Appendix A-SIP
Projection of Improvement in 16 Class I Areas

Overview:
The Western Regional Air Partnership (WRAP) Regional Modeling Center (RMC) has analyzed visibility changes in the 16 Class I Areas on the Colorado Plateau resulting from the implementation of all 309 control strategies.

Scenarios:
The RMC modeled two scenarios. Scenario 1 is designed to assess the effect of the GCVTC-recommended control strategies, implementation of the following GCVTC strategies: the SO_2 Annex Milestones, the regional pollution prevention program, maintenance of existing base smoke management (BSM) programs, and accounting for the 2018 base case emissions (known and adopted federal, tribal, state, and local control programs in the contiguous WRAP region). Scenario 2 is designed to assess the effect of the implementation of Enhanced Smoke Management Programs (ESMP), as reflected in the Fire Emissions Joint Forum's 2018 Optimal Smoke Management (OSM) inventory. ESMPs were recommended by GCVTC and are required in §309 (see further discussion later in this Appendix).

Note that the WRAP did not model visibility improvements resulting from the implementation of control strategies by a specific state or tribe. Such emissions changes and the resulting visibility changes are so small they are likely to be undetectable.

Projected Visibility Changes:
The RMC modeled visibility at the 16 Class I areas on the Colorado Plateau for the 2018 Scenario 1 and Scenario 2 control strategies. Tables 2a and 2b on the following pages display the visibility improvements from the 1997-2001 baseline period to 2018 under Scenario 1 and 2 conditions. Table 2a contains projected visibility improvement for the average 20% worst visibility days (measured in deciView), and Table 2b contains projected visibility improvement for the average 20% best visibility days (in dV).

Note that Worst days are those in which visibility is the most impaired. Best days are those in which visibility is the least impaired. These tables are also contained in the Albuquerque/Bernalillo County's Regional Haze SIP document, as is a discussion of the modeling results for the San Pedro Parks Wilderness Area in New Mexico.

Table 2a. Projected Visibility Improvement at the 16 Colorado Plateau Class I Areas in 2018 on the Average 20% **Worst Visibility Days**, resulting from implementation of "All §309 Control Strategies" 2018 Scenarios 1 and 2.

			Modeling Results (deciviews)		
Colorado Plateau Class I Area	State	1997-2001 Monitoring Data (20% Worst Days' Visibility - deciviews)	2018 Base Case (20% Worst Days' Visibility for all controls "on the books" as of 2002)	2018 Scenario 1 (20% Worst Days' Visibility for all §309 Control Strategies (SO_2 Annex Milestones and Pollution Prevention) with Base Smoke Management)	2018 Scenario 2 (20% Worst Days' Visibility for all §309 Control Strategies (SO_2 Annex Milestones and Pollution Prevention) with Optimal Smoke Management)
Grand Canyon NP	AZ	12.30	11.62	11.56	11.51
Mount Baldy Wilderness	AZ	14.30	12.22	12.02	11.96
Petrified Forest NP	AZ	13.00	11.99	11.82	11.74
Sycamore Canyon Wilderness	AZ	15.40	11.63	11.51	11.48
Black Canyon of Gunnison NP	CO	11.30	10.90	10.76	10.60
Flat Tops Wilderness	CO	10.50	11.04	10.91	10.73
Maroon Bells-Snowmass WA	CO	10.60	11.15	11.00	10.84
Mesa Verde NP	CO	13.10	12.24	12.03	11.84
West Elk Wilderness	CO	10.60	11.19	10.99	10.84
Weminuche Wilderness	CO	11.30	11.08	10.89	10.72
San Pedro Parks Wilderness	**NM**	**10.70**	**12.33**	**12.12**	**11.71**
Arches NP	UT	12.10	12.41	12.29	12.15
Bryce Canyon NP	UT	11.80	12.26	12.24	11.95
Canyonlands NP	UT	12.10	12.41	12.31	12.18
Capitol Reef NP	UT	12.10	12.51	12.49	12.36
Zion NP	UT	13.60	12.13	12.09	12.03

Table 2b. Projected Visibility Improvement at the 16 Colorado Plateau Class I Areas in 2018, on the Average 20% **Best Visibility Days**, resulting from implementation of "All §309 Control Strategies" " 2018 Scenarios 1 and 2.

			Modeling Results (deciviews)		
Colorado Plateau Class I Area	State	1997-2001 Monitoring Data (20% Best Days' Visibility - deciviews)	2018 Base Case (20% Best Days' Visibility for all controls "on the books" as of 2002)	2018 Scenario 1 (20% Best Days' Visibility for all §309 Control Strategies (SO_2 Annex Milestones and Pollution Prevention) with Base Smoke Management)	2018 Scenario 2 (20% Best Days' Visibility for all §309 Control Strategies (SO_2 Annex Milestones and Pollution Prevention) with Optimal Smoke Management)
Grand Canyon NP	AZ	4.80	4.76	4.72	4.64
Mount Baldy Wilderness	AZ	5.50	5.49	5.46	5.36
Petrified Forest NP	AZ	6.50	5.18	5.14	5.10
Sycamore Canyon Wilderness	AZ	6.30	4.85	4.82	4.75
Black Canyon of Gunnison NP	CO	4.60	3.89	3.83	3.75
Flat Tops Wilderness	CO	3.10	3.96	3.90	3.81
Maroon Bells-Snowmass WA	CO	3.10	3.90	3.85	3.80
Mesa Verde NP	CO	5.50	4.40	4.38	4.33
West Elk Wilderness	CO	3.10	3.89	3.83	3.74
Weminuche Wilderness	CO	4.60	3.97	3.92	3.82
San Pedro Parks Wilderness	**NM**	**4.00**	**5.59**	**5.51**	**5.36**
Arches NP	UT	5.50	4.85	4.72	4.61
Bryce Canyon NP	UT	4.30	3.91	3.92	3.89
Canyonlands NP	UT	5.60	4.87	4.76	4.67
Capitol Reef NP	UT	5.60	4.85	4.85	4.75
Zion NP	UT	5.90	3.81	3.79	3.75

Scenarios & Specific Control Strategies Modeled:
The following is an analysis of visibility improvement from §309 control strategies in 2018. As noted, visibility improvement for the 16 Colorado Plateau Class I Areas was modeled for the following two scenarios:

Scenario 1 is designed to assess the effect of the GCVTC-recommended control strategies, comparing the 1996 modeled base case to the visibility improvement resulting from the implementation of the following GCVTC strategies: the SO_2 Annex Milestones, the regional pollution prevention program, maintenance of existing base smoke management (BSM) programs, and accounting for the 2018 base case emissions (known and adopted federal, tribal, state, and local control programs in the contiguous WRAP region). Visibility changes resulting from regional implementation of state pollution prevention programs were modeled by the Regional Modeling Center, as part of the other §309 control strategies. Visibility changes resulting from implementation of pollution prevention programs by individual states or tribes were not modeled. Emissions changes from state or tribal pollution prevention programs, and the resulting visibility changes are small, based on the regional pollution prevention emissions analysis, but are accounted for in the regional modeling.

Scenario 2 is designed to assess the effect of the implementation of Enhanced Smoke Management Programs (ESMP), as reflected in the Fire Emissions Joint Forum's 2018 Optimal Smoke Management (OSM) inventory. ESMPs were recommended by GCVTC and are required in §309. Scenario 2 uses the emissions inventories from Scenario 1, except the OSM inventory was substituted for fire emissions. Thus, the results for Scenario 2 are a comparison of visibility changes resulting from emission reductions between the 2018 BSM and 2018 OSM fire inventories.

Results of WRAP Modeling:
Presented below are modeling results projecting visibility improvement in 2018, resulting from implementation of the §309 Control Strategies for the 16 Class I Areas on the Colorado Plateau.

Using the procedures for projecting changes in visibility discussed in Chapter 1, visibility at the 16 Class I Areas on the Colorado Plateau was estimated for the 2018 Scenario 1 and Scenario 2 control strategies. Tables 30 and 31 display the improvements in visibility from the 1997-2001 baseline period to 2018 under Scenario 1 and 2 conditions for the, respectively, Worst 20% and Best 20% visibility days.

On the average 20% Worst visibility days, projected improvement from 1997-2001 to 2018 Scenario 1 at the 16 Class I Areas on the Colorado Plateau range from a maximum reduction of 3.89 dV at Sycamore Canyon National Park in Arizona to a maximum increase of 1.42 dV at San Pedro Parks Wilderness in New Mexico. On the Worst 20% days, Scenario 1 shows improving visibility at half and degradation in visibility for the other half of the 16 Colorado Plateau Class I areas. On the average 20% Best visibility days, projected change from 1997-2001 to 2018 Scenario 1 ranged from a maximum reduction of 2.11 dV at Zion National Park in Utah to a maximum increase of 1.51 dV at San Pedro Parks Wilderness Area in New Mexico. On the Best 20% days, Scenario 1 improves visibility conditions a ¾ of the Class I areas on the Colorado Plateau.

A comparison of the visibility estimates for 2018 Scenarios 1 and 2 at the 16 Class I Areas on the Colorado Plateau for the Worst 20% (Table 30) and Best 20% (Table 31) days reveals

that 2018 Scenario 2 always estimated reduced (improved) visibility as compared to 2018 Scenario 1. That is, the Optimal Smoke Management (OSM) programs produces visibility improvements over the Base Smoke Management (BSM) programs across all 16 Class I areas for both the Worst 20% and Best 20% days.

Explanation of Modeling Results:

The reason why visibility is projected to improve in some areas and degrade in others is due to the assumptions regarding the growth of emissions and the implementation of all controls "on-the-books" in 2002, as well as artifacts of the June 2000 version of the EPA NONROAD model. Figure 2 below displays the differences in SO_2 emissions between the 1996 and 2018 Base Case emissions scenarios. Due to the implementation of SO_2 controls on the Navajo and Mojave electrical generating units (EGUs) between 1996 and 2018, there are projected to be large reductions in SO_2 emissions in the counties in Arizona and Nevada that contain these two point sources. However, in many of the counties where there are not reductions in point source SO_2 emissions, SO_2 emissions are projected to increase. As discussed in more detail in Section 4, this is due in part to increased activity in non-road mobile source equipment, the assumed continued use of high sulfur diesel fuel in non-road sources and errors in the June 2000 NONROAD model that overstated non-road equipment activity as well as SO_2 emissions from non-road equipment.

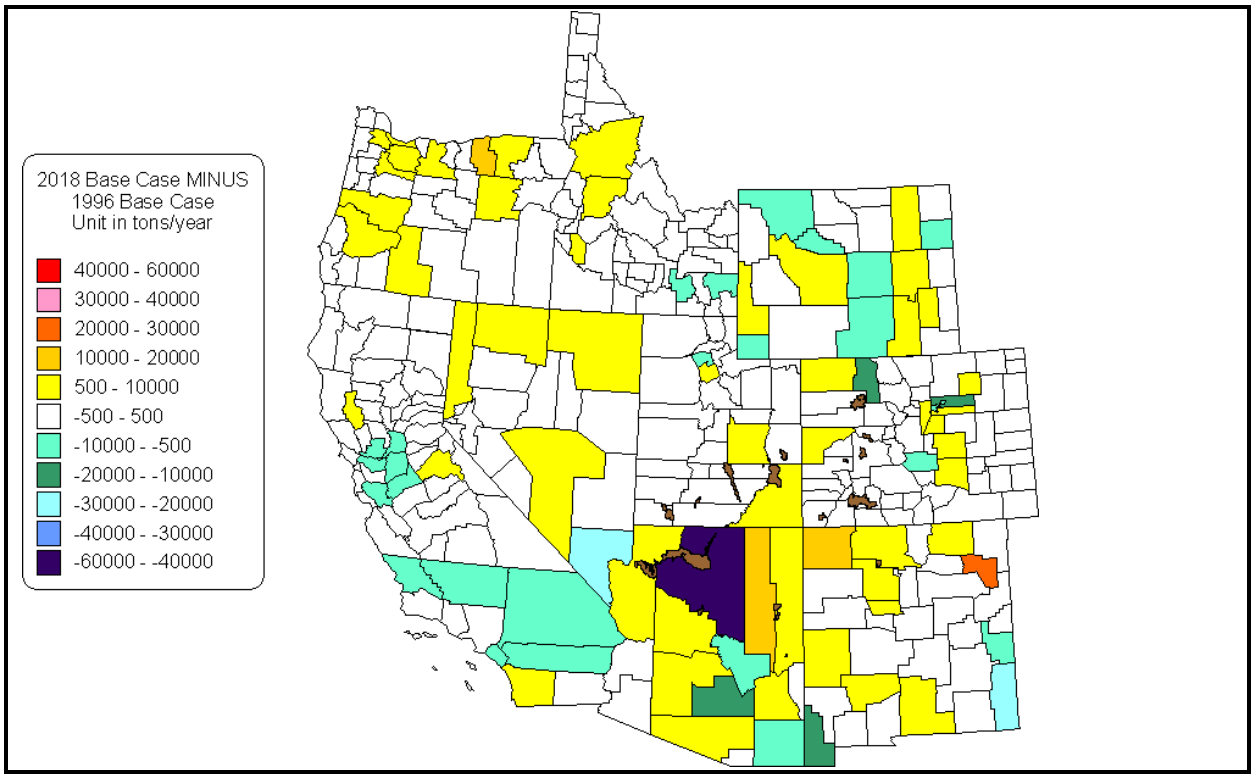

Figure 2: Differences in count average SO_2 emissions between the 1996 Base Case and the 2018 Base Case emissions scenarios.

The Class I Areas where visibility is improved for the Worst 20% and Best 20% days (Tables 2a and 2b) include ones in Arizona and southern Utah in close proximity of the large SO_2 reductions from controls on the Navajo EGU and downwind from the large SO_2 reductions at the Mojave EGU in southern Nevada and in California. Whereas, the Class I Areas where visibility is projected to degrade are near counties where SO_2 emissions are estimated to increase due to the assumed increases in SO_2 emissions from the non-road mobile source sector. For example, the San Pedro Parks Wilderness Area in New Mexico lies in and near counties that are projected to have increases in SO_2 emissions under the 2018 Base Case conditions, and it is not surprising that the modeling projects that visibility would degrade at this Class I Area. Use of the corrected NONROAD model, accounting for potential low sulfur diesel regulations for non-road sources, and account for other local (e.g., 8-hour ozone and fine particulate) and regional (e.g., CSI, regional transport rule) in the 2018 projections would like produce improvements at all 16 areas.