	2002	2003	
supe	Superstition Wilderness	65	1.82	1.16	0.70	33	0.64	0.69	0.75	0.69
maza	Mazatzal Wilderness	74	3.14	0.94	0.65	34	0.76	0.54	0.61	0.64
pimo	Pine Mountain Wilderness	93	1.63	0.57	0.46	17	0.46	0.31	0.48	0.42
sian	Sierra Ancha Wilderness	119	1.29	0.55	0.39	12	0.43	0.38	0.36	0.39
syca	Sycamore Canyon WA	158	0.75	0.39	0.30	4	0.29	0.27	0.30	0.29
gali	Galiuro Wilderness	181	0.63	0.25	0.17	2	0.13	0.18	0.17	0.16
sagu	Saguaro NM	191	0.54	0.19	0.13	1	0.11	0.15	0.10	0.12
moba	Mount Baldy Wilderness	245	0.69	0.16	0.11	2	0.11	0.11	0.09	0.10
pefo	Petrified Forest NP	257	1.55	0.24	0.20	4	0.21	0.14	0.21	0.19
grca	Grand Canyon NP	280	1.09	0.53	0.28	11	0.41	0.24	0.21	0.29
jotr	Joshua Tree NM	291	1.11	0.21	0.11	3	0.19	0.10	0.09	0.12

Table 2-5b. CALPUFF-estimated visibility impacts from the WPGS due to nitrate (NO3) only from the Revised CALPUFF modeling that assumed WPGS was fired by natural gas.

SRC12 APS – West Phoenix Revised Natural Gas Scenario: NOx Only: NOx = TPY										
Class I Area		Minimum Distance (km)	Max Delta-dv (dv)	99th (dv)	98th (dv)	Days > 0.5 dv	98th Percentile for each Year			98th 3 Year Average
							2001	2002	2003	
supe	Superstition Wilderness	65	0.67	0.37	0.24	5	0.27	0.20	0.22	0.23
maza	Mazatzal Wilderness	74	1.26	0.34	0.20	4	0.31	0.16	0.18	0.22
pimo	Pine Mountain Wilderness	93	0.60	0.21	0.14	3	0.17	0.09	0.14	0.13
sian	Sierra Ancha Wilderness	119	0.51	0.19	0.12	1	0.17	0.10	0.10	0.13
syca	Sycamore Canyon WA	158	0.28	0.13	0.10	0	0.12	0.08	0.08	0.09
gali	Galiuro Wilderness	181	0.20	0.08	0.05	0	0.05	0.05	0.05	0.05
sagu	Saguaro NM	191	0.15	0.06	0.04	0	0.04	0.04	0.03	0.04
moba	Mount Baldy Wilderness	245	0.27	0.05	0.04	0	0.04	0.03	0.03	0.03
pefo	Petrified Forest NP	257	0.57	0.09	0.06	1	0.09	0.04	0.06	0.06
grca	Grand Canyon NP	280	0.44	0.16	0.10	0	0.16	0.07	0.06	0.10
jotr	Joshua Tree NM	291	0.38	0.08	0.04	0	0.08	0.03	0.03	0.04

Table 2-6a. CALPUFF-estimated visibility impacts from the WPGS due to fine particulate matter ($PM_{2.5}$) only from the WRAP CALPUFF modeling that assumed WPGS was fired by fuel oil.

SRC12 APS – West Phoenix WRAP Fuel Oil Scenario: PM Only: PM = 567 TPY										
Class I Area		Minimum Distance (km)	Max Delta-dv (dv)	99th (dv)	98th (dv)	Days > 0.5 dv	98th Percentile for each Year			98th 3 Year Average
							2001	2002	2003	
supe	Superstition Wilderness	65	0.16	0.11	0.10	0	0.09	0.10	0.11	0.10
maza	Mazatzal Wilderness	74	0.15	0.07	0.06	0	0.06	0.06	0.06	0.06
pimo	Pine Mountain Wilderness	93	0.06	0.04	0.03	0	0.03	0.04	0.04	0.03
sian	Sierra Ancha Wilderness	119	0.04	0.03	0.02	0	0.02	0.03	0.02	0.02
syca	Sycamore Canyon WA	158	0.02	0.02	0.01	0	0.01	0.01	0.01	0.01
gali	Galiuro Wilderness	181	0.04	0.02	0.02	0	0.01	0.01	0.02	0.02
sagu	Saguaro NM	191	0.03	0.02	0.02	0	0.01	0.01	0.02	0.02
moba	Mount Baldy Wilderness	245	0.01	0.01	0.01	0	0.01	0.01	0.01	0.01
pefo	Petrified Forest NP	257	0.02	0.01	0.01	0	0.01	0.01	0.01	0.01
grca	Grand Canyon NP	280	0.02	0.02	0.01	0	0.01	0.01	0.01	0.01
jotr	Joshua Tree NM	291	0.03	0.02	0.01	0	0.02	0.01	0.01	0.01

Table 2-6b. CALPUFF-estimated visibility impacts from the WPGS due to fine particulate matter ($PM_{2.5}$) only from the Revised CALPUFF modeling that assumed WPGS was fired by natural gas.

SRC12 APS – West Phoenix Revised Natural Gas Scenario: PM Only: PM = TPY										
Class I Area		Minimum Distance (km)	Max Delta-dv (dv)	99th (dv)	98th (dv)	Days > 0.5 dv	98th Percentile for each Year			98th 3 Year Average
							2001	2002	2003	
supe	Superstition Wilderness	65	0.02	0.01	0.01	0	0.01	0.01	0.01	0.01
maza	Mazatzal Wilderness	74	0.02	0.01	0.01	0	0.01	0.01	0.01	0.01
pimo	Pine Mountain Wilderness	93	0.01	0.01	0.00	0	0.00	0.00	0.00	0.00
sian	Sierra Ancha Wilderness	119	0.01	0.00	0.00	0	0.00	0.00	0.00	0.00
syca	Sycamore Canyon WA	158	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
gali	Galiuro Wilderness	181	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
sagu	Saguaro NM	191	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
moba	Mount Baldy Wilderness	245	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
pefo	Petrified Forest NP	257	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
grca	Grand Canyon NP	280	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
jotr	Joshua Tree NM	291	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00

Table 2-7a. CALPUFF-estimated visibility impacts from the WPGS due to nitrate (NO3) and fine particulate matter ($PM_{2.5}$) only from the WRAP CALPUFF modeling that assumed WPGS was fired by fuel oil.

SRC12 APS – West Phoenix: NOx + PM Only: NOx = 8,454 TPY; PM = 567 TPY										
Class I Area		Minimum Distance (km)	Max Delta-dv (dv)	99th (dv)	98th (dv)	Days > 0.5 dv	98th Percentile for each Year			98th 3 Year Average
							2001	2002	2003	
supe	Superstition Wilderness	65	1.93	1.25	0.75	38	0.68	0.75	0.79	0.74
maza	Mazatzal Wilderness	74	3.22	0.99	0.68	35	0.79	0.57	0.64	0.67
pimo	Pine Mountain Wilderness	93	1.68	0.60	0.47	18	0.47	0.32	0.49	0.43
sian	Sierra Ancha Wilderness	119	1.32	0.57	0.40	13	0.44	0.39	0.37	0.40
syca	Sycamore Canyon WA	158	0.76	0.40	0.31	5	0.30	0.28	0.31	0.30
gali	Galiuro Wilderness	181	0.65	0.25	0.17	2	0.14	0.18	0.17	0.16
sagu	Saguaro NM	191	0.55	0.21	0.14	1	0.11	0.16	0.10	0.12
moba	Mount Baldy Wilderness	245	0.70	0.16	0.11	2	0.11	0.11	0.09	0.11
pefo	Petrified Forest NP	257	1.57	0.25	0.21	4	0.22	0.14	0.21	0.19
grca	Grand Canyon NP	280	1.11	0.54	0.28	11	0.42	0.24	0.22	0.30
jotr	Joshua Tree NM	291	1.12	0.23	0.12	4	0.20	0.10	0.10	0.13

Table 2-7b. CALPUFF-estimated visibility impacts from the WPGS due to nitrate (NO3) and fine particulate matter ($PM_{2.5}$) only from the Revised CALPUFF modeling that assumed WPGS was fired by natural gas.

SRC12 APS – West Phoenix: NOx + PM Only: NOx = TPY; PM = TPY										
Class I Area		Minimum Distance (km)	Max Delta-dv (dv)	99th (dv)	98th (dv)	Days > 0.5 dv	98th Percentile for each Year			98th 3 Year Average
							2001	2002	2003	
supe	Superstition Wilderness	65	0.68	0.38	0.25	5	0.28	0.21	0.23	0.24
maza	Mazatzal Wilderness	74	1.27	0.35	0.20	4	0.31	0.17	0.19	0.22
pimo	Pine Mountain Wilderness	93	0.61	0.22	0.14	3	0.18	0.09	0.14	0.13
sian	Sierra Ancha Wilderness	119	0.51	0.19	0.12	1	0.17	0.11	0.11	0.13
syca	Sycamore Canyon WA	158	0.29	0.13	0.10	0	0.12	0.08	0.09	0.09
gali	Galiuro Wilderness	181	0.20	0.08	0.05	0	0.05	0.05	0.05	0.05
sagu	Saguaro NM	191	0.16	0.06	0.04	0	0.04	0.04	0.03	0.04
moba	Mount Baldy Wilderness	245	0.27	0.05	0.04	0	0.04	0.03	0.03	0.03
pefo	Petrified Forest NP	257	0.58	0.09	0.06	1	0.09	0.04	0.06	0.06
grca	Grand Canyon NP	280	0.44	0.16	0.10	0	0.16	0.07	0.06	0.10
jotr	Joshua Tree NM	291	0.38	0.08	0.04	0	0.08	0.03	0.03	0.04

3.0 REFERENCES

Atkinson, D. and T. Fox. 2006. *Dispersion Coefficients for Regulatory Air Quality Modeling in CALPUFF.* Memorandum from U.S. EPA/OAQPS to Kay T. Prince, EPA Region 4. March 16.

EPA. 2003a. "Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule." EPA-454/B-03-005. September 2003.

EPA. 2003b. "Guidance for Tracking Progress under the Regional Haze Rule." U.S. EPA, EPA-454/B-03-004. September 2003.

EPA. 2003c. "Revisions to the Guideline on Air Quality Models: Adoption of a Preferred Long Range Transport Model and Other Resources"; Final Rule. Fed. Reg./Vol. 68, No. 72/Tuesday April 15, 2003/Rules and Regulations. 40 CFR51.

EPA. 2005. "Regional Haze Regulations and Guidelines for Best Available Technology (BART) Determinations". Fed. Reg./Vol. 70, No. 128/Wed. July 6, 2005, Rules and Regulations, pp. 39104-39172. 40 CFR Part 51, FRL-7925-9, RIN AJ31.

FLAG. 2000. "Federal Land Manager's Air Quality Related Values Workgroup (FLAG): Phase I Report," U.S. Forest Service, National Park Service, U.S. Fish and Wildlife Service, December 2000.

IWAQM. 1998. "Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts." EPA-454/R-98-019, December 1998.

Malm, W., M. Pitchford, M. Scruggs, J. Sisler, R. Ames, S. Copeland, K. Gebhart and D. Day. 2000. Spatial and Seasonal Patterns and Temporal Variability of Haze and its Constituents in the United States. Cooperative Institute for Research in the Atmosphere, Colorado State University, Fort Collins, CO. May.

Paise, J.W. 2006a. Regional Haze Regulations and Guidelines for Best Available Retrofit Technology (BART) Determinations. Memorandum to Kay Prince, Branch Chief EPA Region 4. Attachment A to April 20, 2006 DC Circuit Court document UARG vs. EPA, No. 06-1056.

Paise, J.W. 2006b. Letter to Mel S. Schulze, Esq., Hunton and Williams representing the Utility Air Regulatory Group (UARG). Attachment B to April 20, 2006 DC Circuit Court document UARG vs. EPA, No. 06-1056.

Scire, J.S., D.G. Strimaitis, R.J. Yamartino. 2000a. "A User's Guide for the CALPUFF Dispersion Model." Earth Tech, Concord, MA, January 2000.

Scire, J.S., F. Robe, F.E. Fernau, R.J. Yamartino. 2000b. "A User's Guide for the CALMET Meteorological Model." Earth Tech, Concord, MA, January 2000.

Tonnesen, G., Z. Wang, R. Morris, A. Hoats and Y. Jia. 2006. CALMET/CALPUFF Protocol for BART Exemption Screening Analysis for Class I Areas in the Western United States. Wstern Regional Air Partnership (WRAP), Regional Modeling Center (RMC). August 15. (http://pah.cert.ucr.edu/aqm/308/bart/WRAP_RMC_BART_Protocol_Aug15_2006.pdf).