SOUTH DAKOTA

REGIONAL HAZE

STATE IMPLEMENTATION PLAN

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Executive Summary

The Department of Agriculture and Natural Resources (DANR) worked with the Western Regional Air Partnership (WRAP), the Western States Air Resources Council (WESTAR), states not members of WRAP, federal land managers, the Environmental Protection Agency (EPA), the regulated community, and others to develop this document as part of South Dakota's Regional Haze State Implementation Plan (SIP). This document along with the applicable Administrative Rules of South Dakota (ARSD) Chapter 74:36:21 is South Dakota's Regional Haze State Implementation Plan and implemented by DANR to ensure South Dakota's Regional Haze Program meets the goal of achieving natural conditions at the Badlands and Wind Cave National Parks by 2064 as specified in Title 40 of the Code of Federal Regulations (CFR) §51.308.

Chapter 1 provides background information on the initial federal visibility protection program, describes the causes of visibility impairment, and describes the new federal regional haze program regulations. It also provides information on South Dakota's two Class I areas. The two Class I areas are the Badlands National Park and Wind Cave National Park and both are located in the western third of South Dakota.

Chapter 2 describes the process DANR followed to determine natural conditions, baseline conditions, and the uniform rate of improvement for both Class I areas. It also discusses the IMPROVE (Interagency Monitoring of Protected Visual Environments) monitoring data for both Class I areas. This chapter looked at the aerosols impacting both Class I areas, what time of year they occur, and if they are increasing or decreasing over time. It also describes what type of activities are emitting the air emissions, and if the air emissions are generated within South Dakota or from neighboring states and countries.

Chapter 3 describes South Dakota's long-term strategy in achieving natural conditions by 2064. It also outlines DANR's rules (Administrative Rules of South Dakota, Chapter 74:36:21) to ensure new sources and modifications to existing sources will not reasonably contribute to visibility impairment at any Class I area. In addition, DANR developed, and implemented Memorandum of Understandings with the City of Rapid City and the Forest Service for prescribed fires.

Chapter 4 discusses South Dakota's reasonable progress goals, including the modeling WRAP conducted of the western United States to determine if states are meeting the reasonable progress goals in 2028. Using the adjusted 2064 Glideslopes, the overall 2028 visibility projections in Deciviews at both South Dakota's Class I Areas are below the Glideslope, indicating South Dakota is on track to achieving natural visibility conditions by the year 2064. The same model findings hold true for the visibility impairment projections of the individual pollutant species of ammonium nitrate, ammonium sulfate, elemental carbon, organic mass, sea salt, and fine soil. Coarse mass is the only visibility impairing pollutant species of the seven which 2028 visibility impairment may not be below the 2064 Glideslope, and especially at Wind Cave National Park. However, coarse mass is not a major visibility impairing pollutant species at either of South Dakota's Class I Areas, and therefore is not a main concern to South Dakota.

Chapter 5 discusses DANR's monitoring plan for tracking our progress in achieving natural conditions by 2064. It includes South Dakota's emission inventory for past, present, and future air emission inventories in South Dakota.

Chapter 6 describes the consultation DANR went through with federal land managers, states, and the public, how DANR responded to each comment, and their future involvement.

Chapter 7 describes the reporting DANR will perform to track South Dakota's progress in attaining natural conditions by 2064. It also serves as the embedded required progress report and includes a description of the status of implementation of all measures included in the implementation plan for achieving reasonable progress goals for mandatory Class I Federal areas both within and outside the State, a summary of the emissions reductions achieved throughout the State through implementation of all measures included in the implementation plan, an assessment of various visibility conditions and changes, the change in emissions of pollutants contributing to visibility impairment from all sources and activities within the State, and any significant changes in anthropogenic emissions.

1.0 Introduction

1.1 Visibility Impairment

Most visibility impairment occurs when pollution in the form of small particles scatters or absorbs light. Air pollutants are emitted from a variety of natural and anthropogenic (man-made) sources. Natural sources can include windblown dust and smoke from wildfires. Anthropogenic sources can include motor vehicles, electric utility and industrial fuel burning, prescribed burning, and manufacturing operations. More pollutants mean more absorption and scattering of light, which reduce the clarity and color of scenery. Some types of particles such as sulfates and nitrates scatter more light, particularly during humid conditions. Other particles like elemental carbon from combustion processes are highly efficient at absorbing light.

The primary cause of regional haze for many parts of the country is due to the scattering of light by fine particles (e.g., particulate matter 2.5 microns in diameter or less). These fine particles are composed of a variety of chemical species such as carbonaceous species (e.g., organics and elemental carbon) as well as ammonia, nitrate, sulfates, and soil. Coarse particulate (e.g., particulate matter ranging in size from 2.5 to 10 microns in diameter) also contribute to light scattering, and can occur both naturally and as the result of human activity.

Commonly, visibility is observed by the human eye and the object may be a single viewing target or scenery. In the 156 Class I areas across the nation, a person's visual range had been substantially reduced by air pollution. In eastern parks, the average visual range decreased from around 90 miles to around 20 miles. In the West, the visual range decreased from an average of around 140 miles to around 60 miles. However, due to emissions reductions across the nation from the implementation of emission controls added to electric generating units and other facilities through the Regional Haze Rule the visibility has improved over the past decade.

Some particles that cause haze are directly emitted into the air while others are formed when gases emitted into the air form particles as they are carried from the source of the pollutants. Some haze forming pollutants are also linked to human health problems and others to environmental damage. Exposure to very small particles in the air has been linked with increased respiratory illness, decreased lung function, and premature death. In addition, particles such as nitrates and sulfates contribute to acid deposition potentially making lakes, rivers, and streams unsuitable for some forms of aquatic life and impacting flora in the ecosystem. These same acid particles can also erode materials such as paint, buildings or other natural and manmade structures. More general information about visibility and visibility issues can be found in the following two places:

1) https://www.epa.gov/sites/production/files/2015-05/documents/chap01.pdf
2) https://www.epa.gov/visibility/basic-information-about-visibility

1.2 History Of Regional Haze

In August 1977, the federal Clean Air Act was amended by adding section 169A. In section 169A(a)(1), Congress established the following national goal for visibility protection:

“Congress hereby declares as a national goal the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory class I Federal areas which impairment results from man-made air pollution.”

To address this goal for each of the 156 mandatory federal Class I areas across the nation, the federal Environmental Protection Agency (EPA) developed regulations to reduce the impact of large industrial sources on nearby Class I areas. It was recognized at the time that regional haze, which comes from a wide variety of sources that may be located far from a Class I area, was also a part of the visibility problem. However, monitoring networks and visibility models at that time were not developed to the degree necessary to understand the causes of regional haze.

The 1977 Clean Air Act Amendments also established the Prevention of Significant Deterioration (PSD) permit program, which included requirements for protecting visibility in national parks, national wilderness areas, national monuments and national seashores. The Prevention of Significant Deterioration permit program included area specific (e.g., Class I, II and III) increments or limits on the maximum allowable increase in air pollutants (e.g., particulate matter and sulfur dioxide) and a preconstruction permit review process for new or modifying major sources that allows for careful consideration of control technology, consultation with federal land managers on visibility impacts and public participation in permitting decisions. The Prevention of Significant Deterioration permit program was delegated to South Dakota on July 6, 1994, and later approved in South Dakota’s State Implementation Plan on January 22, 2008.

To be enacted during the first Regional Haze Rule implementation period, under Section 169A(b) of the Clean Air Act, Congress established new requirements on major stationary sources in operation within a 15-year period prior to enactment of the 1977 amendments. Major stationary sources within that timeframe that may reasonably be anticipated to cause or contribute to visibility impairment in a Class I area must install best available retrofit technology (BART) as determined by the state. In determining BART, the state must take into consideration the costs of compliance, the energy and non-air quality environmental impacts of compliance, any existing pollution control technology in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology.

In 1980, EPA adopted regulations to address “reasonably attributable visibility impairment”, or visibility impairment caused by one or a small group of man-made sources generally located in close proximity to a specific Class I area. South Dakota did not adopt the visibility rules of 1980 in its first State Implementation Plan. Therefore, EPA implemented the program in a Federal Implementation Plan.

In the 1990 Clean Air Act Amendments, Congress added section 169B to strengthen and reaffirm the national goal and address visibility impairment from a collection of sources whose emissions are mixed and transported over long distances to the Class I areas. Section 169B(e) calls for EPA to “carry out the Administrator’s regulatory responsibilities under section 169A, including criteria for measuring ‘reasonable progress’ toward the national goal.” In response to these mandates, EPA promulgated the regional haze rule on July 1, 1999.

The purpose of this submittal is to address the State Implementation Plan requirements for the State of South Dakota found in 40 CFR § 51.308 – Regional Haze Program Requirements of 40 CFR Part 51 Subpart P – Protection of Visibility. The South Dakota Department of Agriculture and Natural Resources (DANR), the agency designated to administer and coordinate a statewide program of air pollution control, has general legal authority under South Dakota Codified Laws Title 34A-1 – Air Pollution Control to adopt and enforce rules for visibility protection including regional haze visibility impairment.

South Dakota is a member of WRAP which was created in part to be a collaborative effort of tribal governments, state governments and various federal agencies to help states and tribes develop and implement a regional haze program that complies with the EPA's regional haze regulations.

More information about the history of Regional Haze can be found in Appendix A of the document found at the following URL: https://www.epa.gov/sites/production/files/2019-08/documents/8-20-2019_-_regional_haze_guidance_final_guidance.pdf

This document along with the adopted rules is South Dakota's State Implementation Plan. Pursuant to the requirements in 40 CFR § 51.308(a), the State Implementation Plan is intended to meet the requirements in EPA's regional haze regulations that were adopted to comply with the requirements established in Section 169B of the Clean Air Act. This document addresses the following elements of South Dakota's State Implementation Plan:

1. In accordance with 40 CFR § 51.308(f), the core regional haze program requirements (e.g., identification of Class I areas; determination of baseline conditions, natural conditions, and uniform rate of progress; and baseline, current and future emissions inventories);
2. In accordance with 40 CFR § 51.308(f), a commitment to conduct comprehensive periodic revisions of South Dakota's Regional Haze State Implementation Plan;
3. In accordance with 40 CFR § 51.308(g), a commitment to periodically report the progress towards achieving reasonable progress goals;
4. In accordance with 40 CFR § 51.308(h), a commitment to determine the adequacy of the existing implementation plan; and
5. In accordance with 40 CFR § 51.308(i), the requirements for continued coordination with states and federal land managers.

1.3 Class I Areas In South Dakota

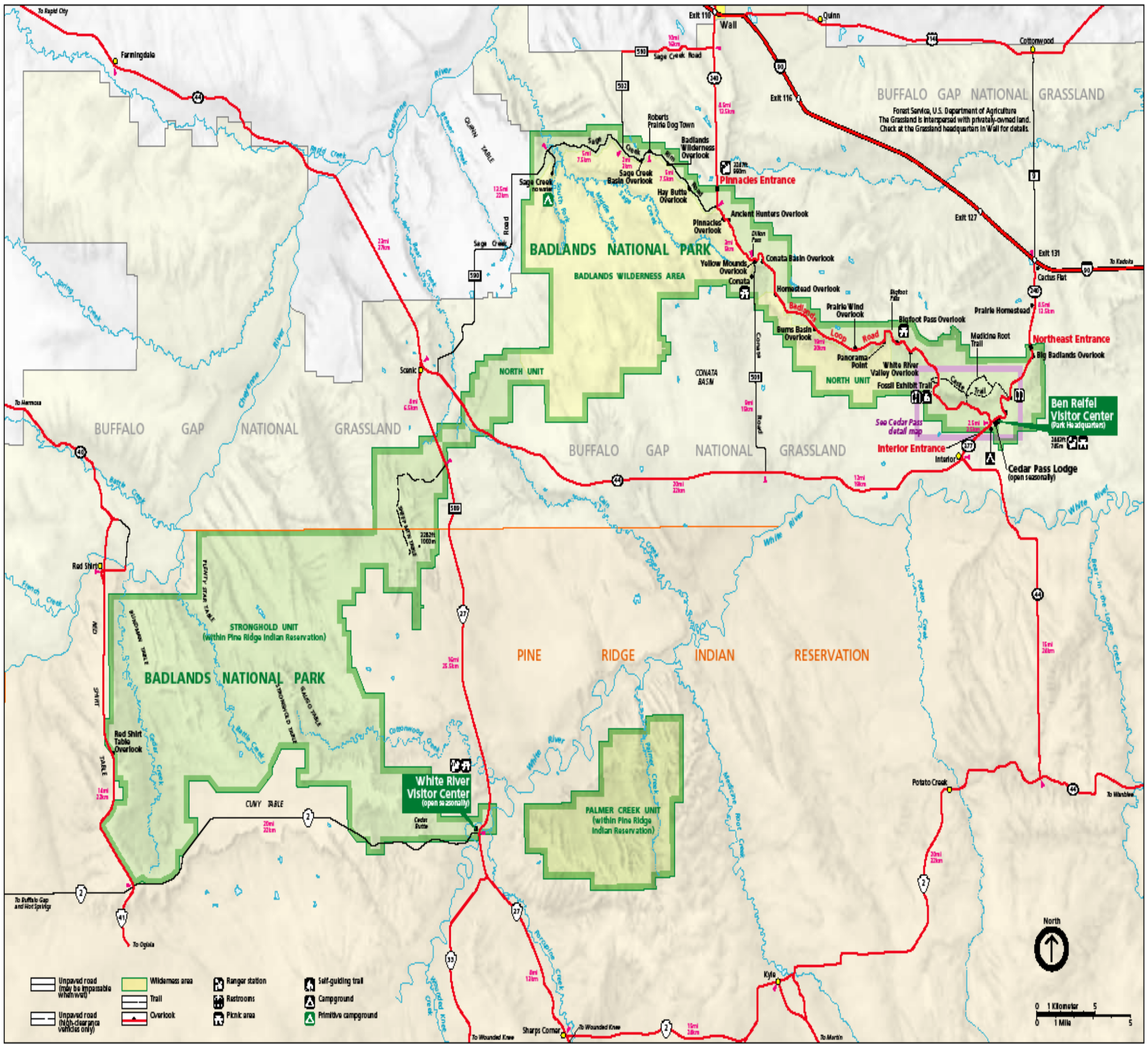
In accordance with 40 CFR § 51.308(f), states must address regional haze in each Class I area located within the state and in each Class I area located outside the state which may be affected by emissions from within the state. An analysis of which Class I Areas are affected by emissions from within South Dakota is found in later sections of the SIP. There are 156 national parks and wilderness areas in the nation that are considered Class I areas in the Clean Air Act (see Figure 1-1). South Dakota is home to two of the 156 national parks and wilderness areas. They are the Badlands National Park and the Wind Cave National Park.

Figure 1-1 – Class I Areas in the United States

There are also national parks and wilderness areas considered Class I areas in our neighboring states. In Wyoming the Class I areas are located in the western part of the state. Montana's Class I areas are located throughout the state but none are located in the southeastern corner which borders South Dakota. North Dakota has probably the closest Class I area of any neighboring state. Minnesota's Class I areas are located in the northeastern corner of the state. Iowa and Nebraska do not have Class I areas.

The Badlands National Park is located in southwestern South Dakota and consists of 244,000 acres of sharply eroded buttes, pinnacles, and spires blended with the largest protected mixed grass prairie in the United States (see Figure 1-2). The closest industrial area from the park boundary is in Rapid City which is approximately 40 miles to the northwest. The general topography is plains; therefore this site is well exposed to regional scale transport winds. The surrounding terrain is predominantly mixed grass prairie and bare rock and sand.

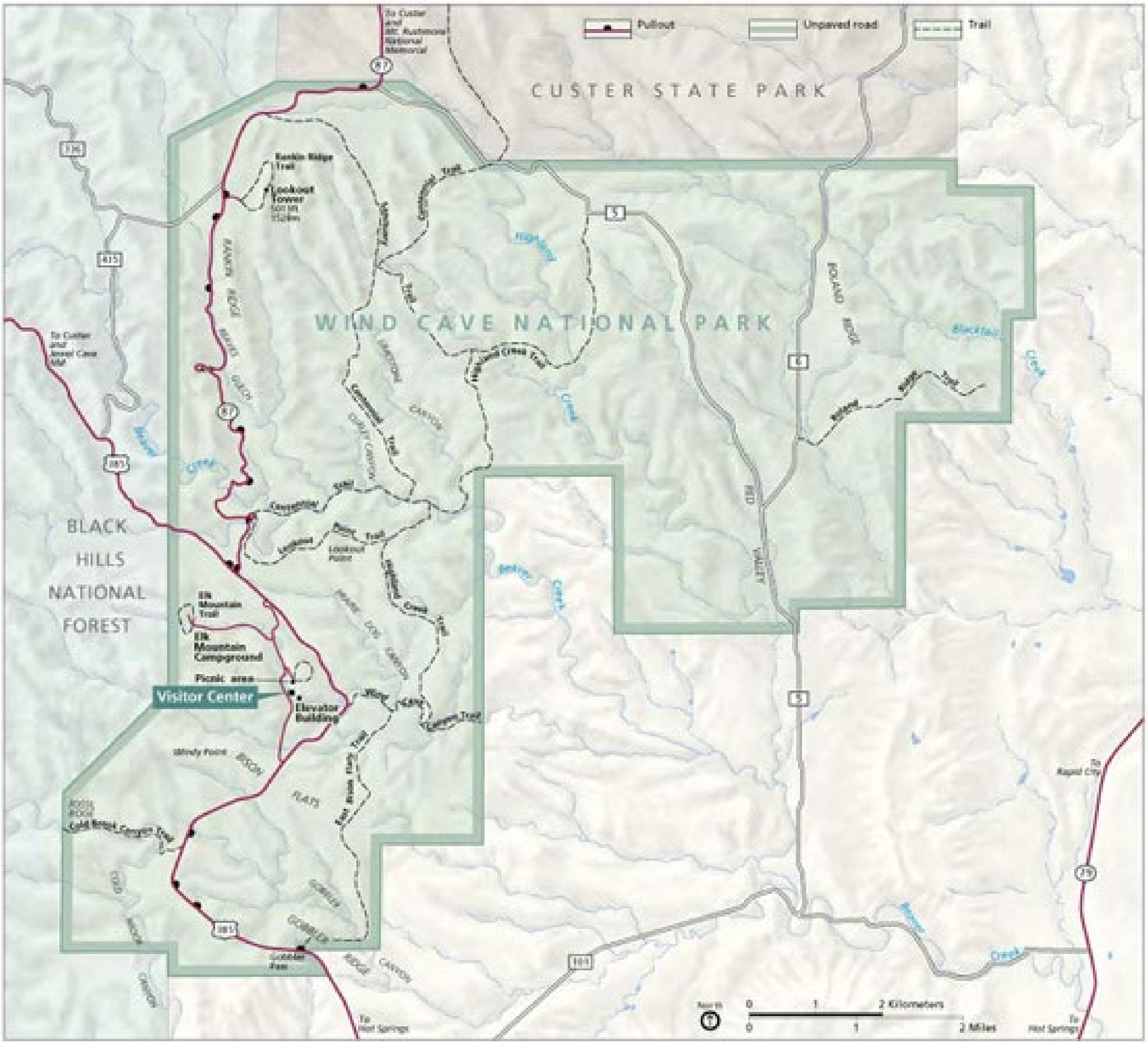
Figure 1-2 – Badlands National Park's Boundary



It was established as the Badlands National Monument in 1939, and was redesignated as a national park in 1978. The area of the park that is actually considered a Class I area is the Badlands Wilderness Area, which consists of 64,000 acres in the north unit.

Wind Cave National Park lies approximately 10 miles north of Hot Springs in southwestern South Dakota (see Figure 1-3). It was the first cave to be designated a national park anywhere in the world and is currently the fourth longest cave in the world with 119.58 miles (192.45 kilometers) of explored cave passageways.

Figure 1-3 – Wind Cave National Park's Boundary



Aboveground, the park includes 28,295 acres of mixed-grass prairie, ponderosa pine forest, and associated wildlife (see Figure 1-4). The park's mixed-grass prairie is one of the largest remaining and home to bison, elk, pronghorn, mule deer, and prairie dogs. The view from Lookout Tower on Rankin Ridge displays a spectacular view of the mixed-grass prairie and ponderosa pine forest (see Figure 1-5).

Figure 1-4 – Prairie, Forest, and Bison at Wind Cave (Courtesy of National Park Service)

Figure 1-5 – View from Lookout Tower (Courtesy of National Park Service)

2.0 South Dakota Visibility Conditions Calculations

In the mid-1980's, the IMPROVE (Interagency Monitoring of Protected Visual Environments) program was established to measure visibility impairment in Class I areas throughout the United States. The monitoring sites are operated and maintained through a formal cooperative relationship between the EPA, National Park Service, U.S. Fish and Wildlife, Bureau of Land Management, and U.S. Forest Service.

The objectives of the IMPROVE program include: 1) establishing the current visibility and aerosol conditions in Class I areas, 2) identifying the chemical species and emission sources responsible for existing human-made visibility impairment, 3) documenting long-term trends for assessing progress towards the national visibility goals, and 4) supporting the requirements of the regional haze rule by providing regional haze monitoring representing all visibility-protected Class I areas where practical.

The data collected at the IMPROVE monitoring sites are used by federal land managers, industry planners, scientists, public interest groups, and air quality regulators to better understand and protect the visual air quality resource in Class I areas. Most importantly, the IMPROVE program scientifically documents for American citizens, the visual air quality of their wilderness areas and national parks.

The IMPROVE network consists of aerosol and optical samplers. Every IMPROVE site deploys an aerosol sampler to measure speciated fine aerosols and coarse mass. Select sites also deploy a transmissometer and nephelometers to measure light extinction and scattering respectively, as well as automatic camera systems to visually measure the scenery. Particulate concentration data is obtained every 24 hours and converted into reconstructed light extinction through a complex calculation using the IMPROVE equation which may be viewed at:

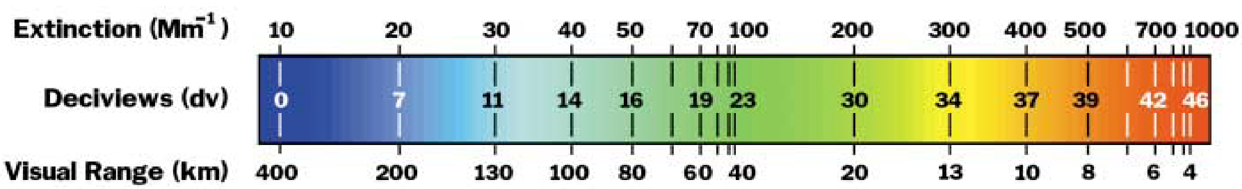
http://vista.cira.colostate.edu/Improve/the-improve-algorithm/

The IMPROVE data undergo quality assurance and control procedures and analyses by its contractors and the National Park Service before it is released. The aerosol and optical data are made publicly available approximately nine months after collection. In addition, seasonal analysis reports are prepared. IMPROVE program resources are available at:

http://vista.cira.colostate.edu/Improve/

Light extinction, the impairment of visibility, occurs due to the reflection and absorption of light by particles and gases. Reconstructed light extinction (denoted as b_{ext}) is expressed in units of inverse mega meters (1/Mm or Mm-1). The relationship between light extinction in Mm-1, Haze Index in Deciviews, and visual range in kilometers is indicted by the scale in Figure 2-1.

Figure 2-1 – Light Extinction-Haze Index-Visual Range Scale



A real-life visibility comparison of the light extinction, haze index, and visual range at different levels may be viewed in Figure 2-2 for the Badlands National Park. Generally, a one Deciview change in the Haze Index is likely humanly perceptible under ideal conditions regardless of background visibility conditions.

Figure 2-2 – Visibility Comparison

Starting in the upper left and going clockwise: Deciview = 5; B_{ext} = 16; visual range = 240 km, Deciview = 11; B_{ext} = 30; visual range = 130 km, Deciview = 19; B_{ext} = 65; visual range = 60 km, Deciview = 23; B_{ext} = 98; visual range = 40 k

Two IMPROVE monitoring sites exist in South Dakota. The Badlands National Park operates the first IMPROVE site (identified as “BADL1”), which is located on a gently sloping flat in the eastern portion of the Badlands National Park, approximately two miles northeast of Interior, South Dakota. DANR operates an ambient air monitoring site at the same location (see Figure 2-3). The site elevation is 2,415 feet and the lowest elevation in the area is the White River at 2,320 feet, approximately two miles south of the monitoring site. The Wind Cave National Park operates the second IMPROVE site (identified as “WICA1”) located near the park’s visitors center. DANR also operates an ambient air monitoring site at the same location (see Figure 2-4). Site elevation at the monitoring site is 4,240 feet and the general topography is hilly.

Figure 2-3 -- Badlands' State Ambient Monitoring Site

Figure 2-4 -- Wind Caves' IMPROVE and State Monitoring Site

2.1 Baseline Visibility Conditions

40 CFR § 51.308(f)(1) and 40 CFR § 51.308(f)(1)(i) state: "Calculations of baseline, current, and natural visibility conditions; progress to date; and the uniform rate of progress. ***For each mandatory Class I Federal area located within the State, the State must determine the following: Baseline visibility conditions for the most impaired and clearest days.*** The period for establishing baseline visibility conditions is 2000 to 2004. ***The State must calculate the baseline***

visibility conditions for the most impaired days and the clearest days using available monitoring data. To determine the baseline visibility condition, the State must calculate the average of the annual Deciview index values for the most impaired days and for the clearest days for the calendar years from 2000 to 2004. The baseline visibility condition for the most impaired days or the clearest days is the average of the respective annual values. For purposes of calculating the uniform rate of progress, the baseline visibility condition for the most impaired days must be associated with the last day of 2004. For mandatory Class I Federal areas without onsite monitoring data for 2000-2004, the State must establish baseline values using the most representative available monitoring data for 2000-2004, in consultation with the Administrator or his or her designee. For mandatory Class I Federal areas with incomplete monitoring data for 2000-2004, the State must establish baseline values using the 5 complete years of monitoring data closest in time to 2000-2004."

DANR determined the baseline visibility conditions for the Badlands and Wind Cave National Parks based on IMPROVE data from each respective park. The actual raw IMPROVE data used to determine the baseline visibility conditions may be viewed at the following two websites:

http://vista.cira.colostate.edu/Improve/rhr-summary-data/
http://views.cira.colostate.edu/tssv2/SiteBrowser/Default.aspx?appkey=SBCF_VisSum

In the case where a day in the IMPROVE database did not have enough data to calculate a Deciview value, the data was not considered in determining the baseline visibility conditions. The baseline visibility conditions were determined by calculating the average Deciview value for the 20% clearest days and the 20% most impaired days for each of the five baseline years (2000 through 2004) and by averaging those five year values. The baseline visibility conditions for the Badlands and Wind Cave National Parks are summarized in Tables 2-1 and 2-2.

Table 2-1 -- First Implementation Period Baseline Visibility Conditions in South Dakota's Class I Areas

	Badlands National Park		Wind Cave National Park	
	20% Clearest	20% Most Impaired	20% Clearest	20% Most Impaired
Calendar Year	Deciviews	Deciviews	Deciviews	Deciviews
2000	7.4	14.3	5.6	12
2001	7.5	16.1	5.1	13.6
2002	6.7	14.4	5.2	13
2003	6.3	15.2	5	13.5
2004	6.6	14.9	4.8	13.3
5-Year Average	6.9	15	5.1	13.1

Table 2-2 -- Second Implementation Period Baseline Visibility Conditions in South Dakota's Class I Areas

	Badlands National Park		Wind Cave National Park	
	20% Clearest	20% Most	20% Clearest	20% Most

Calendar Year	Deciviews	Impaired Deciviews	Deciviews	Impaired Deciviews
2014	5.6	12.2	3.2	10.3
2015	5.7	11.5	3.8	10.5
2016	5.2	12.1	3.3	9.9
2017	5.2	12.8	3.8	10.7
2018	5.3	13	3.6	11.2
5-Year Average	5.4	12.3	3.5	10.5

2.2 Natural Visibility Conditions

40 CFR § 51.308(f)(1) and 40 CFR § 51.308(f)(1)(ii) state: "Calculations of baseline, current, and natural visibility conditions; progress to date; and the uniform rate of progress. ***For each mandatory Class I Federal area located within the State, the State must determine the following: Natural visibility conditions for the most impaired and clearest days. A State must calculate natural visibility condition*** by estimating the average Deciview index existing under natural conditions for the most impaired days or the clearest days based on available monitoring information and appropriate data analysis techniques; and"

The ultimate goal of the regional haze program is to remedy existing, and prevent future human-caused impairments of visibility in order to achieve natural conditions in each Class I area by 2064. Natural conditions reflect naturally occurring phenomena that reduce visibility (as measured in terms of light extinction, visual range, contrast, or coloration), and may refer to the conditions on a single day or a set of days. These phenomena include, but are not limited to, humidity, fire events, dust storms, volcanic activity, and biogenic emissions from soils and trees. These phenomena may be near or far from a Class I area and may be outside the United States. Natural visibility means visibility (contrast, coloration, and texture) on a day or days that would have existed under natural conditions. Natural visibility varies with time and location, is estimated or inferred rather than directly measured, and may have long-term trends due to long-term trends in natural conditions. Natural visibility condition means the average of individual values of daily natural visibility unique to each Class I area for either the most impaired days or the clearest days.

Since no visibility monitoring data exists from the pre-manmade impairment period, the EPA developed guidance on how to estimate natural conditions. EPA published "*Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Program"*, in September 2003, which provides two methods of estimating natural conditions. The first method is called the default natural conditions, where EPA provides estimates of natural conditions for each Class I area. The second method is called refined natural conditions, where individual states may estimate site specific natural conditions if the state can provide sufficient evidence that supports refined natural conditions.

Since EPA's 2003 guidance was written, a revised natural light extinction formula was developed and adopted by EPA as the basis for the regional haze metric used to track progress in reducing haze levels in Class I areas. This revised algorithm was developed by Marc Pitchford et. al in a paper titled "Revised Algorithm for Estimating Light Extinction from IMPROVE

Particle Speciation Data," published in the Journal of the Air & Waste Management Association on January 24, 2012. The new IMPROVE equation accounts for the effect of particle size distribution on light extinction of small and large size sulfate, nitrate and organic carbon mass. The revised formula is displayed in Equation 2-1.

Equation 2-1 -- Revised Natural Light Extinction Formula

$$b_{ext} = 2.2 f_s(RH)[small\ sulfate] + 4.8 f_L(RH)[l\arg e\ sulfate] + 2.4 f_s(RH)[small\ nitrate]$$
$$+ 5.1 f_L(RH)[l\arg e\ nitrate] + 2.8[small\ organic\ mass] + 6.1[l\arg e\ organic\ mass]$$
$$+ 10[light\ absorbing\ carbon] + [soil] + 0.6[coarse\ matter] + 1.7 f_{ss}(RH)[sea\ salt]$$
$$+ Rayleigh\ Scattering + 0.33[NO_2(ppb)]$$

The result of the revised light extinction is used in the formula displayed in Equation 2-2 to estimate the annual average of the haze index values (HI), in Deciviews.

Equation 2-2 -- Annual Average Haze Index

$$HI = 10\ln\left(b_{ext} \div 10\right)$$

Where:

- HI = annual average of the haze index values, in Deciviews; and
- b_{ext} = natural light extinction, in Mm^{-1}.

For this second planning period which ends in 2028, the EPA guidance from December 2018 titled "Technical Guidance on Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program," was also used in addition to the above two equations to determine natural conditions. This EPA 2018 document further elucidates the recommended procedures for determining natural visibility conditions for the 20% most impaired days and the 20% clearest days. It is recognized that natural conditions are not constant, but change over time, and that this estimation process is complicated. As the difference between current and natural conditions becomes smaller and methods of estimating natural conditions improve, natural conditions may change as the regional haze program for each state is re-evaluated.

Table 2-3 -- Natural Visibility Conditions for South Dakota's Class I Areas

Class I Area	Natural Visibility Conditions	
	Clearest Days (dv)	Most Impaired Days (dv)
Badlands	2.9	6.1
Wind Cave	1.9	5.6

2.3 Current Visibility Conditions

40 CFR § 51.308(f)(1) and 40 CFR § 51.308(f)(1)(iii) state: "Calculations of baseline, current, and natural visibility conditions; progress to date; and the uniform rate of progress. ***For each mandatory Class I Federal area located within the State, the State must determine the following: Current visibility conditions for the most impaired and clearest days.*** The period for

calculating current visibility conditions is the most recent 5-year period for which data are available. The State must calculate the current visibility conditions for the most impaired days and the clearest days using available monitoring data. To calculate each current visibility condition, the State must calculate the average of the annual Deciview index values for the years in the most recent 5-year period. The current visibility condition for the most impaired or the clearest days is the average of the respective annual values."

Current visibility conditions for this second implementation period must be calculated as the average of the annual Deciview index values for the five year period from 2014-2018. DANR reviewed the current visibility conditions data provided to it by WRAP, and displayed the current visibility conditions for each Class I Area for both the 20% clearest and 20% most impaired days in Table 2-4 below.

Table 2-4 -- Current Visibility Conditions for South Dakota's Class I Areas

Class I Area	Current Visibility Conditions	
	Clearest Days (dv)	Most Impaired Days (dv)
Badlands	5.4	12.3
Wind Cave	3.5	10.5

2.4 Progress To Date

40 CFR § 51.308(f)(1) and 40 CFR § 51.308(f)(1)(iv) state: "Calculations of baseline, current, and natural visibility conditions; progress to date; and the uniform rate of progress. ***For each mandatory Class I Federal area located within the State, the State must determine the following: Progress to date for the most impaired and clearest days. Actual progress made towards the natural visibility condition since the baseline period, and actual progress made during the previous implementation period up to and including the period for calculating current visibility conditions, for the most impaired and for the clearest days."***

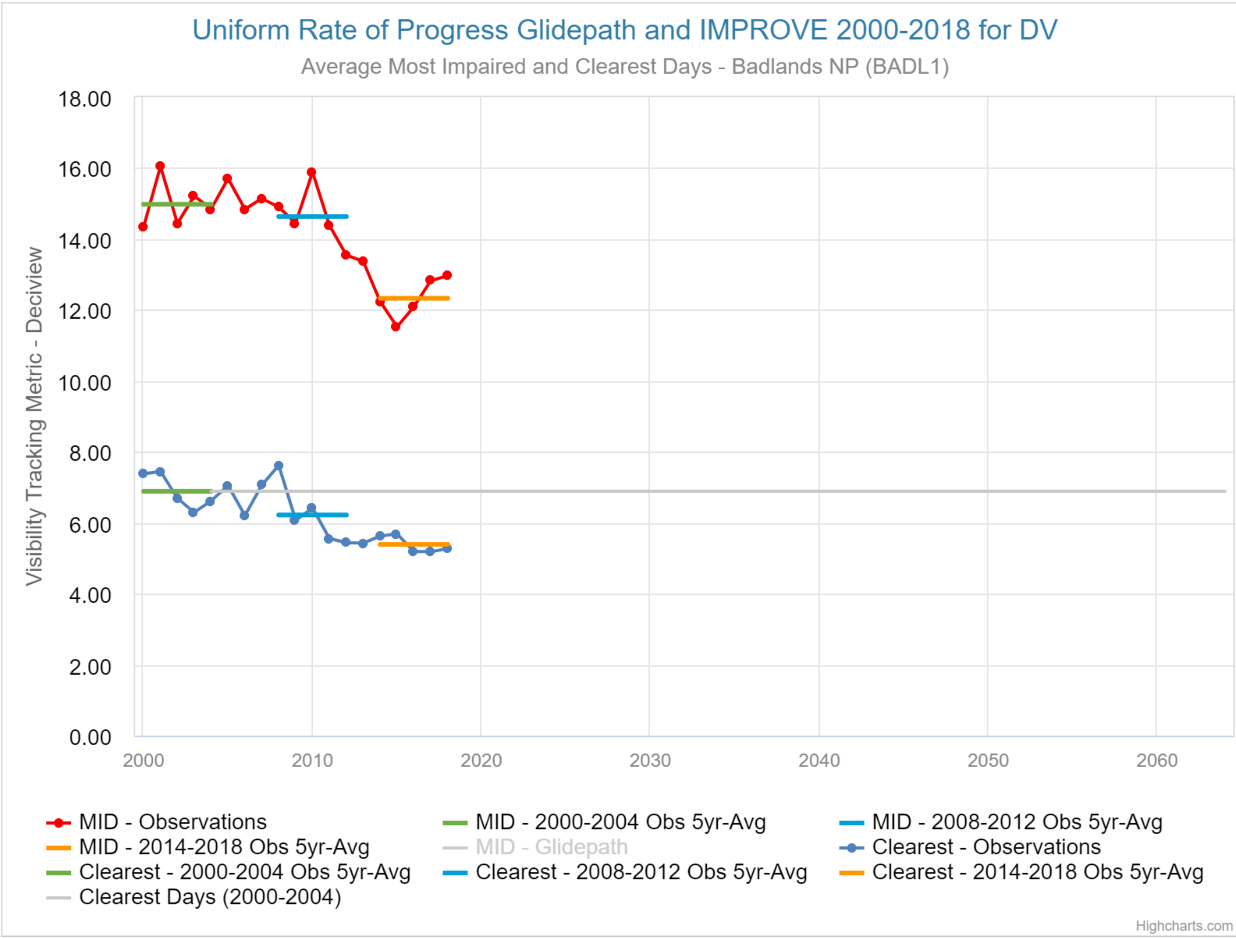
Actual progress made towards the natural visibility condition since the 2000-2004 baseline period for both the 20% most impaired and the 20% clearest days has been fairly substantial at both the Badlands and Wind Cave Class I Areas.

Regarding the Badlands Class I area, progress to date at the Badlands Class I Area towards the natural visibility condition for the period since the baseline period for the 20% most impaired days is 2.7dv, from 15dv during the five year average between 20002004 to 12.3dv during the five year average between 2014-2018. Progress to date towards the natural visibility condition for the period since the baseline period for the 20% clearest days is 1.5dv, from 6.9dv during the five year average between 2000-2004 to 5.4dv during the five year average between 2014-2018. Progress to date towards the natural visibility condition during the previous implementation period up to and including the period for calculating current visibility conditions for the 20% most impaired days is 2.3dv, from 14.6dv during the five year average between 2008-2012 to 12.3dv during the five year average between 2014-2018. Progress to date towards the natural visibility condition during the previous implementation period up to and including the period for calculating current visibility conditions for the 20% clearest days is 0.8dv, from 6.2dv during the five year average between 2008-2012 to 5.4dv during the five year average between 2014-2018.

Regarding the Wind Cave Class I Area, Progress to date towards the natural visibility condition for the period since the baseline period for the 20% most impaired days is 2.6dv, from 13.1dv during the five year average between 2000-2004 to 10.5dv during the five year average between 2014-2018. Progress to date towards the natural visibility condition for the period since the baseline period for the 20% clearest days is 1.6, from 5.1dv during the five year average between 2000-2004 to 3.5dv during the five year average between 2014-2018. Progress to date towards the natural visibility condition during the previous implementation period up to and including the period for calculating current visibility conditions for the 20% most impaired days is 2dv, from 12.5dv during the five year average between 2008-2012 to 10.5dv during the five year average between 2014-2018. Progress to date towards the natural visibility condition during the previous implementation period up to and including the period for calculating current visibility conditions for the 20% clearest days is 0.6dv, from 4.1dv during the five year average between 2008-2012 to 3.5dv during the five year average between 2014-2018.

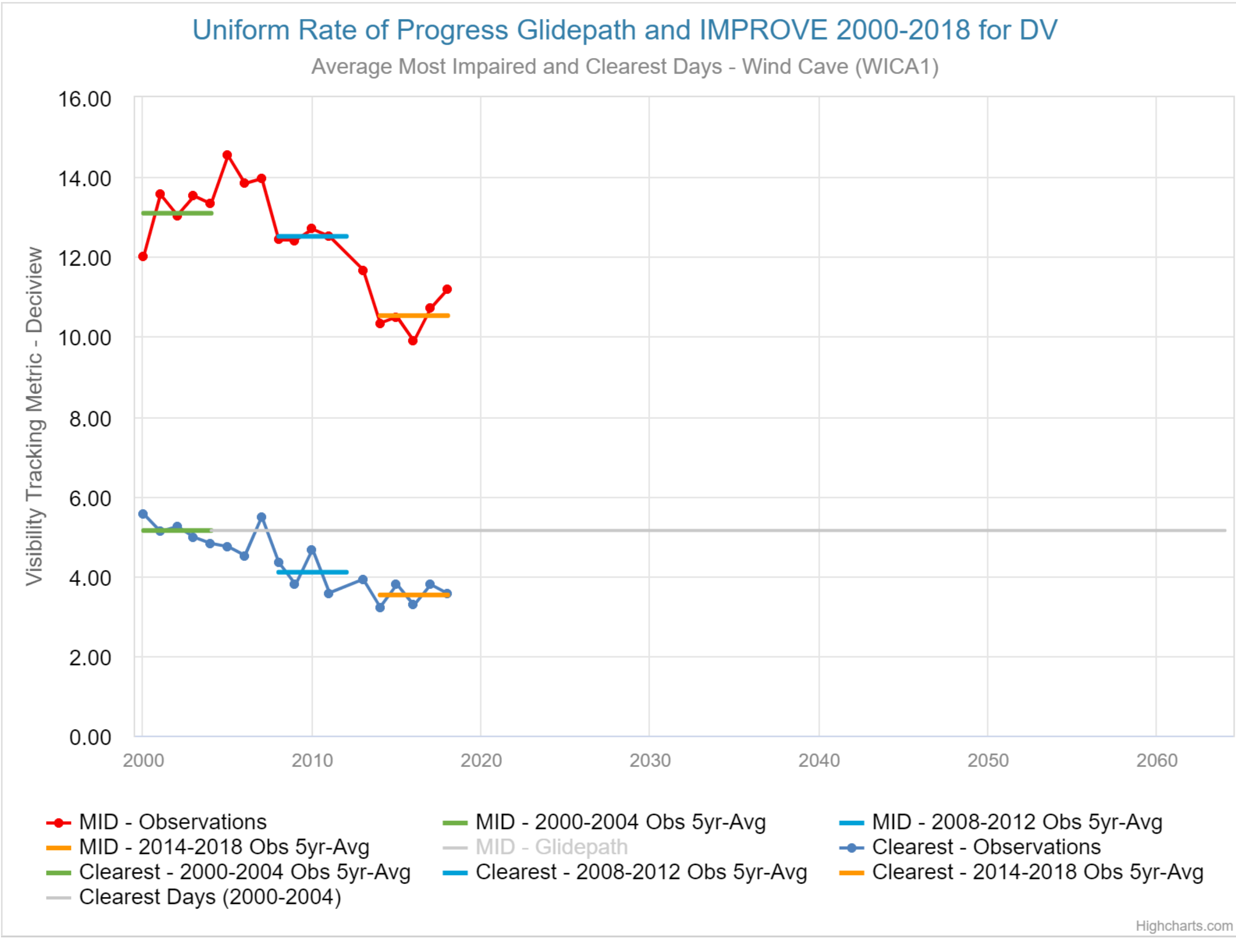
Figures 2-5 and 2-6 graphically show the progress to date at both of South Dakota’s Class I Areas.

Figure 2-5 -- Progress to Date Badlands National Park



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 2-6 -- Progress to Date Wind Cave National Park



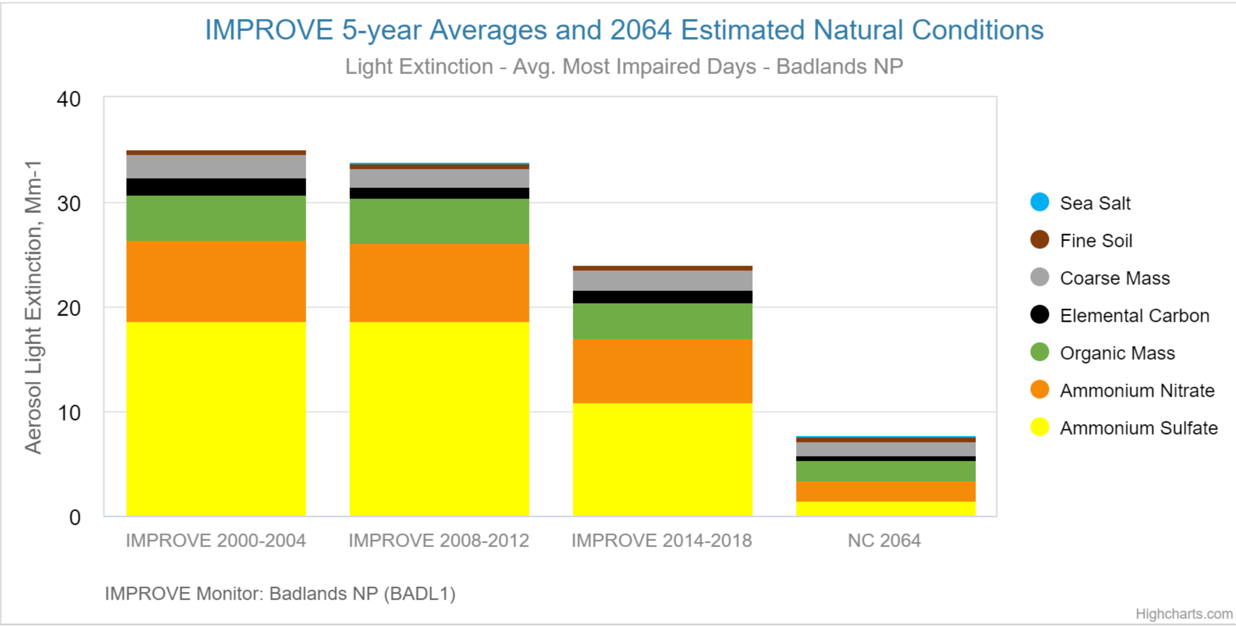
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Additional progress to date information can be found in the below grouping of charts and tables.

Regarding Figures 2-7 through 2-8 and Tables 2-5 through 2-6, when looking at the 20% Most Impaired Days, a consistent decreasing aerosol light extinction trend can be seen in the IMPROVE datasets through time, with the most significant downward jump occurring between the 2008-2012 and 2014-2018 IMPROVE datasets. Given that since the 2000-2004 dataset between a third and half of the total progress towards the 2064 natural conditions goal has already been reached by the latest 2014-2018 data, indications suggest both of South Dakota's class I areas are on track to reaching their natural visibility goals on time.

Regarding Figures 2-9 through 2-10 and Tables 2-7 through 2-8, when looking at the Clearest Days, similar observations can be made to the 20% Most Impaired Days data. At both South Dakota's Class I Areas, noticeable improvements have been made since the year 2000, and again it seems that both Class I Areas will very likely reach their 2064 natural visibility goals, as the Regional Haze Rule at 40 CFR § 51.308(f)(3)(i) states that the 20% Clearest Days only need to show no degradation in visibility since the baseline period. The 20% Clearest Days will not be a large focus of this second State Implementation Plan from this point forward therefore.

Figure 2-7 -- IMPROVE data five year averages and estimated 2064 natural conditions compared for Badlands National Park, defined by EPA guidance[1]

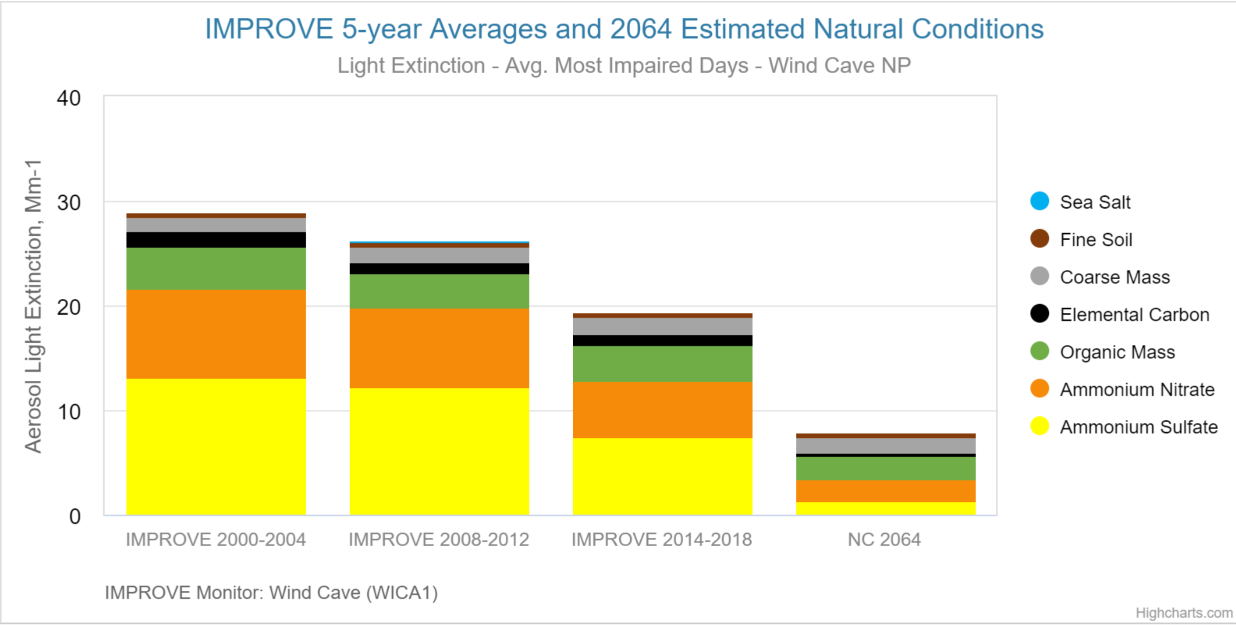


1) U.S. EPA. December 2018. Technical Guidance on Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program. EPA-454/R-18-010
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Table 2-5 -- Data from Figure 2-7 displayed in tabular form

Parameter Code	IMPROVE 2000-2004	IMPROVE 2008-2012	IMPROVE 2014-2018	Estimated Natural Conditions 2064
Deciview	14.9804	14.6351	12.3304	6.09116
Ammonium Nitrate Extinction	7.70909	7.46695	6.07968	1.8474
Ammonium Sulfate Extinction	18.7048	18.6	10.927	1.53778
Coarse Mass Extinction	2.15173	1.84062	1.92515	1.41211
Elemental Carbon Extinction	1.75567	1.05054	1.11877	0.32887
Fine Soil Extinction	0.49487	0.49866	0.46152	0.46903
Organic Mass Extinction	4.25937	4.31282	3.50896	2.03622
Sea Salt Extinction	0.02619	0.07033	0.05981	0.05526

Figure 2-8 -- IMPROVE data five year averages and estimated 2064 natural conditions compared for Badlands National Park, defined by EPA guidance[1]

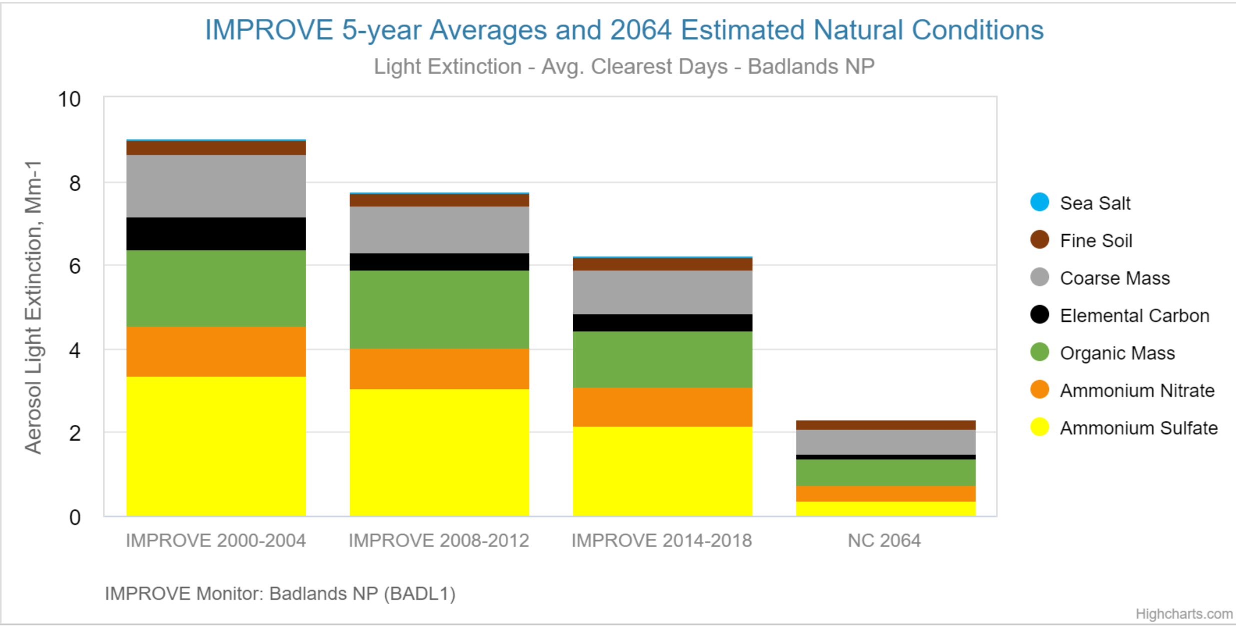


1) U.S. EPA. December 2018. Technical Guidance on Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program. EPA-454/R-18-010
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Table 2-6 -- Data from Figure 2-8 displayed in tabular form

Parameter Code	IMPROVE 2000-2004	IMPROVE 2008-2012	IMPROVE 2014-2018	Estimated Natural Conditions 2064
Deciview	13.0923	12.5123	10.5258	5.63799
Ammonium Nitrate Extinction	8.52314	7.53455	5.36073	2.10531
Ammonium Sulfate Extinction	13.1538	12.2555	7.4656	1.34242
Coarse Mass Extinction	1.35776	1.41607	1.66235	1.48947
Elemental Carbon Extinction	1.52397	1.07529	1.09296	0.32704
Fine Soil Extinction	0.38583	0.47649	0.41234	0.47928
Organic Mass Extinction	3.9418	3.37285	3.37312	2.15354
Sea Salt Extinction	0.03723	0.07837	0.0797	0.05639

Figure 2-9 -- IMPROVE data five year averages and estimated 2064 natural conditions compared for Badlands National Park, defined by EPA guidance[1]

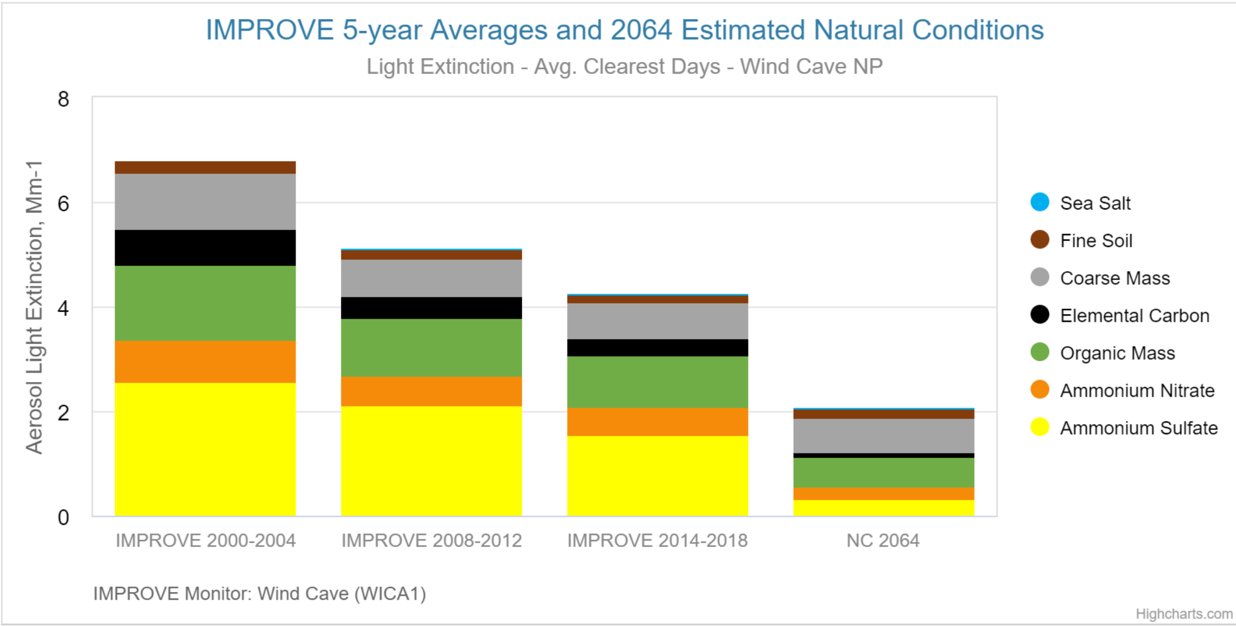


1) U.S. EPA. December 2018. Technical Guidance on Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program. EPA-454/R-18-010
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Table 2-7 -- Data from Figure 2-9 displayed in tabular form

Parameter Code	IMPROVE 2000-2004	IMPROVE 2008-2012	IMPROVE 2014-2018	Estimated Natural Conditions 2064
Deciview	6.88854	6.22098	5.392	2.86107
Ammonium Nitrate Extinction	1.19966	0.97046	0.92829	0.36559
Ammonium Sulfate Extinction	3.35657	3.07478	2.15471	0.3636
Coarse Mass Extinction	1.50811	1.12202	1.06479	0.59134
Elemental Carbon Extinction	0.7877	0.42206	0.39676	0.10705
Fine Soil Extinction	0.33276	0.2813	0.27863	0.21594
Organic Mass Extinction	1.80986	1.8523	1.36322	0.66079
Sea Salt Extinction	0.02358	0.04934	0.04768	0.01777

Figure 2-10 -- IMPROVE data five year averages and estimated 2064 natural conditions compared for Badlands National Park, defined by EPA guidance[1]



1) U.S. EPA. December 2018. Technical Guidance on Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program. EPA-454/R-18-010
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Table 2-8 -- Data from Figure 2-10 displayed in tabular form

Parameter Code	IMPROVE 2000-2004	IMPROVE 2008-2012	IMPROVE 2014-2018	Estimated Natural Conditions 2064
Deciview	5.13996	4.09471	3.52462	1.88114
Ammonium Nitrate Extinction	0.80416	0.57583	0.52735	0.2437
Ammonium Sulfate Extinction	2.57776	2.12193	1.55485	0.31718
Coarse Mass Extinction	1.05495	0.72876	0.66741	0.63223
Elemental Carbon Extinction	0.70183	0.40752	0.33023	0.09991
Fine Soil Extinction	0.234	0.18043	0.17117	0.19495
Organic Mass Extinction	1.42161	1.09751	0.99852	0.57784
Sea Salt Extinction	0.01579	0.03191	0.02478	0.01416

The next set of figures, Figures 2-11 through 2-16, more specifically pinpoint the sources of light extinction through a greater timespan. These sources again include ammonium sulfate, ammonium nitrate, organic mass, elemental carbon, soil, coarse mass, and sea salt, on the 20% Most Impaired Days and the 20% Clearest Days, from the years 2000 to 2018 for each of South Dakota's two Class I Areas. Data used to construct these charts was obtained from the IMPROVE monitoring data, and from the Federal Land Manager Environmental Database, found at this URL: http://views.cira.colostate.edu/fed/SiteBrowser/Default.aspx?appkey=SBCF_VisSum.

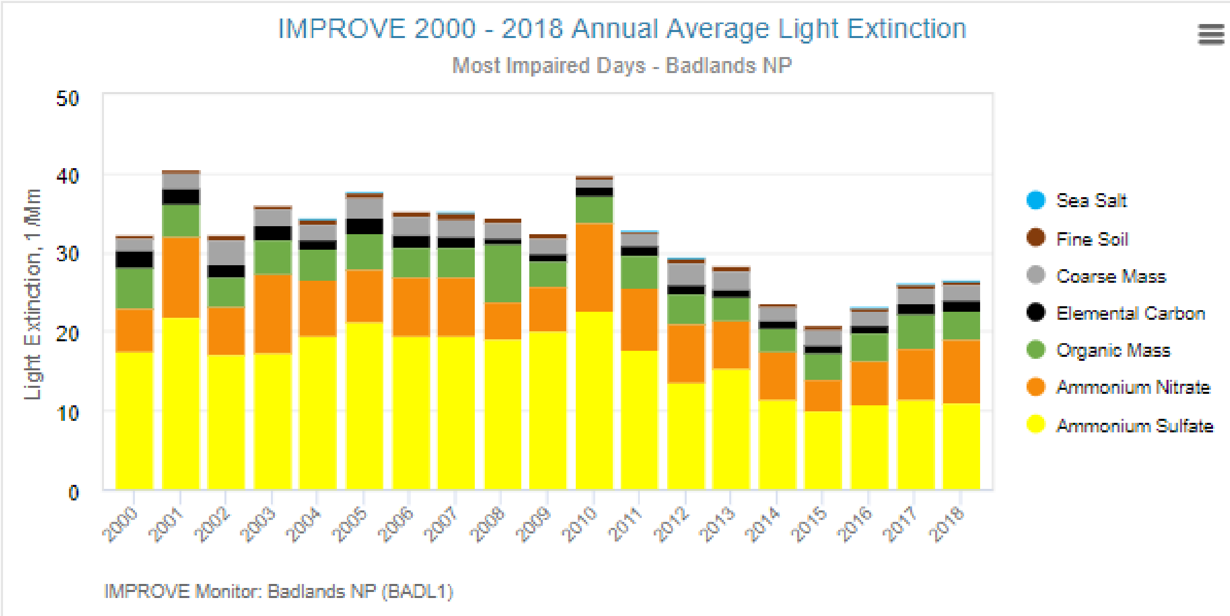
Regarding Figure 2-11, there are some important trends to note. From 2000 to 2018, overall, light extinction from the seven main pollutant species at Badlands National Park on the 20% Most Impaired Days has been decreasing. Also, the vast majority of this overall decreasing trend can be attributed to reductions in ammonium sulfate and ammonium nitrate; organic mass, elemental carbon, soil, coarse mass, and sea salt all seem to be holding constant through the years.

Regarding Figure 2-12, similar trends can be seen at Wind Cave National Park. Overall the general trend is for decreasing light extinction values. The majority of the decreases appear to be coming from reduced light extinction from ammonium sulfate, with ammonium nitrate making up a smaller portion of the overall decreases.

Regarding Figures 2-13 and 2-14, the first noteworthy observation is how much larger of an effect anthropogenic emissions have on visibility impairment compared to natural sources used to have compared to more recent years. Historically anthropogenic sources produced double the amount of visibility impairment compared to natural sources, however in recent years there is no longer a significant difference. Also noteworthy is how through time natural sources of visibility impairment virtually do not change, whereas a distinctive drop in anthropogenic emission sources can be seen. Furthermore, of the anthropogenic emission sources of visibility impairment, ammonium sulfate has historically dominated the picture, whereas in more recent years its effects have been reduced quite substantially. Ammonium sulfate still produces the largest amount of light extinction, however ammonium nitrate is no longer significantly trailing.

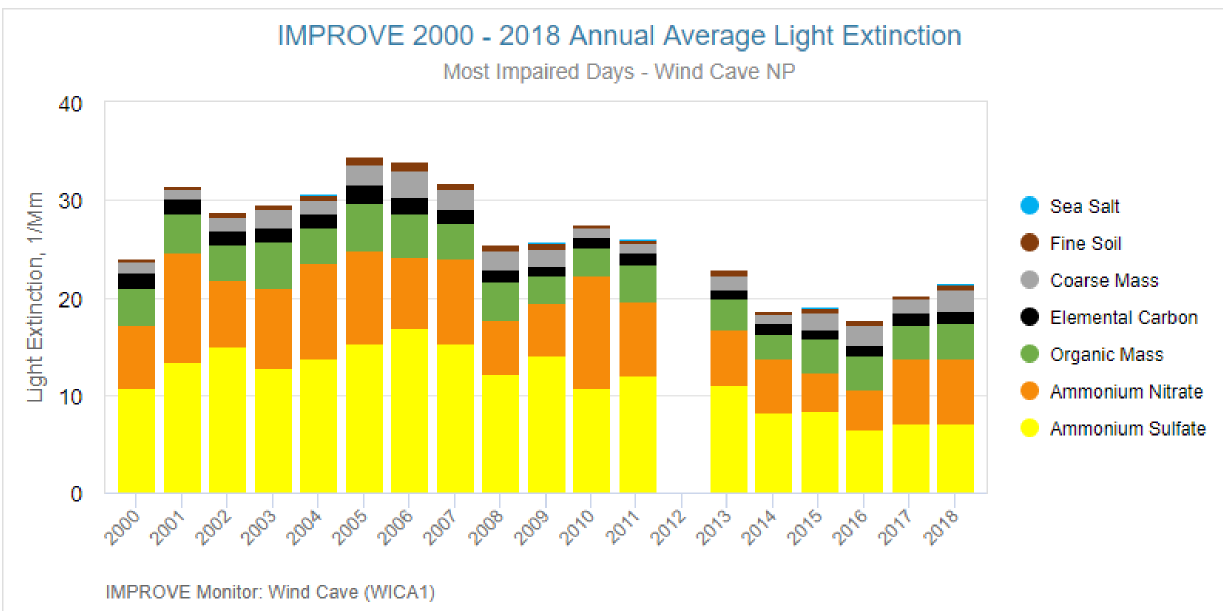
Regarding Figures 2-15 and 2-16, South Dakota is well below the Clearest Days threshold established in 40 CFR §51.308(f)(3)(i), stated as follows: "[…] The long-term strategy and the reasonable progress goals must provide for an improvement in visibility for the most impaired days since the baseline period and ensure no degradation in visibility for the clearest days since the baseline period." South Dakota has included the charts anyway because the Clearest Days concept is an important cornerstone concept in the Regional Haze Rule and shouldn't be completely excluded from public viewing and scrutiny.

Figure 2-11 -- Light extinction separated by pollutant species during the 20% Most Impaired Days each year, according to the Badlands National Park IMPROVE monitor



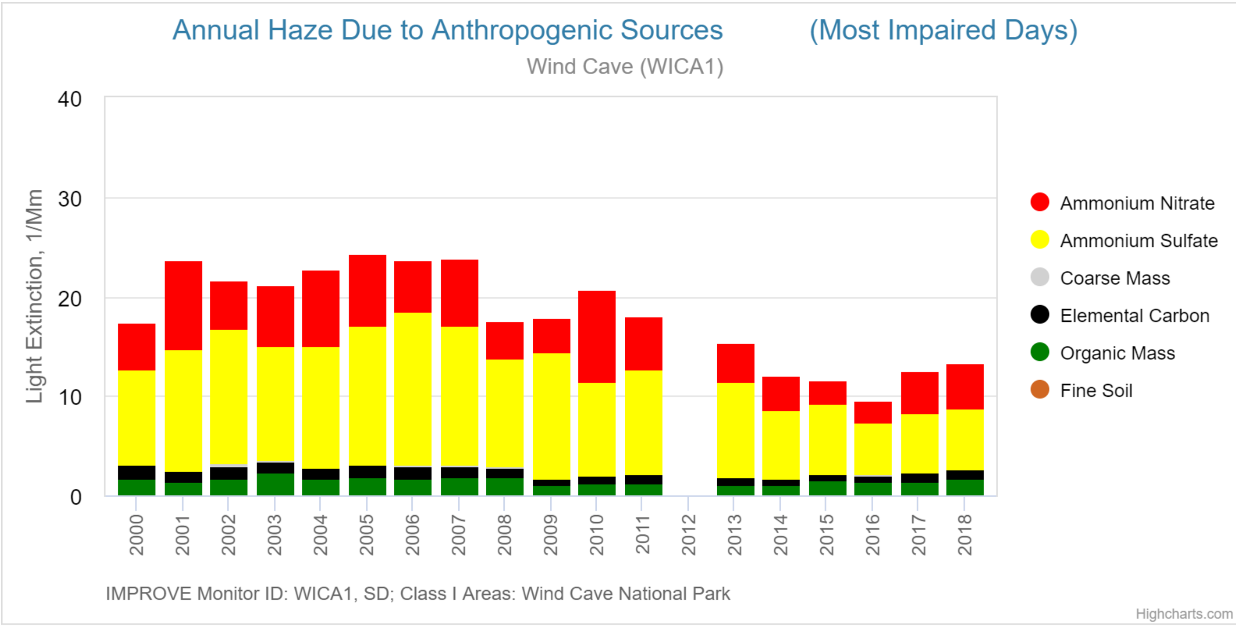
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 2-12 -- Light extinction separated by pollutant species during the 20% Most Impaired Days each year, according to the Wind Cave National Park IMPROVE monitor



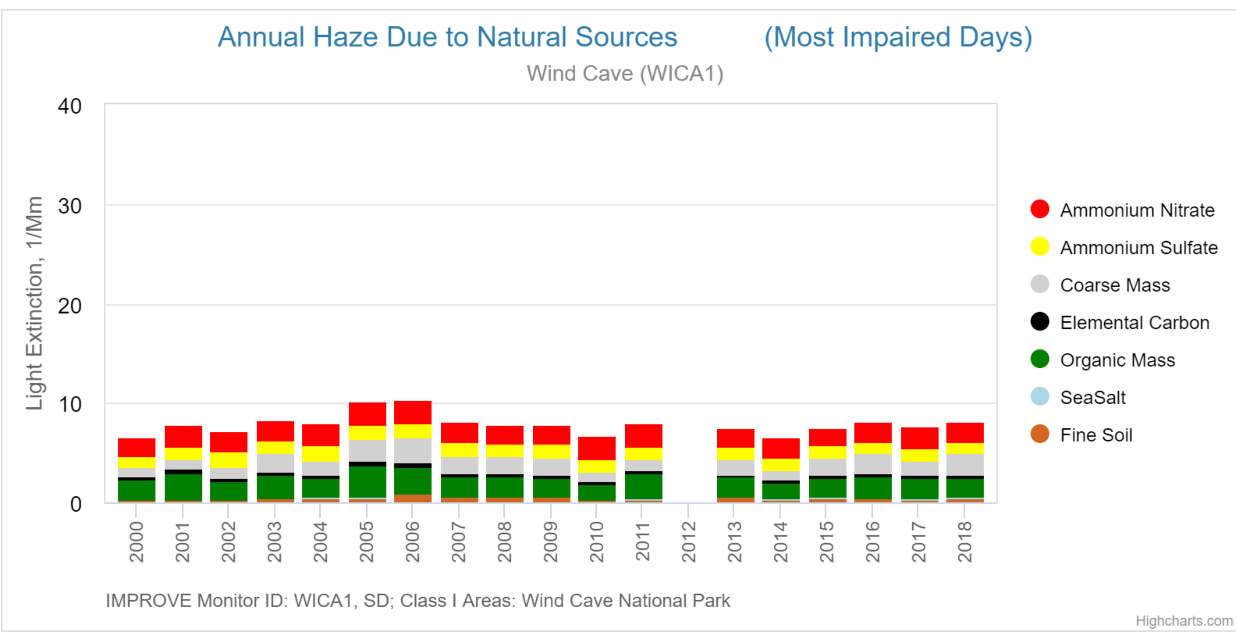
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 2-13 -- Anthropogenic light extinction from the IMPROVE monitor on the 20% Most Impaired Days by pollutant type at Wind Cave National Park through time



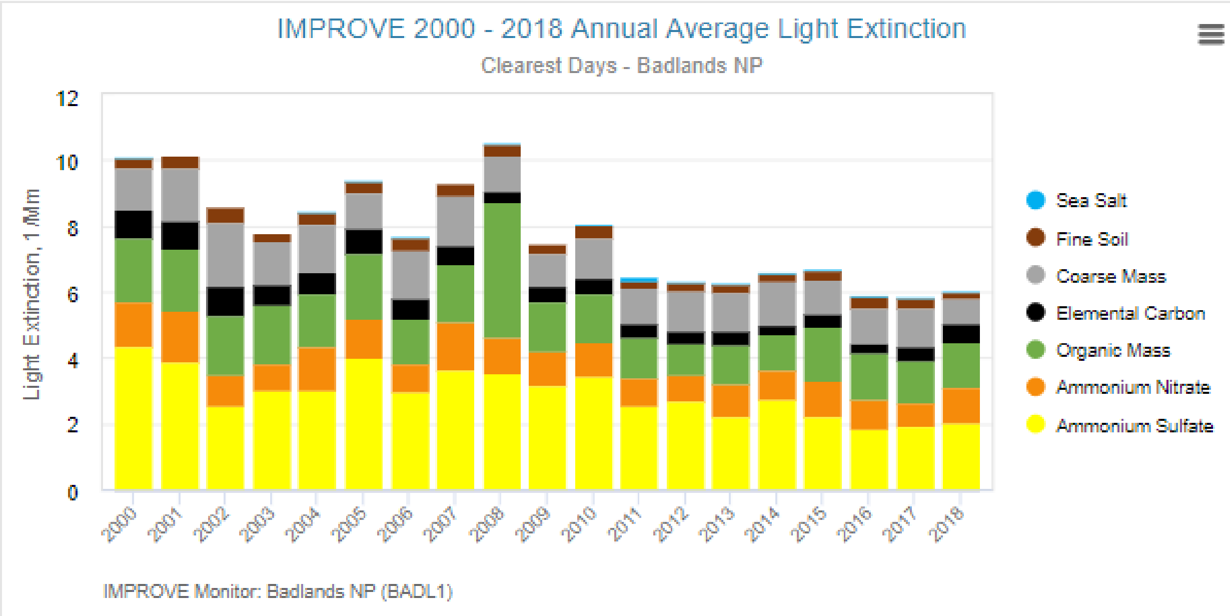
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 2-14 -- Natural light extinction from the IMPROVE monitor on the 20% Most Impaired Days by pollutant type at Wind Cave National Park through time



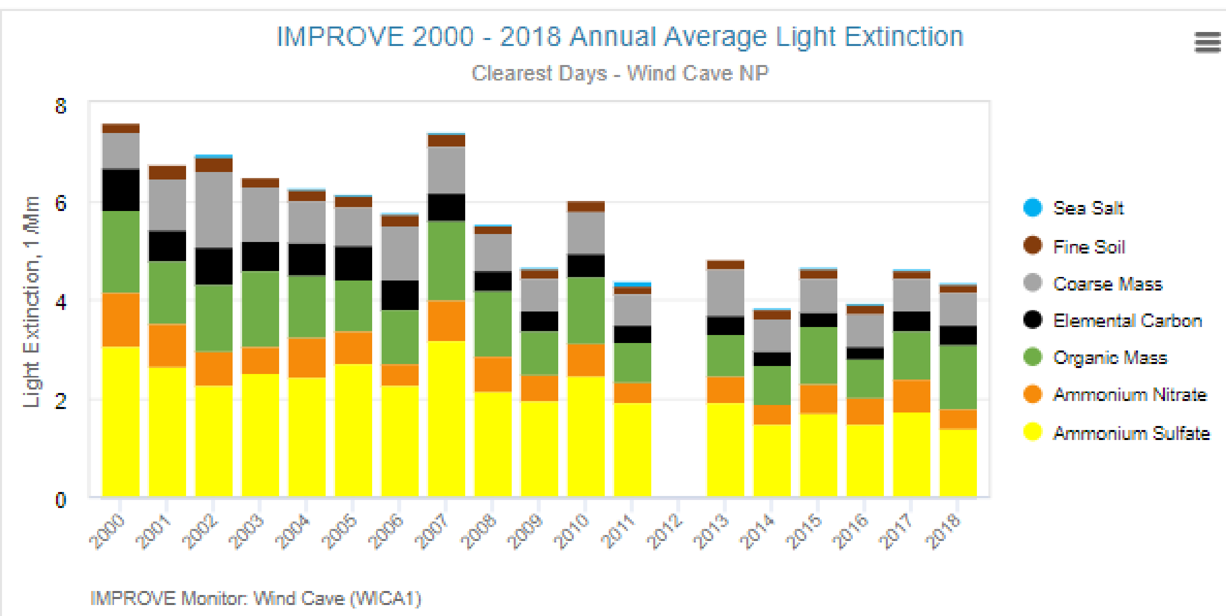
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 2-15 -- Light extinction separated by pollutant species during the Clearest Days each year, according to the Badlands National Park IMPROVE monitor



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 2-16 -- Light extinction separated by pollutant species during the Clearest Days each year, according to the Wind Cave National Park IMPROVE monitor



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

2.5 Differences Between Current And Natural Visibility Conditions

40 CFR § 51.308(f)(1) and 40 CFR § 51.308(f)(1)(v) state: "Calculations of baseline, current, and natural visibility conditions; progress to date; and the uniform rate of progress. ***For each***

mandatory Class I Federal area located within the State, the State must determine the following: Differences between current visibility condition and natural visibility condition. The number of Deciviews by which the current visibility condition exceeds the natural visibility condition, for the most impaired and for the clearest days."

At the Badlands Class I Area, the number of Deciviews by which the current visibility condition exceeds the natural visibility condition for the 20% most impaired days is 6.2dv, from 12.3dv during the five year average between 2014-2018 to 6.1dv at the 2064 endpoint.

At the Wind Cave Class I Area, the number of Deciviews by which the current visibility condition exceeds the natural visibility condition for the 20% most impaired days is 4.9dv, from 10.5dv during the five year average between 2014-2018 to 5.6dv at the 2064 endpoint.

Table 2-9 -- 20% Most Impaired Days Current and Natural Visibility Conditions

Badlands		
	Current (2014-2018) Visibility Condition	
		12.3 dv
	Natural (2064) Visibility Condition	
		6.1 dv
	Difference between Current and Natural Visibility	
		6.2 dv
Wind Cave		
	Current (2014-2018) Visibility Condition	
		10.5 dv
	Natural (2064) Visibility Condition	
		5.6 dv
	Difference between Current and Natural Visibility	
		4.9 dv

At the Badlands Class I Area, the number of Deciviews by which the current visibility condition exceeds the natural visibility condition for the 20% clearest days is 2.5dv, from 5.4dv during the five year average between 2014-2018 to 2.9dv at the 2064 endpoint.

At the Wind Cave Class I Area, the number of Deciviews by which the current visibility condition exceeds the natural visibility condition for the 20% clearest days is 1.6dv, from 3.5dv during the five year average between 2014-2018 to 1.9dv at the 2064 endpoint.

Table 2-10 -- 20% Clearest Days Current and Natural Visibility Conditions

Badlands		
	Current (2014-2018) Visibility Condition	
		5.4 dv
	Natural (2064) Visibility Condition	

		2.9 dv
	Difference between Current and Natural Visibility	
		2.5 dv
Wind Cave		
	Current (2014-2018) Visibility Condition	
		3.5 dv
	Natural (2064) Visibility Condition	
		1.9 dv
	Difference between Current and Natural Visibility	
		1.6 dv

2.6 Uniform Rate Of Progress

40 CFR § 51.308(f)(1) and 40 CFR § 51.308(f)(1)(vi)(A) state: "Calculations of baseline, current, and natural visibility conditions; progress to date; and the uniform rate of progress. ***For each mandatory Class I Federal area located within the State, the State must determine the following: The uniform rate of progress for each mandatory Class I Federal area in the State.*** To calculate the uniform rate of progress, the State must compare the baseline visibility condition for the most impaired days to the natural visibility condition for the most impaired days in the mandatory Class I Federal area and determine the uniform rate of visibility improvement (measured in Deciviews of improvement per year) that would need to be maintained during each implementation period in order to attain natural visibility conditions by the end of 2064."

The uniform rate of visibility improvement, measured in Deciviews, is determined by taking the difference between the baseline visibility conditions and the natural visibility conditions and dividing by 60 years, which is the time frame for attaining natural visibility conditions by 2064. The uniform rate of improvement is required to be considered as South Dakota establishes its reasonable progress goals for attaining natural visibility conditions. The uniform rate of improvement for the Badlands and Wind Cave National Parks is based on the formula in Equation 2-3 and the baseline and natural background values in Table 2-5. The results are displayed in Table 2-11. The uniform rate of improvement was calculated for the 20% most impaired days for each national park.

Equation 2-3 -- Uniform Rate of Progress

$$Uniform\ Rate\ of\ \mathrm{Pr}ogress = \left(Baseline - Natural\right) \div 60$$

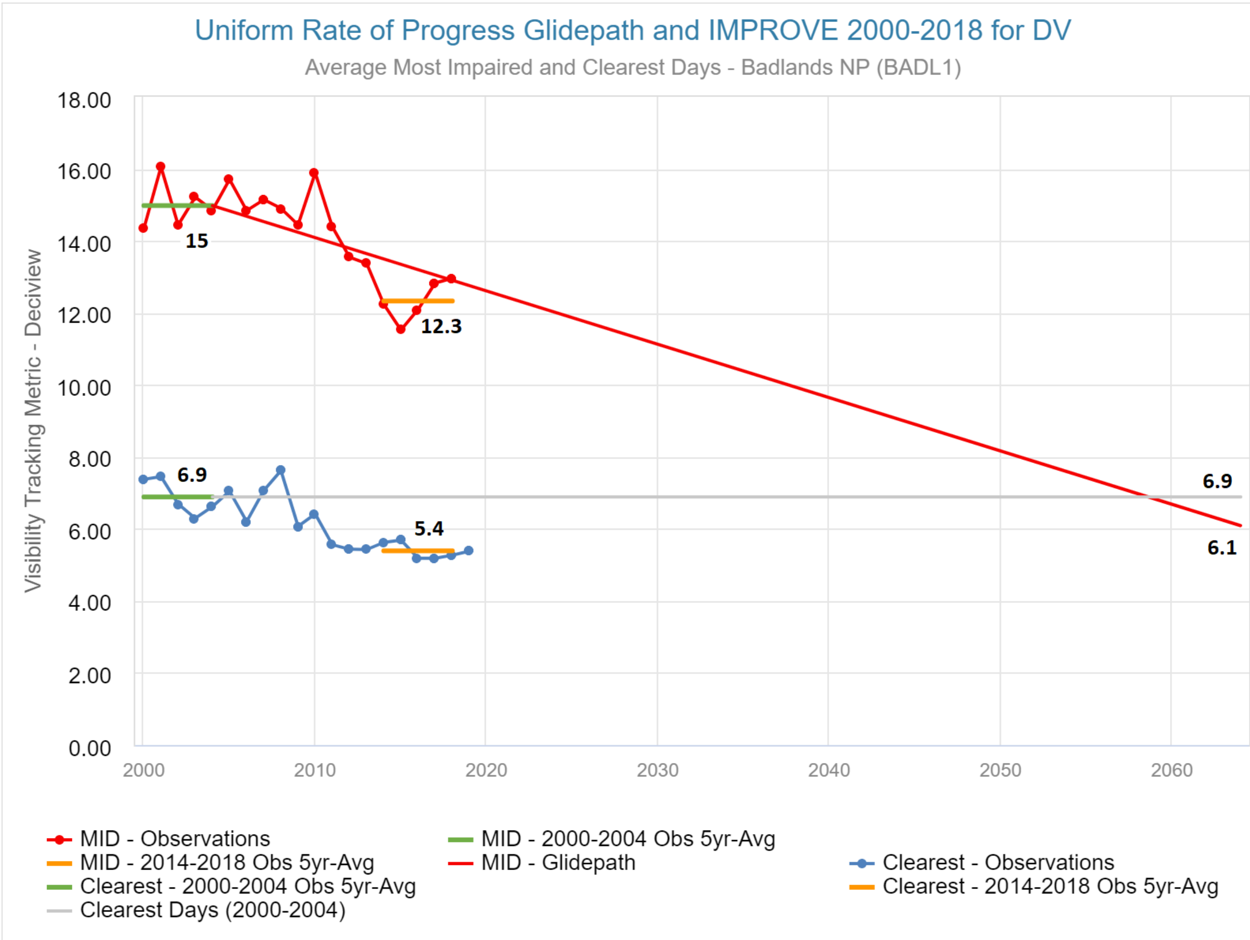
Table 2-11 -- Annual Uniform Rate of Improvement

Description	Badlands (dv)	Wind Cave (dv)
Baseline Conditions 20% MIDs	15	13.1
Natural Conditions 20% MIDs	6.1	5.6
Annual Improvement	0.14833	0.125

The uniform rate of improvement was used to establish the slope of reduction necessary to achieve the natural visibility conditions in 2064. The slope of reduction for the 20% most impaired days for the Badlands and Wind Cave National Parks are displayed in Figures 2-19 and 2-20. The improvement needed by 2028 was calculated based on the annual uniform rate of improvement identified for each Class I area. The baseline is based on calendar years 2000 through 2004. Therefore, there are 24 years from the baseline (2000-2004) to the end of the second planning period (2028). The improvement needed for the 20% most impaired days by calendar year 2028 for each Class I area was determined by multiplying the annual uniform rate of improvement by 24 years then subtracting that from the baseline value for the 20% most impaired days in Table 2-11.

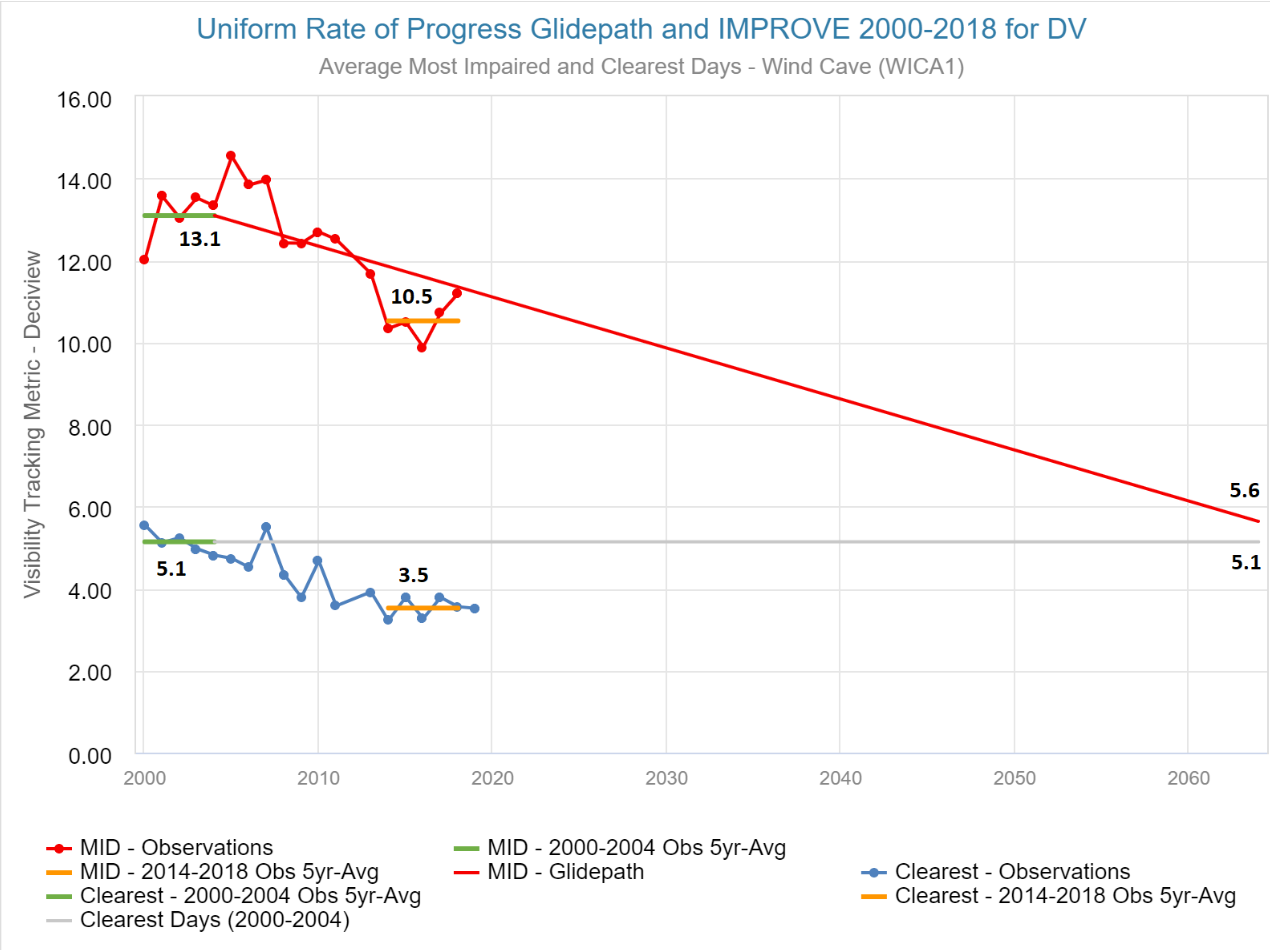
The unadjusted Uniform Rate of Progress (URP) for both Badlands and Wind Cave National Parks are displayed in Figures 2-19 and 2-20 as solid red lines. The URP is superimposed over IMPROVE data collected at the site representing the Class I Area between 2000 and 2018. The glideslope begins with the average of the 5 year baseline period of the 20% Most Impaired Days, and ends with the estimated natural conditions at 2064. 2064 natural conditions estimates are calculated from the 15 year average of the natural conditions on the most impaired days or clearest days for each year from 2000-2014. Another metric of progress is illustrated by the solid horizontal grey lines, which represent the average of the 20% clearest days from the years 2000-2004. The goal for these clearest days until the year 2064 is for no degradation in visibility to occur since that initial 2000-2004 year period. Small points plotted include the yearly averages of both the 20% Most Impaired Days and the Clearest Days.

Figure 2-17 -- Uniform Rate of Improvement Badlands National Park



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 2-18 -- Uniform Rate of Improvement Wind Cave National Park



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

2.7 Adjustments To The Uniform Rate Of Progress

40 CFR § 51.308(f)(1) and 40 CFR § 51.308(f)(1)(vi)(B) state: "Calculations of baseline, current, and natural visibility conditions; progress to date; and the uniform rate of progress. ***For each mandatory Class I Federal area located within the State, the State must determine the following: As part of its implementation plan submission, the State may propose (1) an adjustment to the uniform rate of progress for a mandatory Class I Federal area to account for impacts from anthropogenic sources outside the United States and/or (2) an adjustment to the uniform rate of progress for the mandatory Class I Federal area to account for impacts from wildland prescribed fires that were conducted with the objective to establish, restore, and/or maintain sustainable and resilient wildland ecosystems, to reduce the risk of catastrophic wildfires, and/or to preserve endangered or threatened species during which appropriate basic smoke management practices were applied.*** To calculate the proposed adjustment(s), the State must add the estimated impact(s) to the natural visibility condition and compare the baseline visibility condition for the most impaired days to the resulting sum. If the Administrator determines that the State has estimated the impact(s) from anthropogenic sources outside the United States and/or wildland prescribed fires using scientifically valid data and

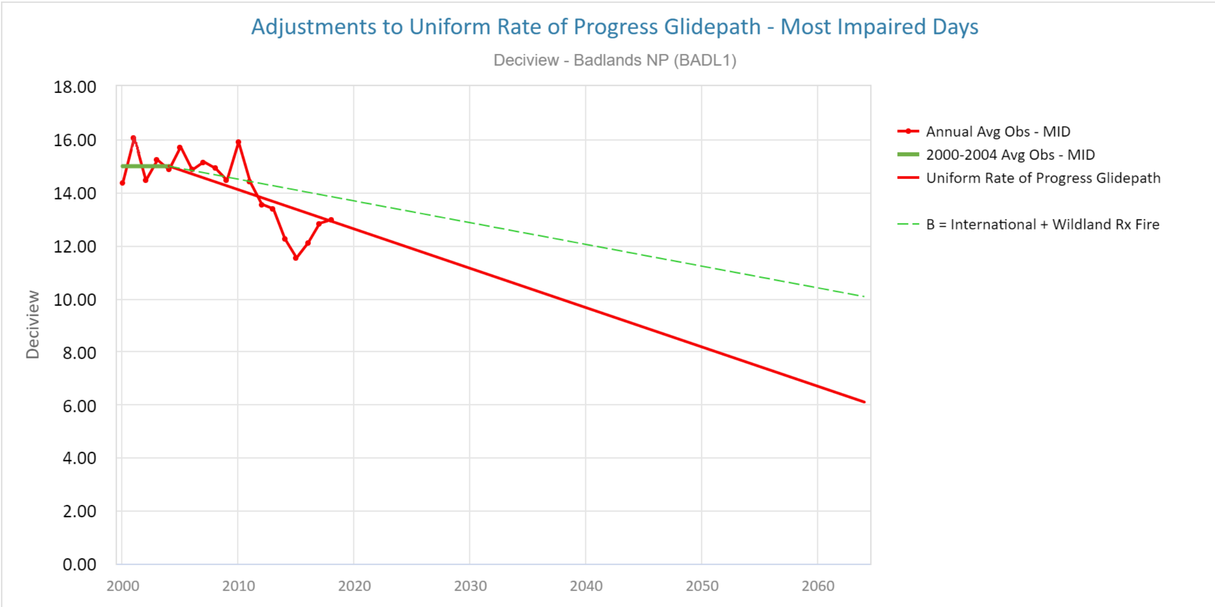
methods, the Administrator may approve the proposed adjustment(s) to the uniform rate of progress."

South Dakota chose to use the 2064 Glideslope adjustment option during this second implementation period. Both visibility impairing effects from international anthropogenic emissions and U.S. prescribed fire emissions are being adjusted for, because South Dakota is unable to control these forms of emissions affecting its two Class I Areas. Contributions from international anthropogenic and prescribed fire emissions from the 2028OTBa2 high level source apportionment results were utilized to develop the adjusted Uniform Rate of Progress Glidepaths. Specifically, these contributions are based on 2028 modeling results and moralized to monitoring data, and are then added onto the 2064 natural conditions endpoint, causing a decrease in the slope of the Glidepath. The two alternative adjusted Glideslopes can be found in the Technical Support Document found here (https://www.epa.gov/visibility/technical-support-document-epas-updated-2028-regional-haze-modeling). These adjusted Glideslopes also start from the MIDs for the 2000-2004 five year baseline period, and connect a straight line from here to the newly adjusted estimated 2064 natural conditions endpoint. All endpoints are only estimates, and therefore do not have representative solid datapoints on the graphs. The endpoint estimates are based on the 15-year natural conditions average on the Most Impaired Days from 2000-2014. The adjusted charts are also similar to the unadjusted charts in that historical MID annual average values are plotted as points, and the MID five year average values are plotted as solid lines for both the 2000-2004 baseline and the most recent 5-year average (2014-2018).

Additional information about the adjusted 2064 Glideslopes can be found at the following URL: http://www.wrapair2.org/pdf/URP_Glidepath_Adjust_WRAP_2020-07-24draft.pdf

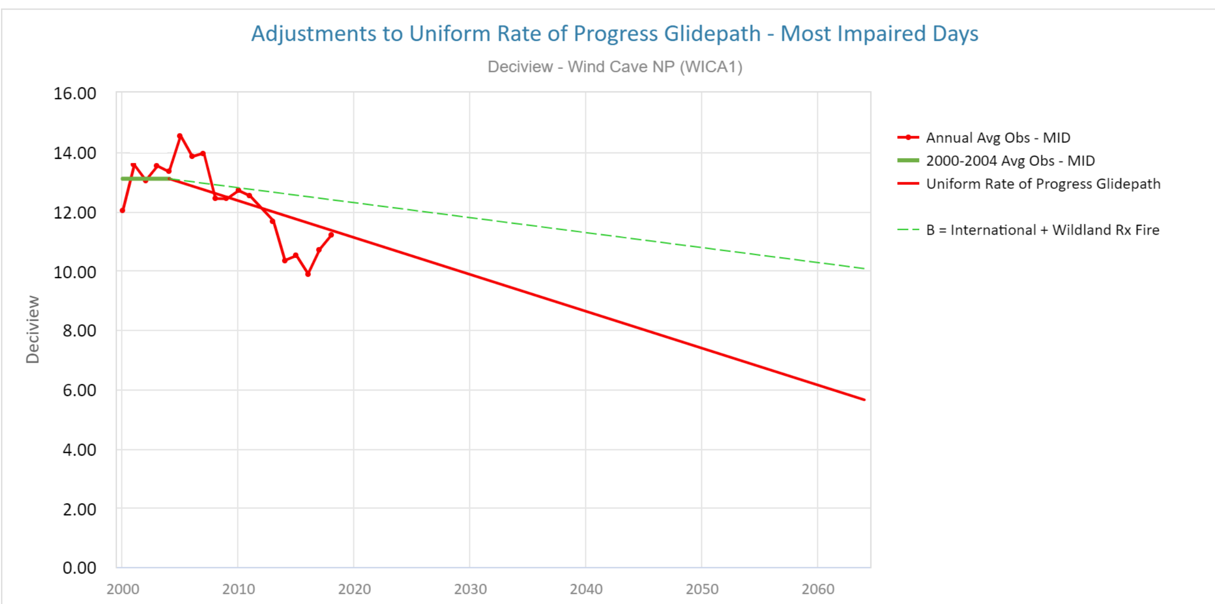
The below figures, Figures 2-21 and 2-22, illustrate the WRAP-defined EPA default 2064 URP Glidepath in red, plus an additional international anthropogenic emissions adjusted Glidepath in orange, plus an additional international anthropogenic and prescribed fires emissions adjusted Glidepath in green.

Figure 2-19 -- Adjustments to the Uniform Rate of Progress at Badlands National Park



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 2-20 -- Adjustments to the Uniform Rate of Progress at Wind Cave National Park



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

3.0 Long-Term Strategy For Regional Haze

3.1 Source Apportionment Analysis

For the purposes of the Regional Haze Rule, the pollutants of most concern are the anthropogenic pollutants and their precursors that are known to cause visibility impairment.

Anthropogenic sources of visibility extinction is the focus, despite the large role natural visibility impairment can have on total visibility reduction. Seven particulate matter pollutant species are most known to contribute to light extinction: ammonium sulfate, ammonium nitrate, organic carbon, elemental carbon, fine soil, and coarse particulate matter (PM10).

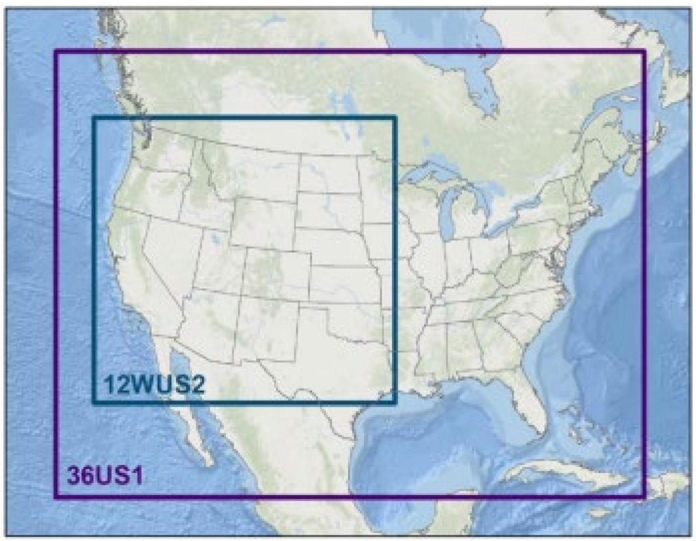
The second period State Implementation Plan helps determine how necessary putting in place additional enforceable measures is for reducing anthropogenic regional haze-forming pollutants, including sulfur dioxides (SOx), and nitrogen oxides (NOx). NOx and SO2 emissions from facilities are the precursors of nitrate (NO3) and sulfate (SO4), which are two major particulate matter pollutants which account for much of the anthropogenic impairment of visibility at the various Class I Areas. Emissions of sulfur occur mainly due to the burning of fuels that contain sulfur. These anthropogenic SO2 and SO4 point, area, and mobile source emissions are well tracked and inventoried. Nitrogen oxides (NOx) are the precursors to nitrate particulates, and these emissions occur mainly from the combustion of fuel, including wood, coal, and natural gas. These anthropogenic NOx point, area, and mobile source emissions are also well inventoried.

Ammonia (NH3) is known as a necessary ingredient for the secondary formation of sulfate and nitrate particulates, however ammonia will not be analyzed further because nitrate and sulfate particulate matter formation is best reduced by decreasing SO2 and NOx emissions NOx and SO2, not by reducing the anthropogenic ammonia emissions themselves. Ammonia is also not regulated by South Dakota. Organic carbon emissions occur primarily from fires or biogenic sources, and therefore are not of large concern from an anthropogenic perspective. Anthropogenic volatile organic compounds (VOCs) are known to contribute to organic carbon pollution, but not significantly or notably so. Elemental carbon emissions typically come from sources including many types of burning, including wildfires and fossil fuel combustion including emissions resulting from industrial processes, vehicles, boilers, etc. Elemental carbon is not inventoried by South Dakota, therefore a four-factor analysis of potential emission control measures is not practical. Fine soil is defined as particulates that are smaller than 2.5 microns in diameter. These are generated mainly from windblown dust, fugitive dust, and area sources (road dust or fires). South Dakota also does not inventory soil emissions. Coarse mass is defined as particulates that are between 10 and 2.5 microns in diameter. These are created mainly by point sources, road dust, windblown dust, and fugitive dust. Coarse Mass is not inventoried by South Dakota.

The following charts and tables in this section were generated from the WRAP Regional Haze high level and low level source apportionment modeling using the 2028OTBa2 emissions scenarios, which includes the representative baseline fire emissions which were created by the WRAP Fire and Smoke Work Group. The model used was the CAMx v7.0 model, and the domain used was the 36 km 36US1 and 12 km 12WUS2, using two-way nesting, shown below in Figure 3-1. Boundary conditions used were WRAP Revised 2014 GOES-Chem Base Case. The 2028OTBa2 high level source apportionment CAMx simulations orchestrated Particulate Source Apportionment Technology (PSAT) source apportionment. The PSAT source apportionment tool makes possible the use of a source region map which is able to define grid cells of the source regions from which contributions are tracked, however separate emission inputs for each source group of interest were provided for the enabling of a more efficient analysis. Given emissions information from the 2028OTBa2 estimates, the model is able to project conditions at Class I Areas for the year 2028.

Specifically regarding the CAMx 20218OTBa2 Low Level Source Apportionment PM modeling run, just the PSAT NO3 and SO4 families of PSAT tracers will run in the model, and only six source sectors, including Electric Generating Unit (EGU) Point, non-EGU Point, Oil and Gas, Mobile, Remainder Anthropogenic, and everything else (fires and natural).

Figure 3-1 -- WRAP/WAQS modeling domains used in all three WRAP CAMx simulations: 2014v2, RepBase2 and 2028OTBa2



For more information regarding the WRAP/ WAQS Regional Haze High and Low Level Source Apportionment Modeling, see the associated run specification sheet at the following URL: https://views.cira.colostate.edu/docs/iwdw/platformdocs/WRAP_2014/SourceApportionmentSpecifications_WRAP_RepBase2_and_2028OTBa2_High-LevelPMandO3_and_Low-Level_PM_andOptionalO3_Sept29_2020.pdf

For more information on the WRAP/ WAQS 2014v2 Modeling Platform and Western Regional Performance Evaluation (MPE), see the following URL: https://views.cira.colostate.edu/iwdw/docs/WRAP_WAQS_2014v2_MPE.aspx

The first set of figures, Figures 3-2 through 3-7, show the results of the low level source apportionment modeling. Specifically, they show which states' anthropogenic emissions of ammonium sulfate and ammonium nitrate are projected to affect the visibility impairment at each Class I Area in question, during the year 2028.

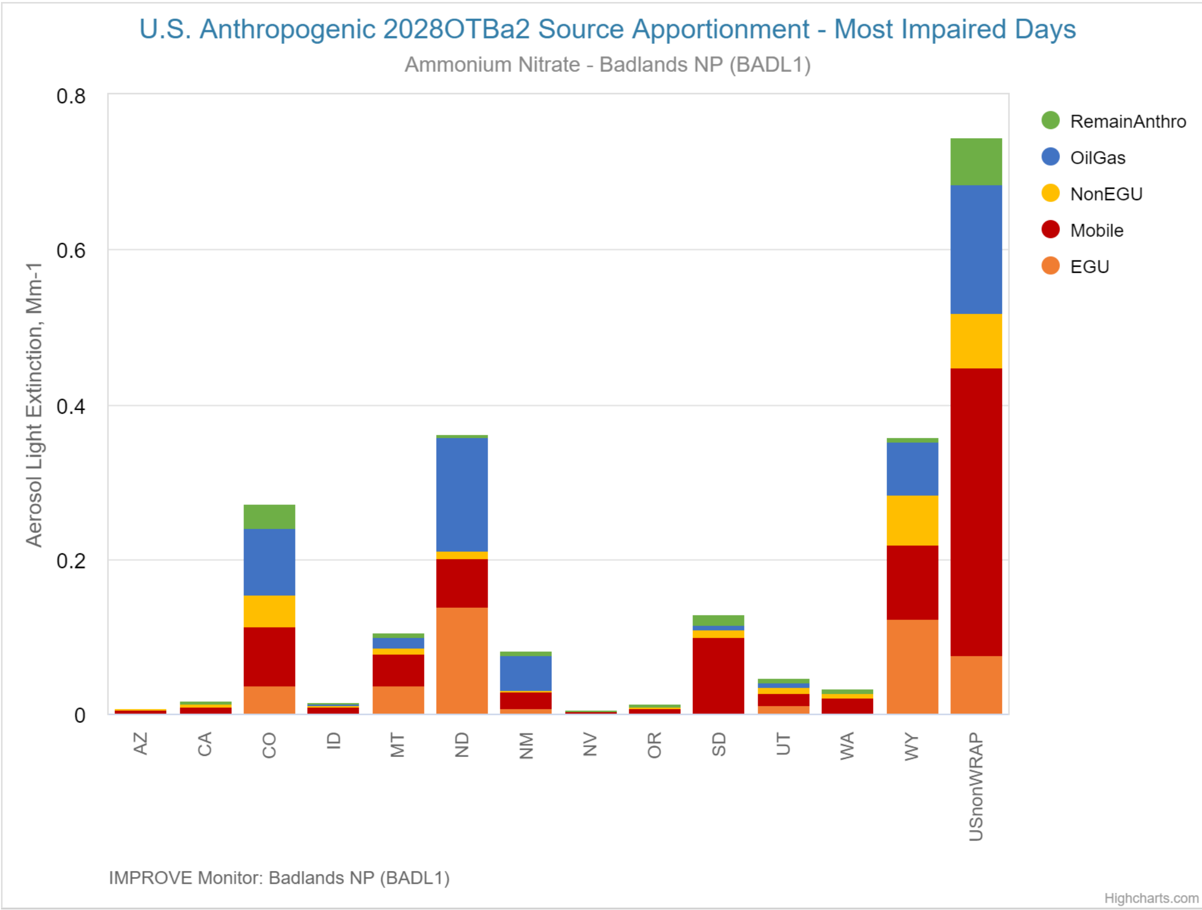
Figure 3-2 shows which states' anthropogenic emissions of ammonium nitrate are projected to negatively affect visibility at Badlands National Park in the year 2028. The largest visibility impairing emissions source category emanating from South Dakota is the "mobile" emissions source category. The source categories coming from South Dakota of Remaining Anthropogenic, Oil and Gas, Non Electric Generating Unit, and Electric Generating Unit combined play an insignificant role in visibility impairment. States which negatively affect visibility at Badlands National Park due to emissions of ammonium nitrate more than South Dakota's own sources include Colorado, North Dakota, Wyoming, and the combined category of all non-WRAP states which includes South Dakota's other neighboring states of Iowa and Nebraska. These other states combined produce significantly more visibility impairment at Badlands National Park than South Dakota's own sources do.

Figure 3-3 shows which states' anthropogenic emissions of ammonium nitrate are projected to affect visibility reduction at Wind Cave National Park in the year 2028. The situation at Wind Cave National Park is very similar to that of Badlands National Park, with both charts looking quite similar.

Figure 3-4 shows which states' anthropogenic emissions of ammonium sulfate are projected to negatively affect visibility at Badlands National Park in the year 2028. It is difficult to determine the largest visibility impairing emissions source category emanating from South Dakota, as all source categories combined play an insignificant role in visibility impairment at this Class I Area. States which negatively affect visibility at Badlands National Park due to emissions of ammonium sulfate more than South Dakota's own sources include Washington, New Mexico, Colorado, Montana, Wyoming, North Dakota, and the combined category of all non-WRAP states which includes South Dakota's other neighboring states of Iowa and Nebraska. These other states combined produce significantly more visibility impairment at Badlands National Park than South Dakota's own sources do.

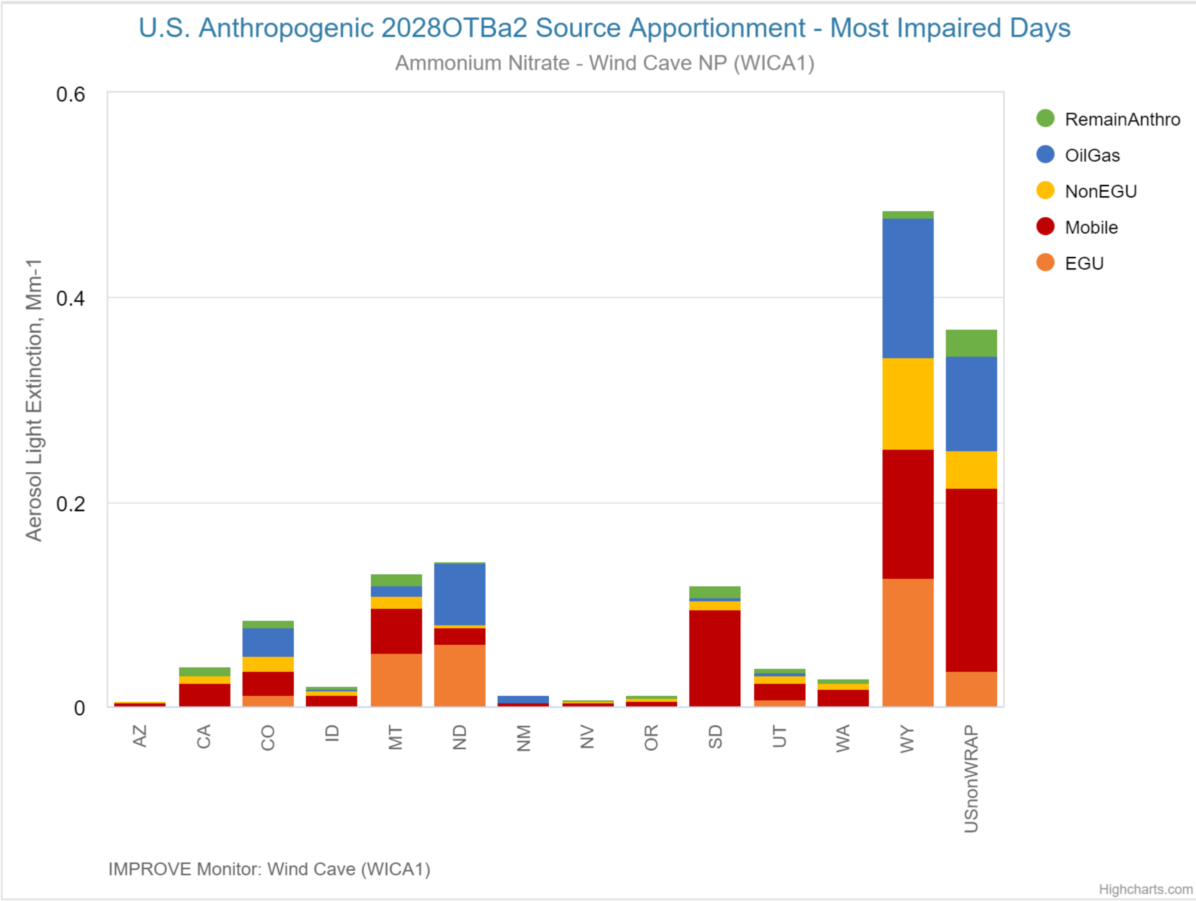
Figure 3-5 shows which states' anthropogenic emissions of ammonium sulfate are projected to affect visibility reduction at Wind Cave National Park in the year 2028. The situation at Wind Cave National Park is very similar to that of Badlands National Park, with both charts looking quite similar.

Figure 3-2 -- 2028 visibility impairment projections from U.S. ammonium nitrate sources at Badlands National Park



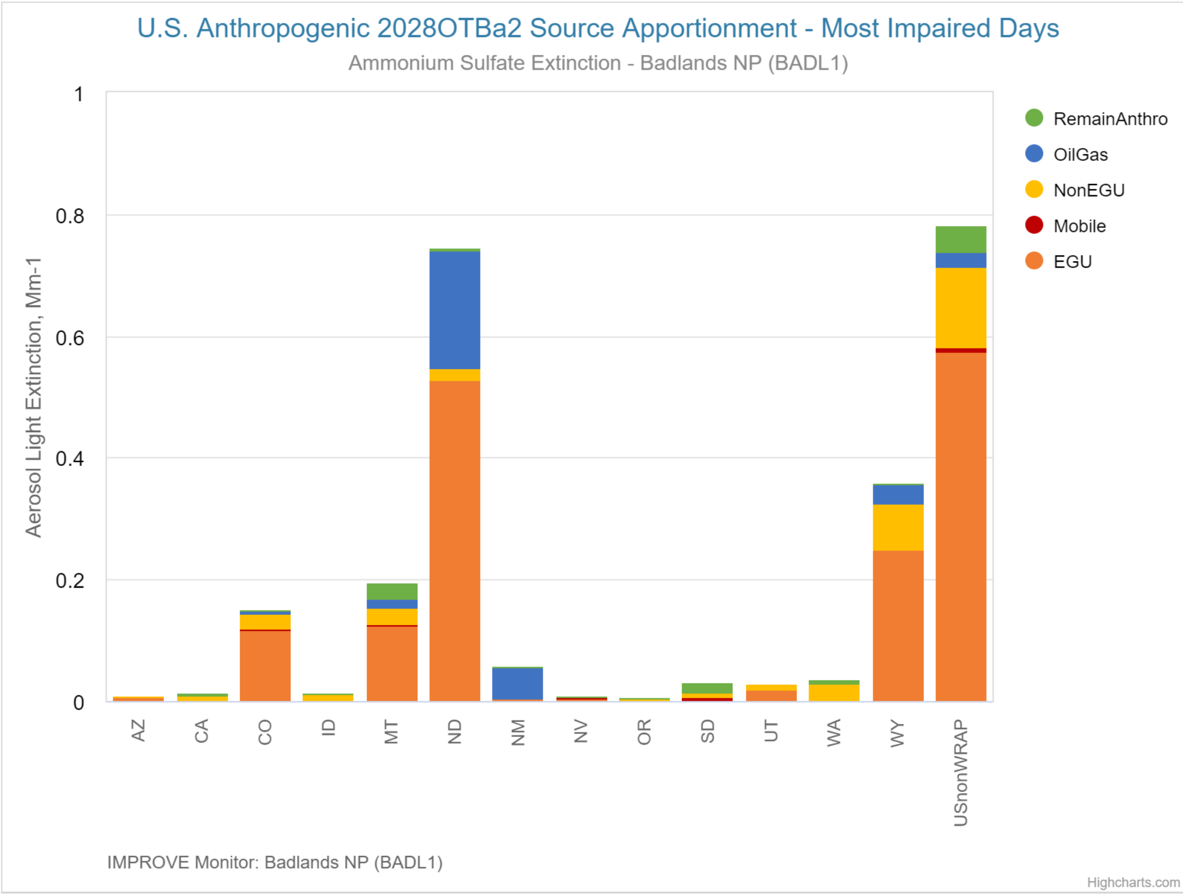
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-3 --2028 visibility impairment projections from U.S. ammonium nitrate sources at Wind Cave National Park



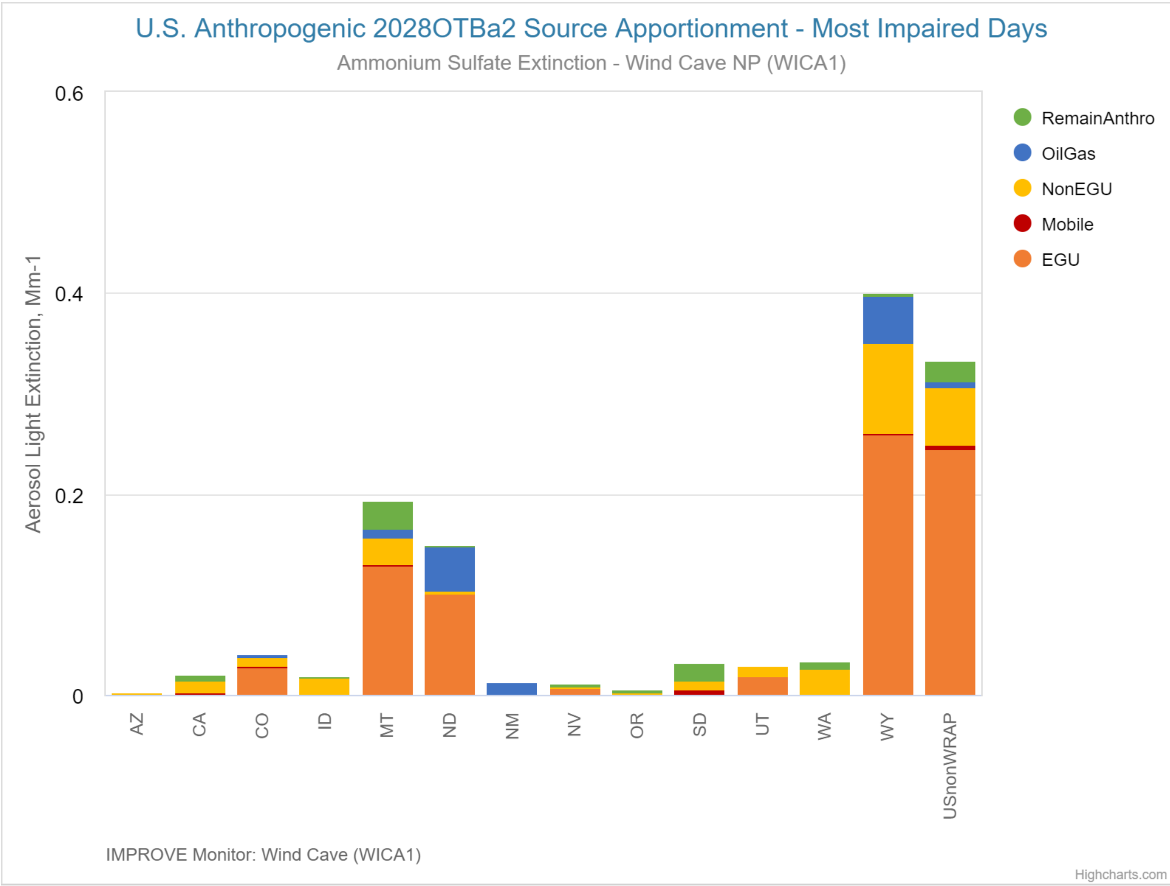
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-4 -- 2028 visibility impairment projections from U.S. ammonium sulfate sources at Badlands National Park



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

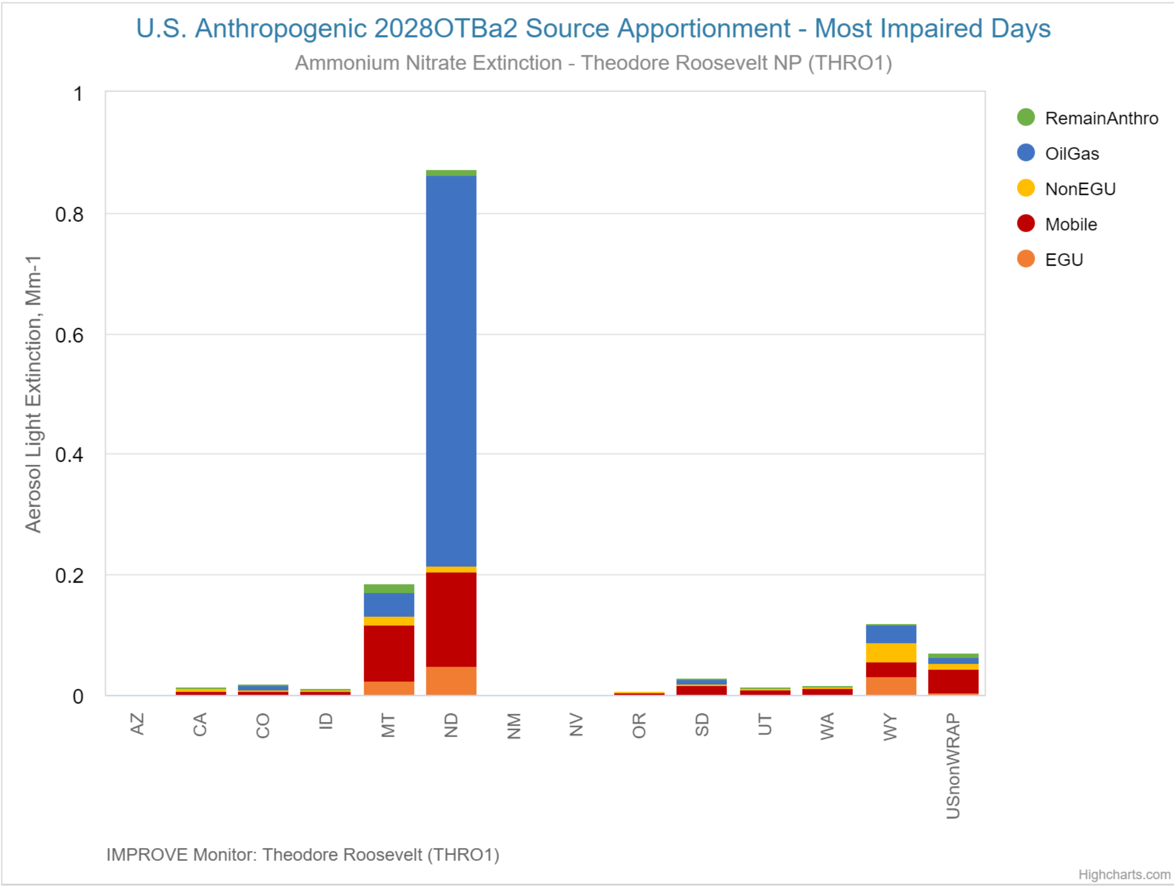
Figure 3-5 -- 2028 visibility impairment projections from U.S. ammonium sulfate sources at Wind Cave National Park



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

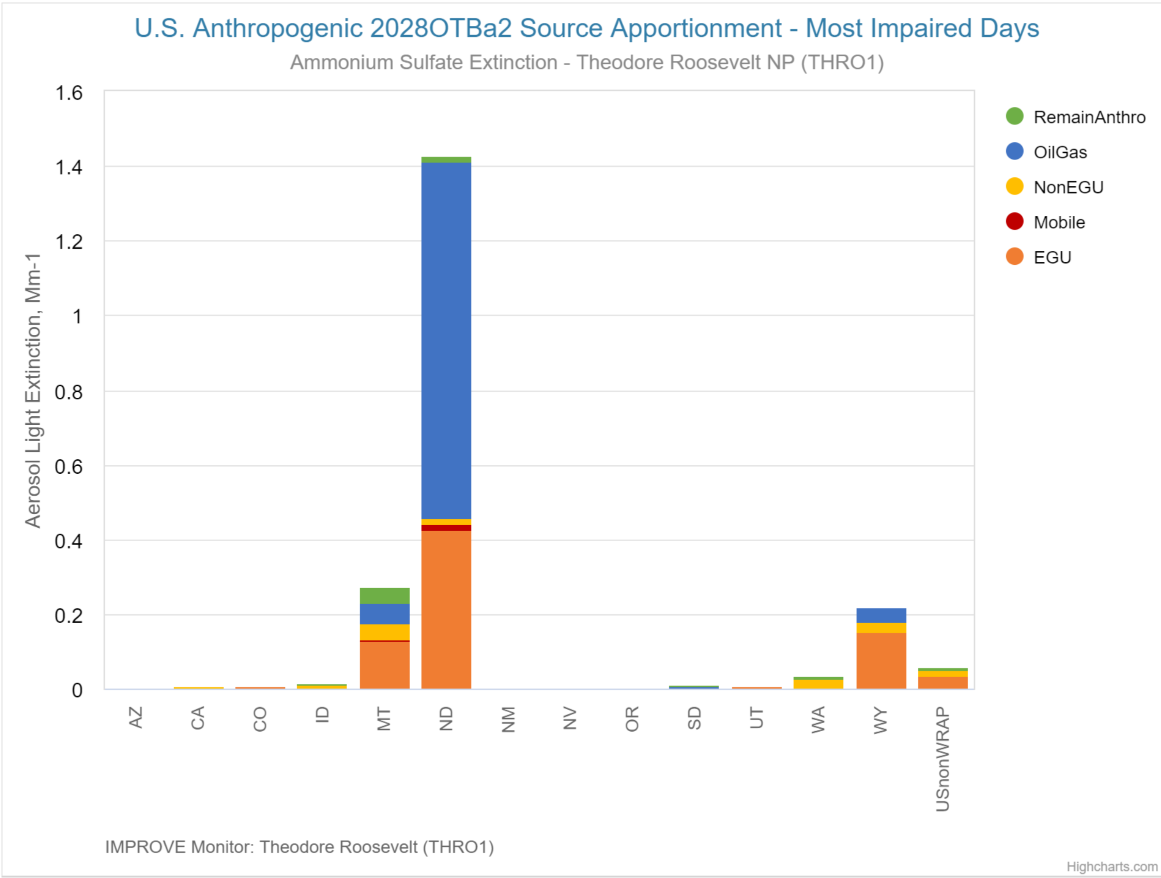
Figures 3-6 and 3-7 look at a Class I Area outside of South Dakota—specifically Theodore Roosevelt National Park in North Dakota, again for anthropogenic sources of both ammonium sulfate and ammonium nitrate which are projected to negatively affect visibility there in the year 2028. Theodore Roosevelt National Park was chosen because it very representatively shows the effects South Dakota emissions of ammonium sulfate and ammonium nitrate have on all the neighboring states' Class I Areas regarding visibility impairment in comparison to all the other WRAP and non-WRAP states. According to the modeling for 2028, South Dakota emission sources of both ammonium nitrate and ammonium sulfate contribute an insignificant amount to the visibility impairment at Theodore Roosevelt and all other neighboring states' Class I Areas.

Figure 3-6 -- 2028 visibility impairment projections from U.S. ammonium sulfate sources at Theodore Roosevelt National Park



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-7 -- 2028 visibility impairment projections from U.S. ammonium sulfate sources at Theodore Roosevelt National Park



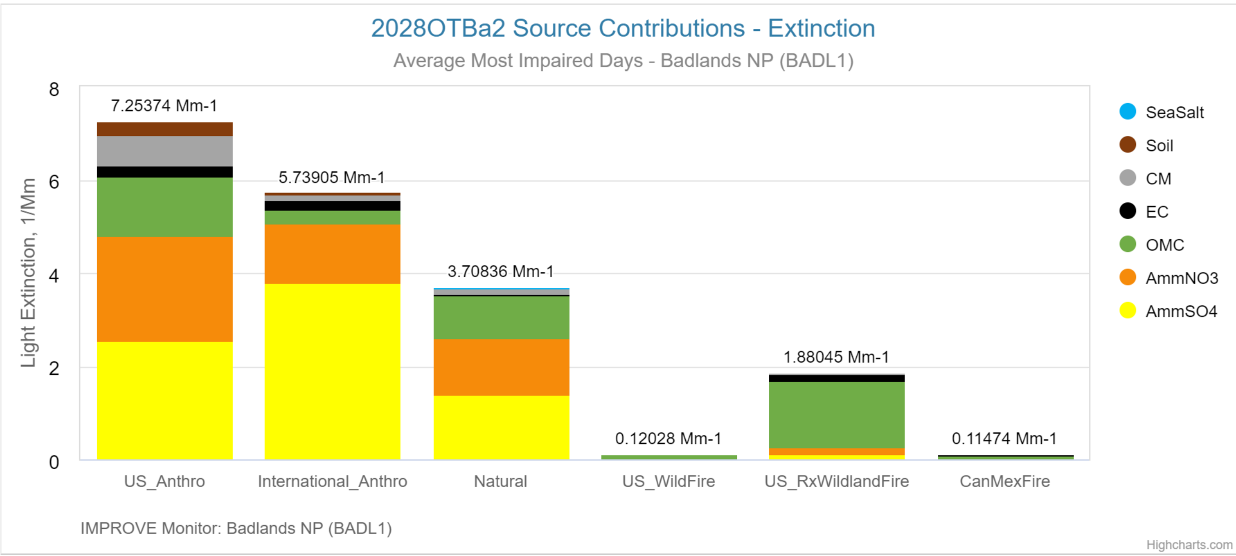
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

The next set of figures, Figures 3-8 and 3-9, detail out projected 2028 light extinction from the five main sources of extinction by the seven main pollutant species, for the average of both the 20% Most Impaired Days and the Clearest Days at both the Badlands and Wind Cave National Parks.

Regarding Figure 3-8, various interesting points are worth noting. First and most striking is that of the five source categories, only U.S. Anthropogenic can be considered alterable by efforts from South Dakota. South Dakota cannot change the international anthropogenic light extinction levels, nor the natural and non-U.S. fire levels, nor the U.S. prescribed wildland fire levels, even though these source categories have significant light extinction values. Also, although a significant portion of the U.S. Anthropogenic light extinction values come from ammonium sulfate, ammonium nitrate, and organic mass, more of each of these pollution species come from combining the other four source categories. Overall, although South Dakota is able to reduce the amount of light extinction at Badlands National Park, its in-state sources only make up a small sliver of the total U.S. Anthropogenic light extinction that occurs, which only makes up 38.5% of the overall light extinction at the site.

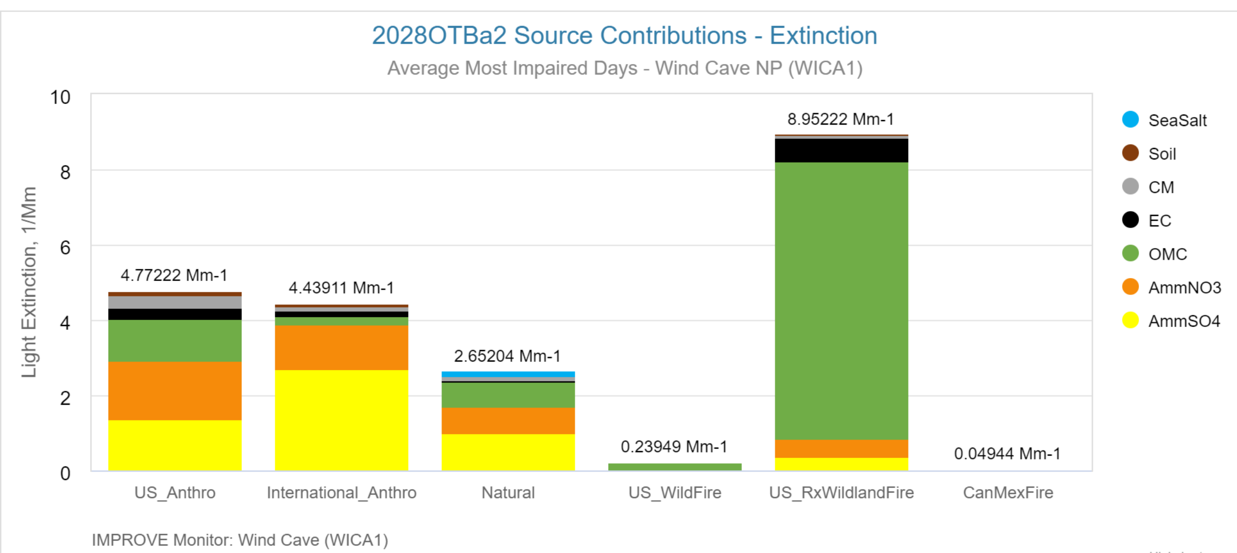
Regarding Figure 3-9, various important points also should be highlighted. First is, again, the fact that the only source category South Dakota has the ability to alter makes up only 22.6% of the total light extinction at the site. The largest concern at this site appears obvious, that being organic mass from U.S. prescribed wildland fires. A significant reduction here could dramatically increase the visibility at this site. South Dakota plans on eliminating both the effects of international anthropogenic and prescribed fire light extinction through a 2064 glideslope adjustment, as these factors are either considered natural or aren't able to be controlled by South Dakota.

Figure 3-8 --Modeled 2028 light extinction for the average of the 20% Most Impaired Days by source category for the seven main pollutant species at Badlands National Park



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-9 -- Modeled 2028 light extinction for the average of the 20% Most Impaired Days by source category for the seven main pollutant species at Wind Cave National Park



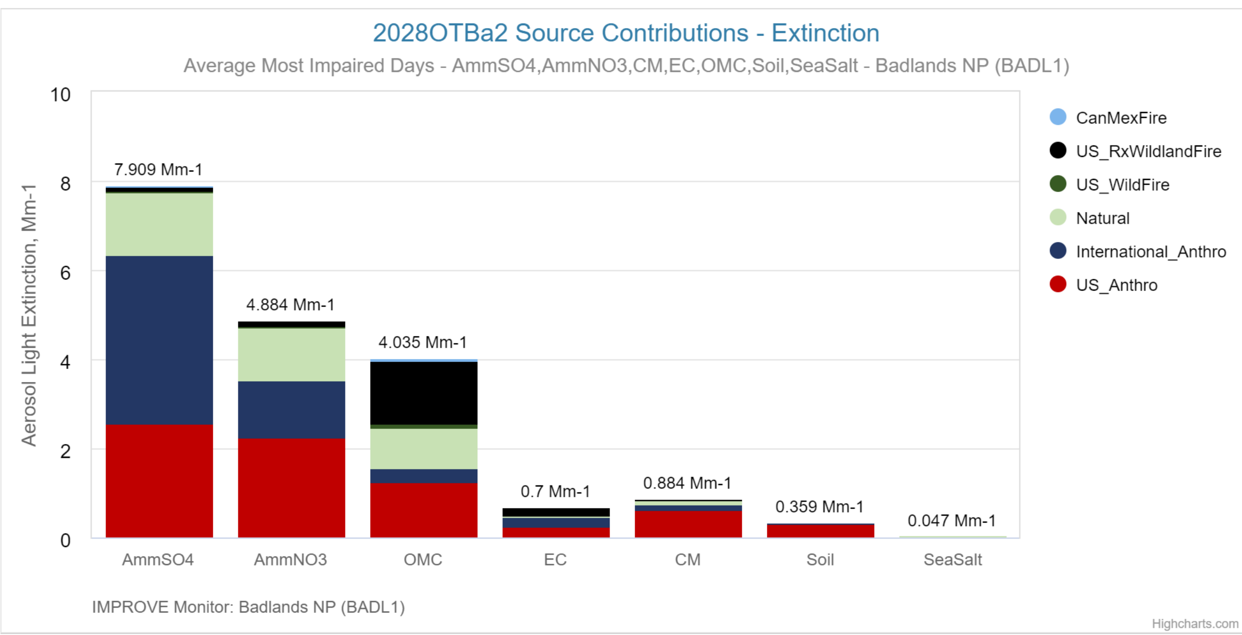
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

The next set of figures, Figures 3-10 and 3-11 detail out projected 2028 light extinction for the seven main pollutant species by the five main sources of extinction, for the average of both the 20% Most Impaired Days and the 20% Clearest Days at both the Badlands and Wind Cave National Parks.

Regarding Figure 3-10 and Badlands National Park, the color to pay most attention to in each bar is the red color, which represents the U.S. Anthropogenic source category, which is again the only category South Dakota or any other state has the ability to alter. Looking at only the U.S. anthropogenic bar areas, ammonium sulfate, ammonium nitrate, and organic carbon mass are the largest contributors to light extinction at Badlands National Park, and therefore should primarily be focused on in any effort to improve visibility at this Class I Area.

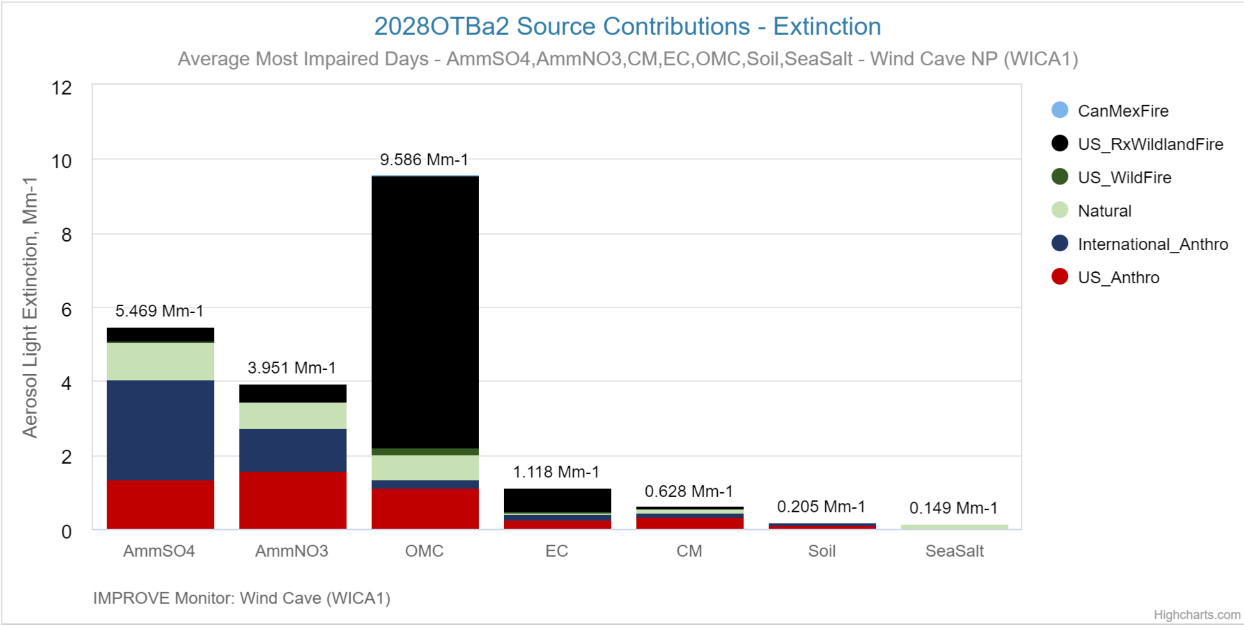
Regarding Figure 3-11 and Wind Cave National Park, it's important to focus on the red sections of each bar for each of the pollutant species, and to note relatively speaking how small of an overall effect U.S. anthropogenic contributions have on light extinction at this Class I Area. Again, ammonium sulfate, ammonium nitrate, and organic carbon mass appear to be the largest areas of U.S. anthropogenic light extinction concern for the 20% Most Impaired Days.

Figure 3-10 -- Projected 2028 light extinction for the average of the 20% Most Impaired Days by pollutant species for the five main sources of light extinction at Badlands National Park



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-11 -- Projected 2028 light extinction for the average of the 20% Most Impaired Days by pollutant species for the five main sources of light extinction at Wind Cave National Park



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

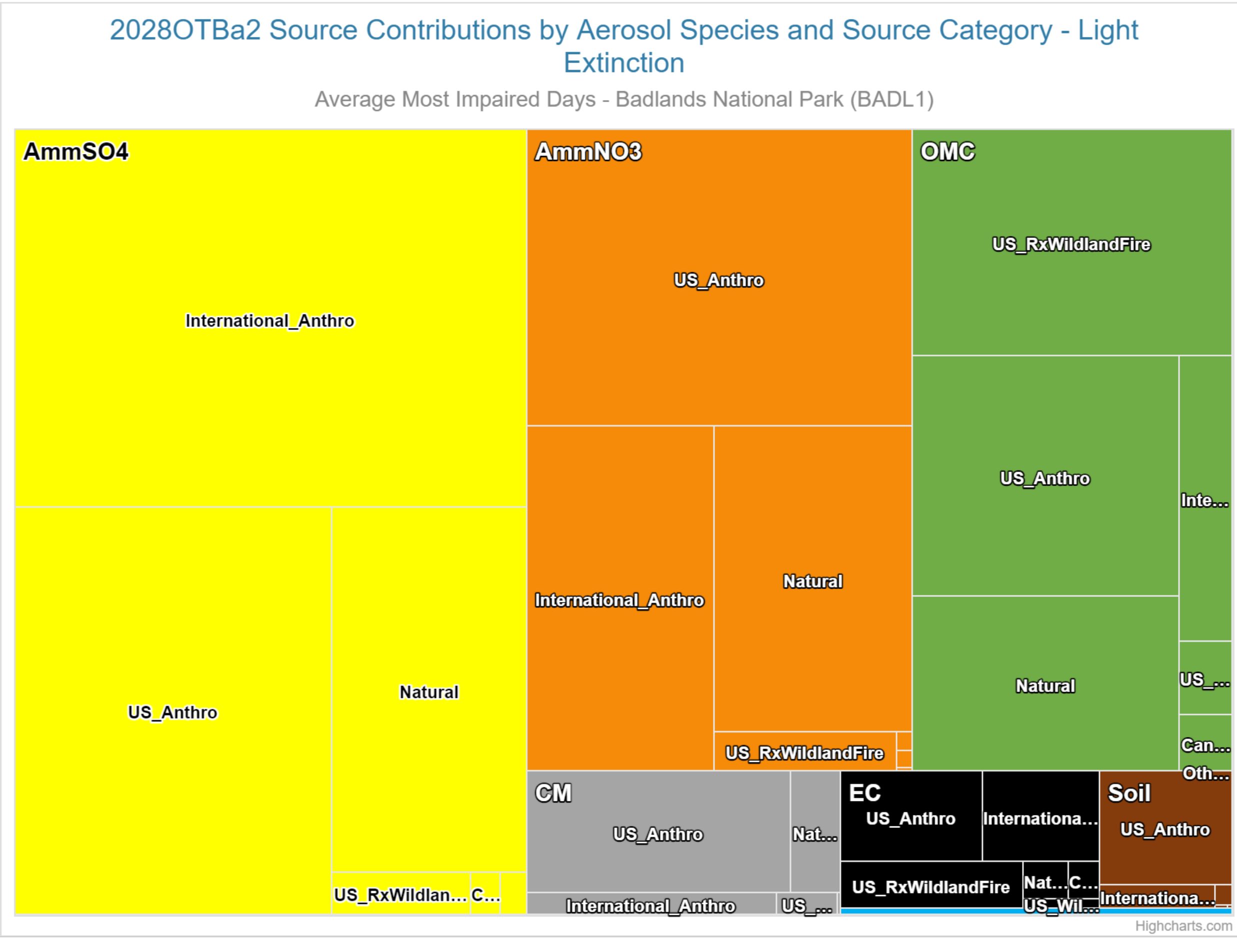
The next set of figures, Figures 3-12 through 3-15, detail out the same information as the last two sets, with again a slight change in how the information is laid out. Here, the information is grouped principally by the seven pollutant species of Ammonium Sulfate, Ammonium Nitrate, Organic Carbon Mass, Elemental Carbon, Coarse Mass, Soil, and Natural and Non-U.S. Fire. The information is grouped secondly by the five main source categories of U.S. Anthropogenic, International Anthropogenic, Natural and non-U.S. Fire, U.S. Prescribed Wildland Fire, and U.S. Wildfire.

Regarding Figure 3-12, the same information is presented here as elsewhere, except the information here is displayed in a different format to better help the reader visualize the data in a different way. Again, it becomes apparent when viewing the chart that ammonium sulfate makes up the majority of the visibility-impairing pollution that affects Badlands National Park, and that the U.S. anthropogenic subcategory makes up a sizeable portion of the overall ammonium sulfate pollution category. Ammonium nitrate and organic carbon mass also compose large areas, with U.S. anthropogenic subcategories making up sizeable portions of those categories as well. Overall, when compared to the entire chart's area, the effect of U.S. anthropogenic emissions in total is also not insignificant.

Regarding Figure 3-13, the same information is presented here as elsewhere, except the information here is displayed in a different format. This chart shows the large effect that organic carbon mass from U.S. prescribed fires subcategory has on projected 2028 visibility impairment. Reducing the amount of prescribed fires on days that wind is blowing towards Wind Cave National Park would seem like a simple and free way to significantly and dramatically reduce visibility impairment at this Class I Area.

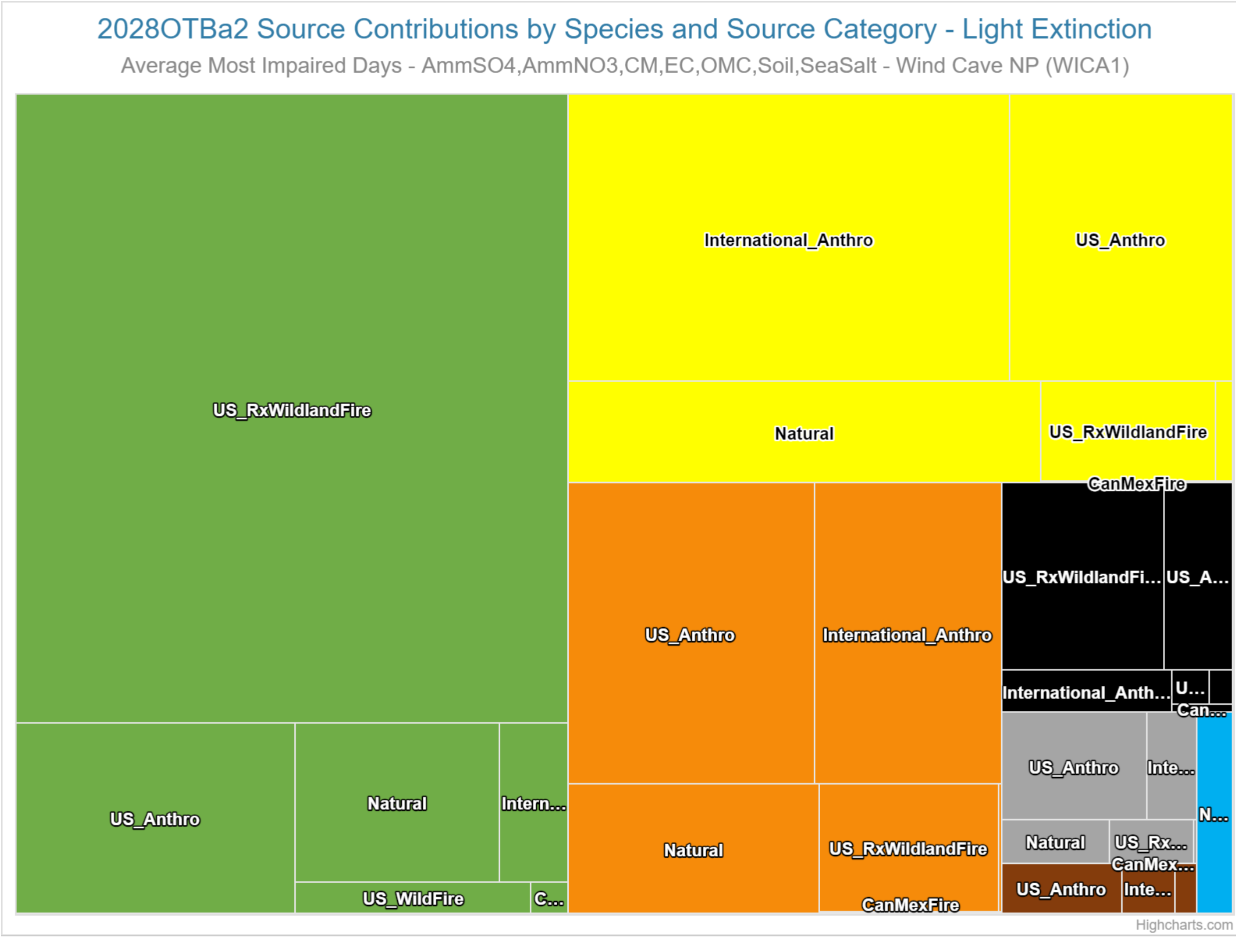
Regarding Figures 3-14 and 3-15, South Dakota is well below the Clearest Days threshold established in 40 CFR §51.308(f)(3)(i), stated as follows: "[…] The long-term strategy and the reasonable progress goals must provide for an improvement in visibility for the most impaired days since the baseline period and ensure no degradation in visibility for the clearest days since the baseline period." South Dakota has included these charts anyway because the Clearest Days concept is an important cornerstone concept in the Regional Haze Rule and shouldn't be completely excluded from public viewing and scrutiny.

Figure 3-12 -- Modeled 2028 light extinction by pollutant species and source category for the average of the 20% Most Impaired Days at Badlands National Park



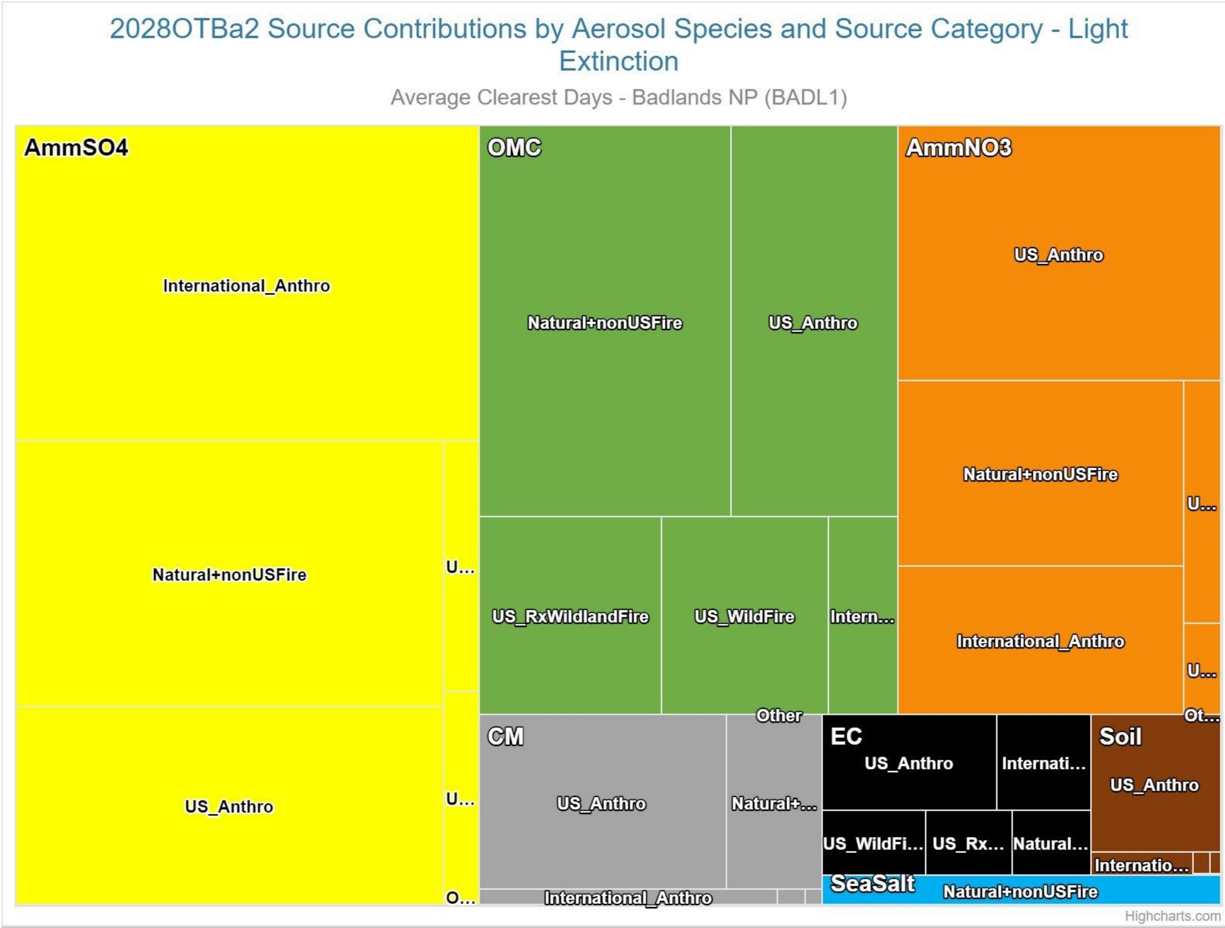
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-13 -- Modeled 2028 light extinction by pollutant species and source category for the average of the 20% Most Impaired Days at Wind Cave National Park



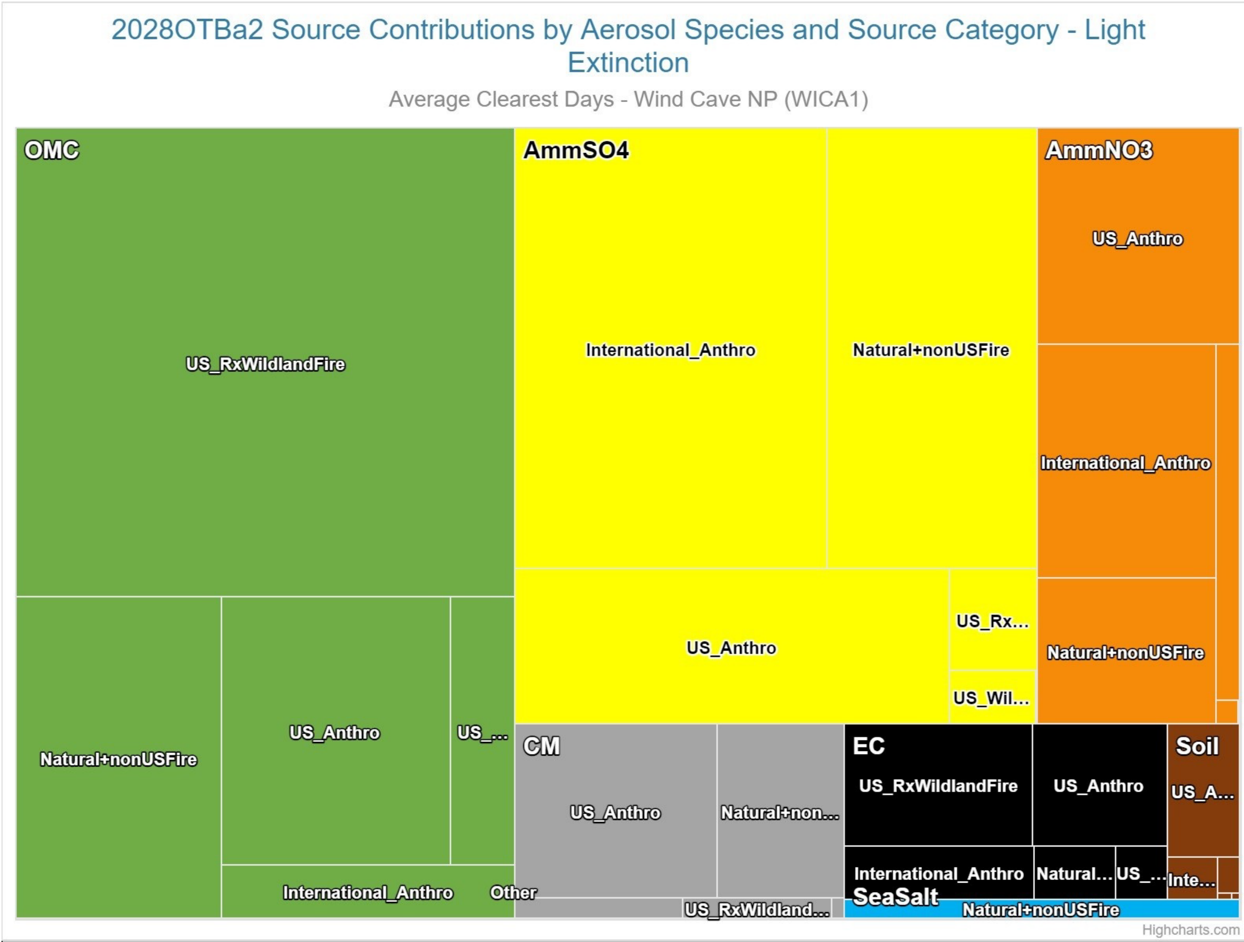
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-14 -- Modeled 2028 light extinction by pollutant species and source category for the average of the Clearest Days at Badlands National Park



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-15 -- Modeled 2028 light extinction by pollutant species and source category for the average of the Clearest Days at Wind Cave National Park



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

3.2 Determining Which CIAs Are Affected By South Dakota Emissions And Selecting Anthropogenic Emission Sources

40 CFR § 51.308(f)(2) states: "Long-term strategy for regional haze. ***Each State must submit a long-term strategy that addresses regional haze visibility impairment for each mandatory Class I Federal area within the State and for each mandatory Class I Federal area located outside the State that may be affected by emissions from the State.*** The long-term strategy must include the enforceable emissions limitations, compliance schedules, and other measures that are necessary to make reasonable progress, as determined pursuant to (f)(2)(i) through (iv). In establishing its long-term strategy for regional haze, the State must meet the following requirements:"

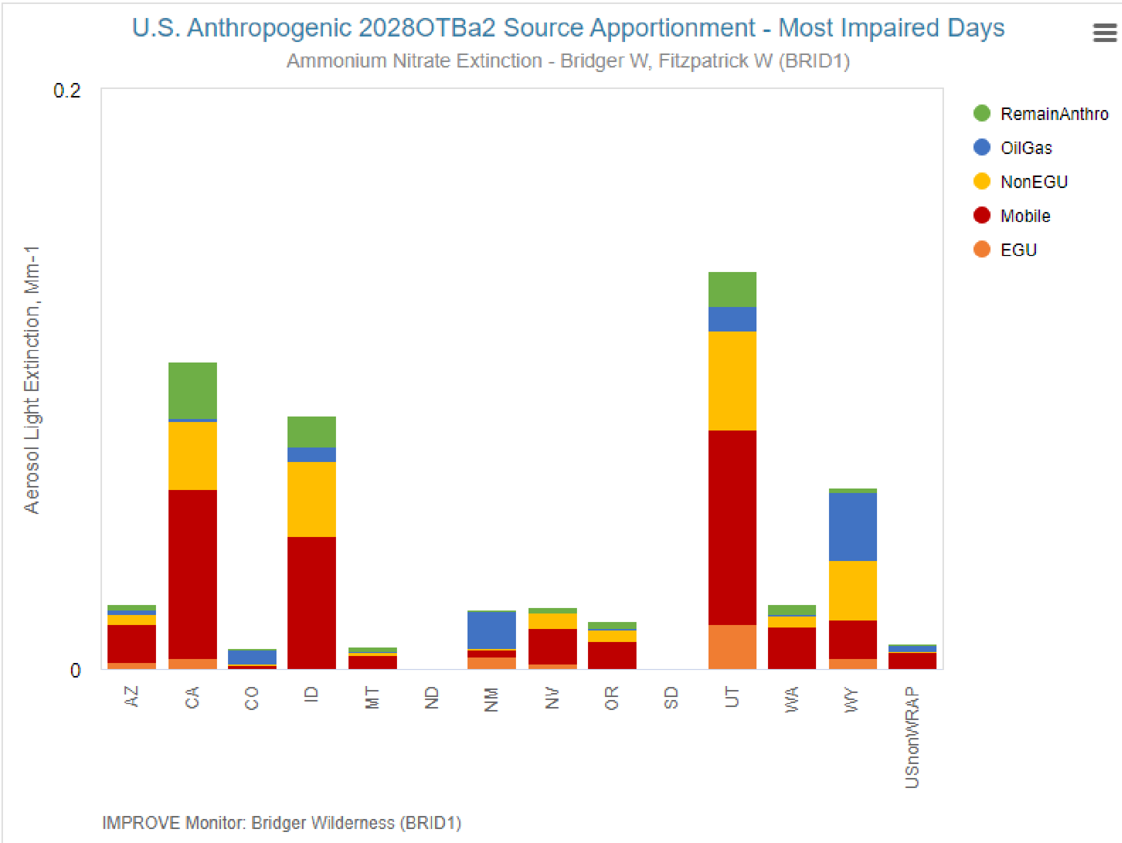
40 CFR § 51.308 (f)(3)(ii)(B) states: ***"If a State contains sources which are reasonably anticipated to contribute to visibility impairment in a mandatory Class I Federal area in another State*** for which a demonstration by the other State is required under (f)(3)(ii)(A), the State must demonstrate that there are no additional emission reduction measures for anthropogenic sources or groups of sources in the State that may reasonably be anticipated to contribute to visibility impairment in the Class I area that would be reasonable to include in its

own long-term strategy. The State must provide a robust demonstration, including documenting the criteria used to determine which sources or groups or sources were evaluated and how the four factors required by paragraph (f)(2)(i) were taken into consideration in selecting the measures for inclusion in its long-term strategy."

40 CFR § 51.308(f)(2)(i) states: "The State must evaluate and determine the emission reduction measures that are necessary to make reasonable progress by considering the costs of compliance, the time necessary for compliance, the energy and non-air quality environmental impacts of compliance, and the remaining useful life of any potentially affected anthropogenic source of visibility impairment. The State should consider evaluating major and minor stationary sources or groups of sources, mobile sources, and area sources. ***The State must include in its implementation plan a description of the criteria it used to determine which sources or groups of sources it evaluated*** and how the four factors were taken into consideration in selecting the measures for inclusion in its long-term strategy. In considering the time necessary for compliance, if the State concludes that a control measure cannot reasonably be installed and become operational until after the end of the implementation period, the State may not consider this fact in determining whether the measure is necessary to make reasonable progress."

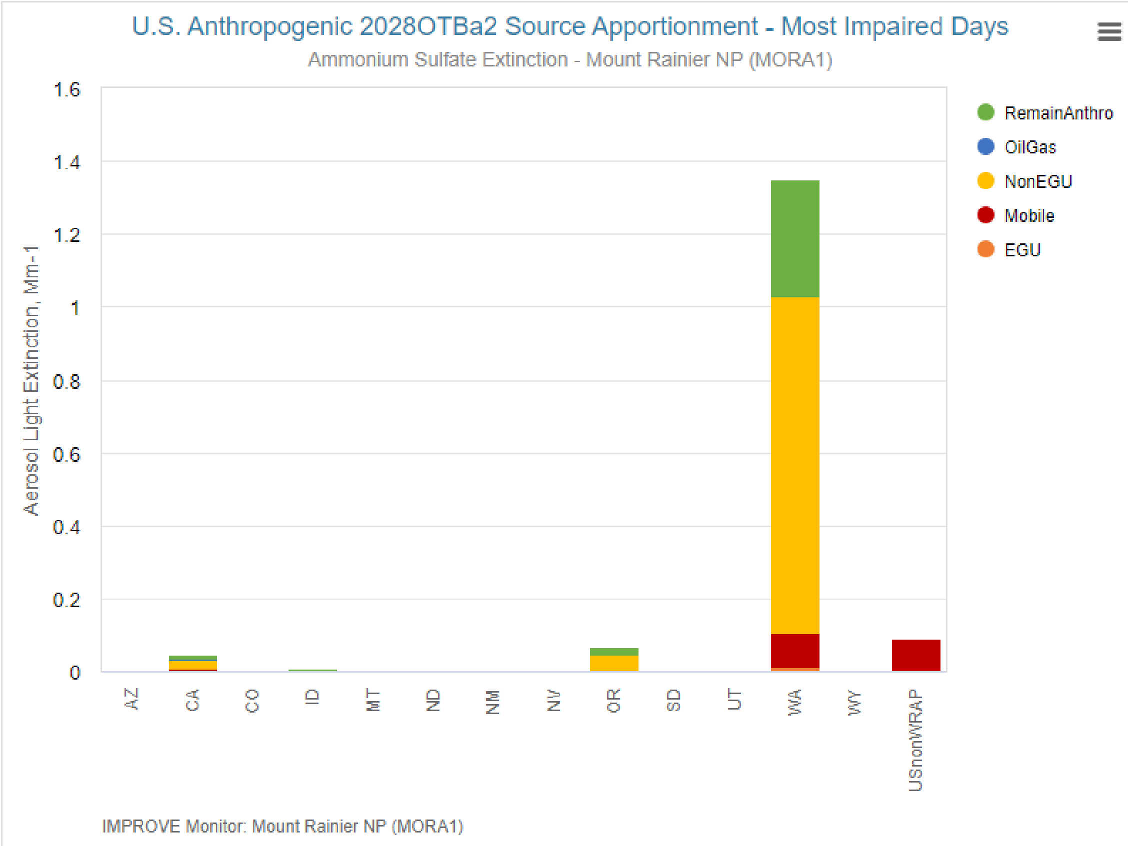
In order for South Dakota to satisfy the above requirements, it needs first to be able to determine through reasonable means which Class I Areas outside of South Dakota are being affected by visibility-impairing emissions from within South Dakota. South Dakota chose to use the WRAP state source group contributions source apportionment modeling results to make this determination. Because many Class I Areas exist in the West, South Dakota will only display one WRAP state source group contributions source apportionment chart per contiguous state, and one which is representative of all the Class I Areas in that state regarding the effects of South Dakota ammonium nitrate and ammonium sulfate sources out of state. South Dakota has deemed no additional or more detailed analysis to be necessary, due to the self-evidently minimal affects in-state sources have on out of state Class I Areas. Figures 3-16 through 3-27 depict the findings of this analysis, to fulfill this requirement of the Regional Haze Rule.

Figure 3-16 – WRAP 2028 state source group contributions source apportionment visibility impairment projections from South Dakota ammonium nitrate-producing sources at Bridger and Fitzpatrick Wilderness Areas in Wyoming



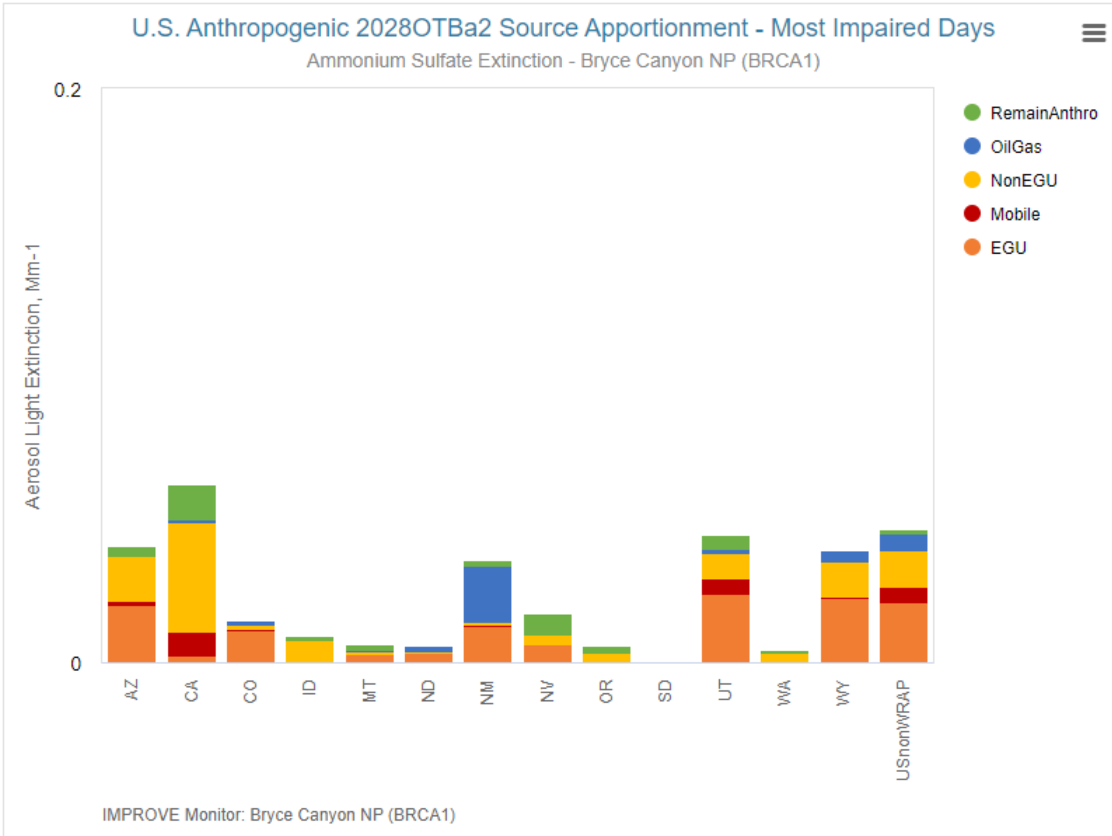
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-17 -- WRAP 2028 state source group contributions source apportionment visibility impairment projections from South Dakota ammonium sulfate-producing sources at Mount Rainier National Park in Washington



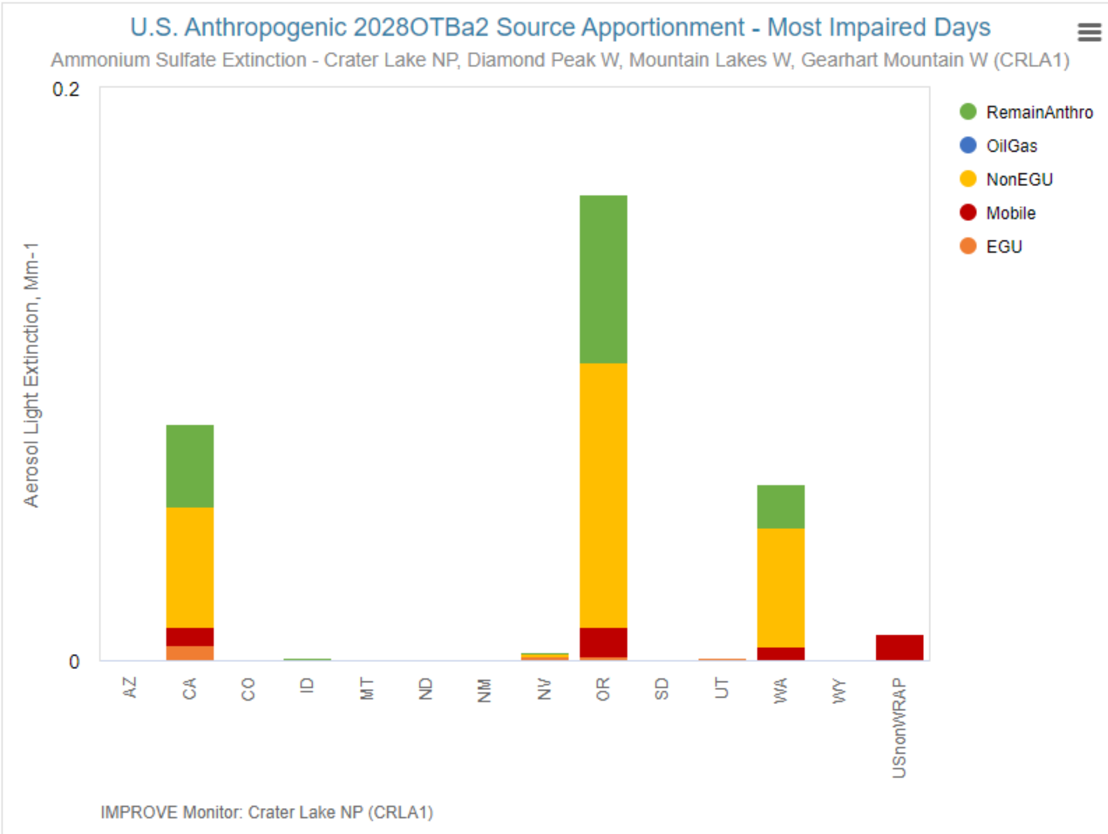
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-18 -- WRAP 2028 state source group contributions source apportionment visibility impairment projections from South Dakota ammonium sulfate-producing sources at Bryce Canyon National Park in Utah



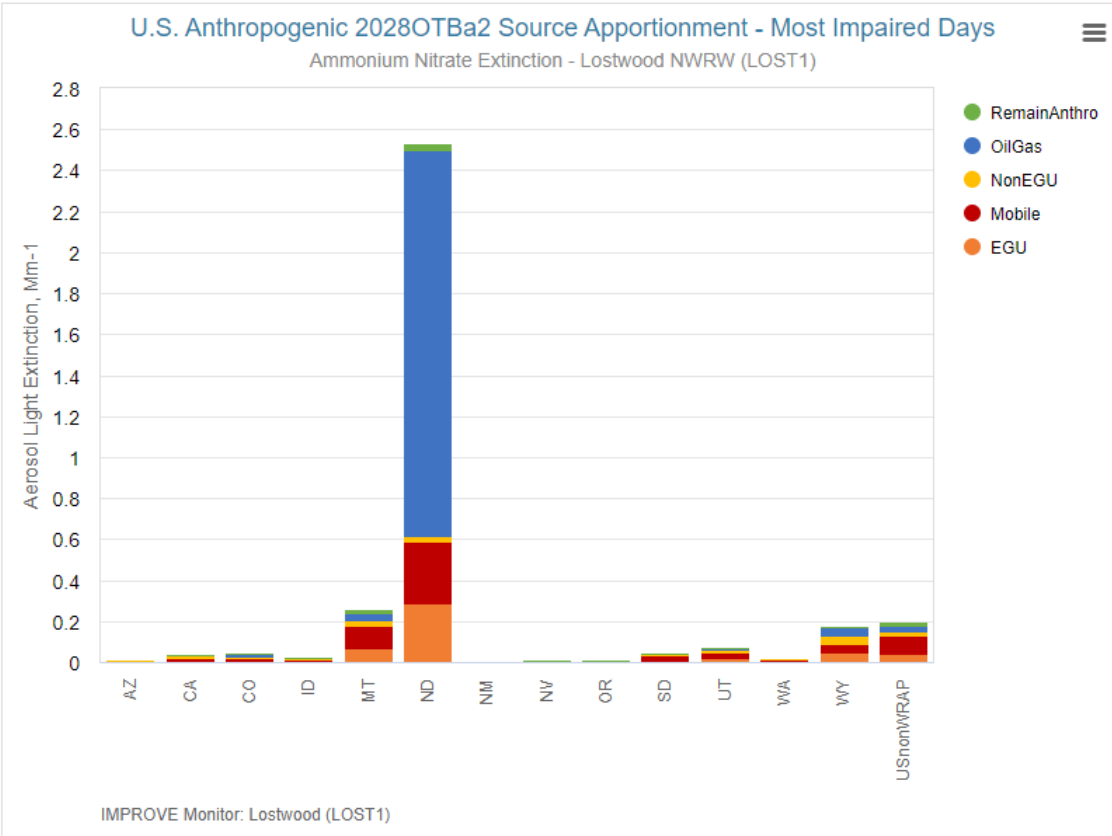
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-19 -- WRAP 2028 state source group contributions source apportionment visibility impairment projections from South Dakota ammonium sulfate-producing sources at Crater Lake National Park in Oregon



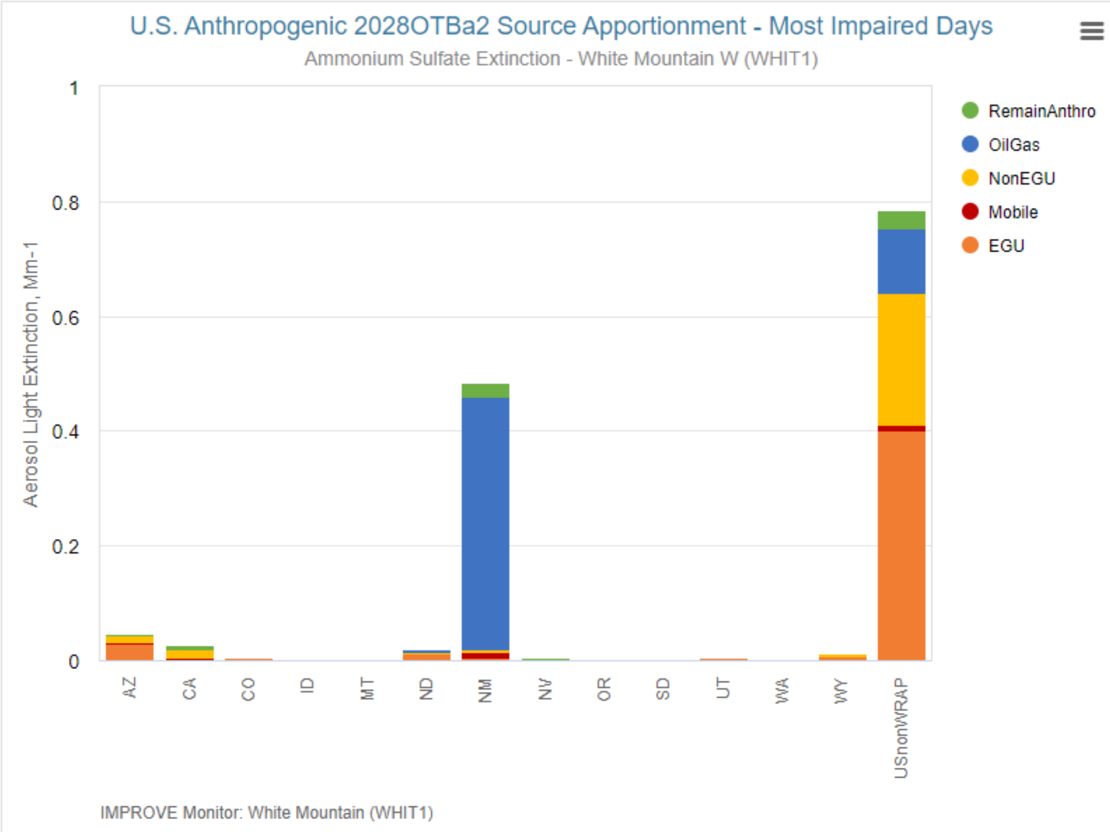
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-20 -- WRAP 2028 state source group contributions source apportionment visibility impairment projections from South Dakota ammonium nitrate-producing sources at the Lostwood Wilderness Area in North Dakota



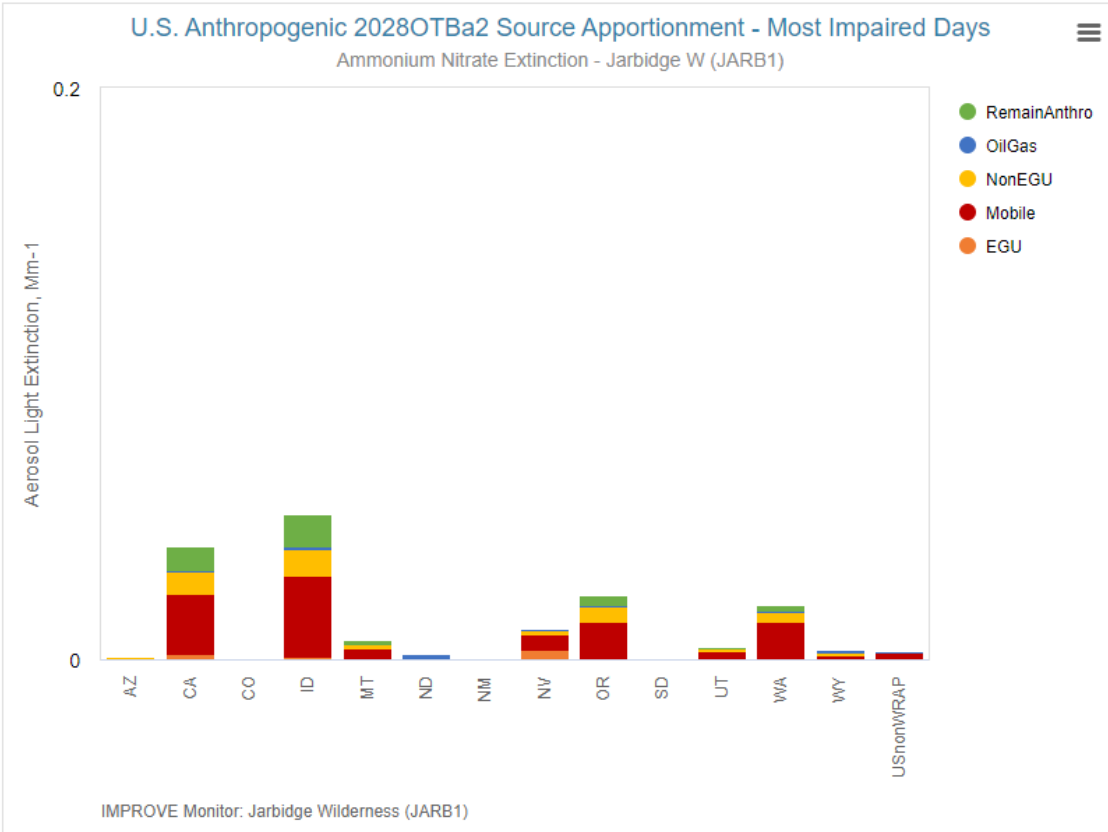
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-21 -- WRAP 2028 state source group contributions source apportionment visibility impairment projections from South Dakota ammonium sulfate-producing sources at the White Mountains Wilderness Area in New Mexico



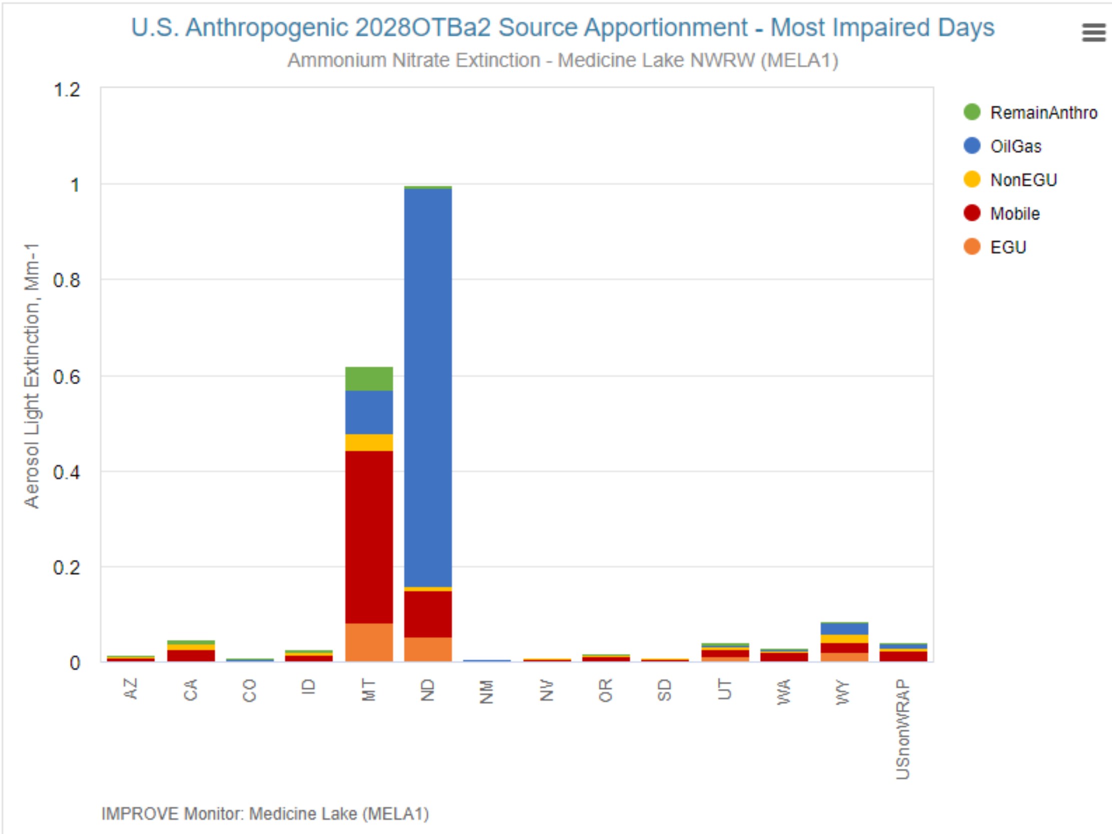
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-22 -- WRAP 2028 state source group contributions source apportionment visibility impairment projections from South Dakota ammonium nitrate-producing sources at the Jarbridge Wilderness Area in Nevada



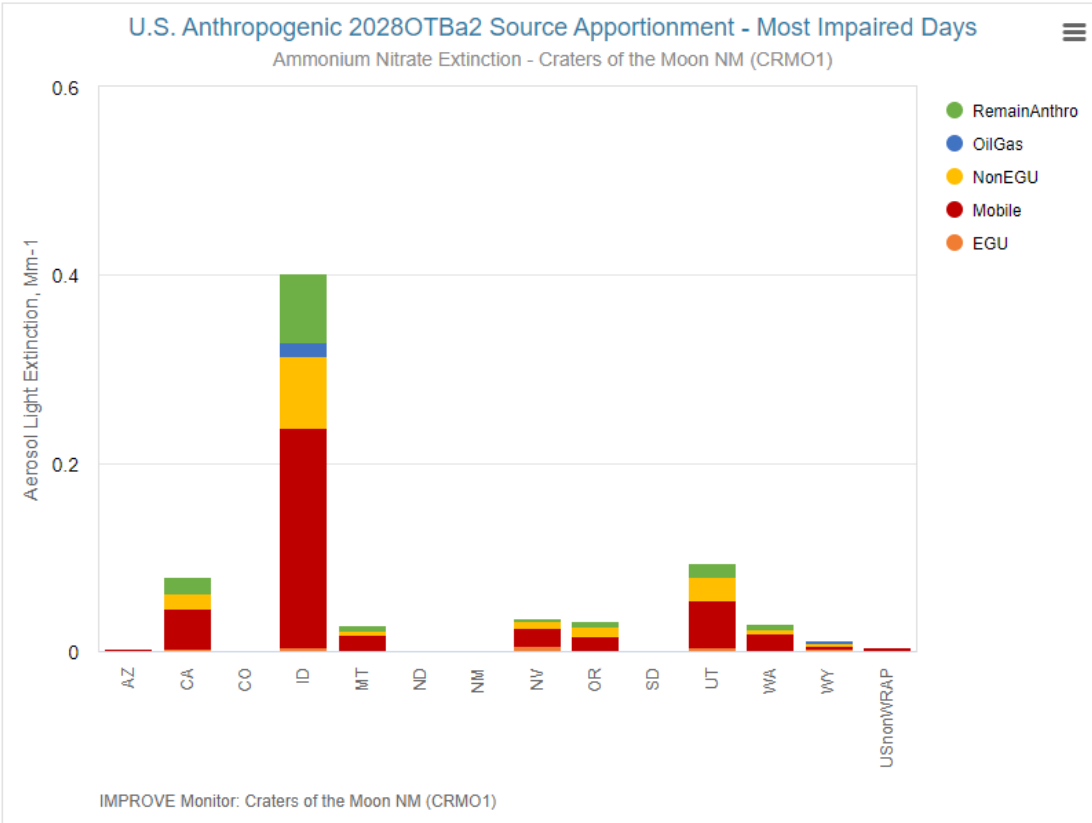
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-23 -- WRAP 2028 state source group contributions source apportionment visibility impairment projections from South Dakota ammonium nitrate-producing sources at the Medicine Lake Area in Montana



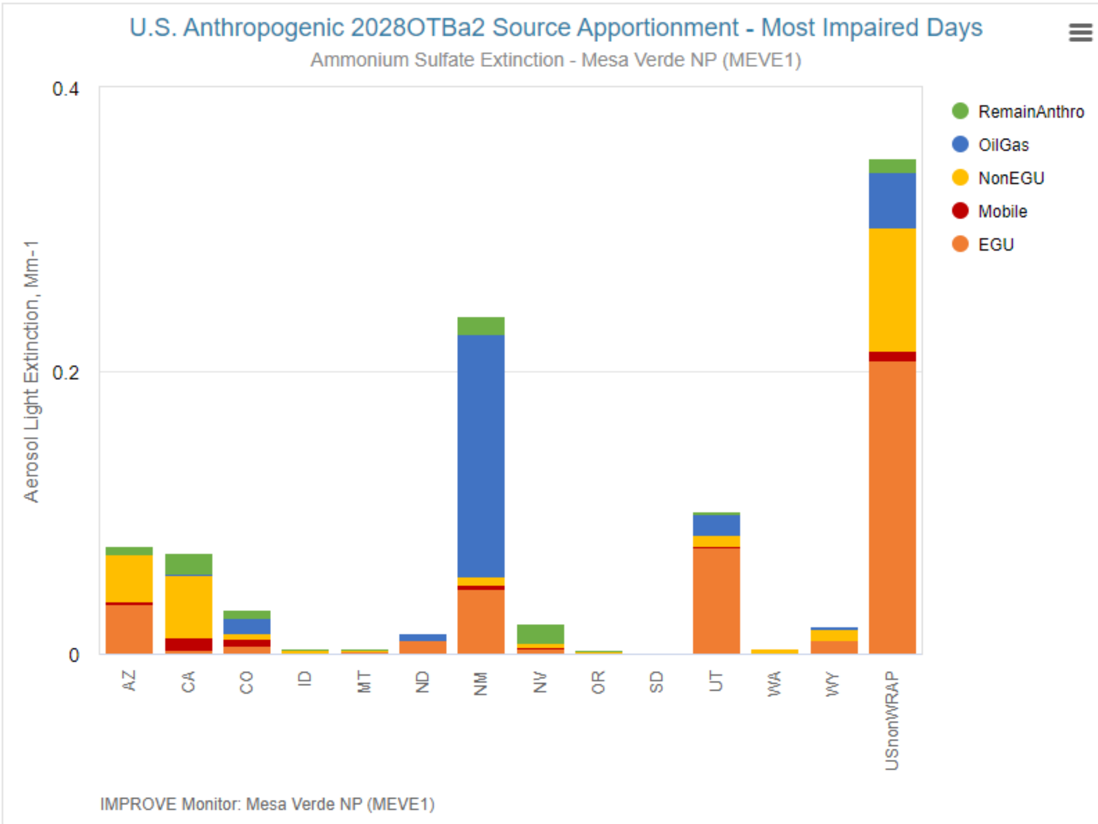
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-24 -- WRAP 2028 state source group contributions source apportionment visibility impairment projections from South Dakota ammonium nitrate-producing sources at the Craters of the Moon Area in Idaho



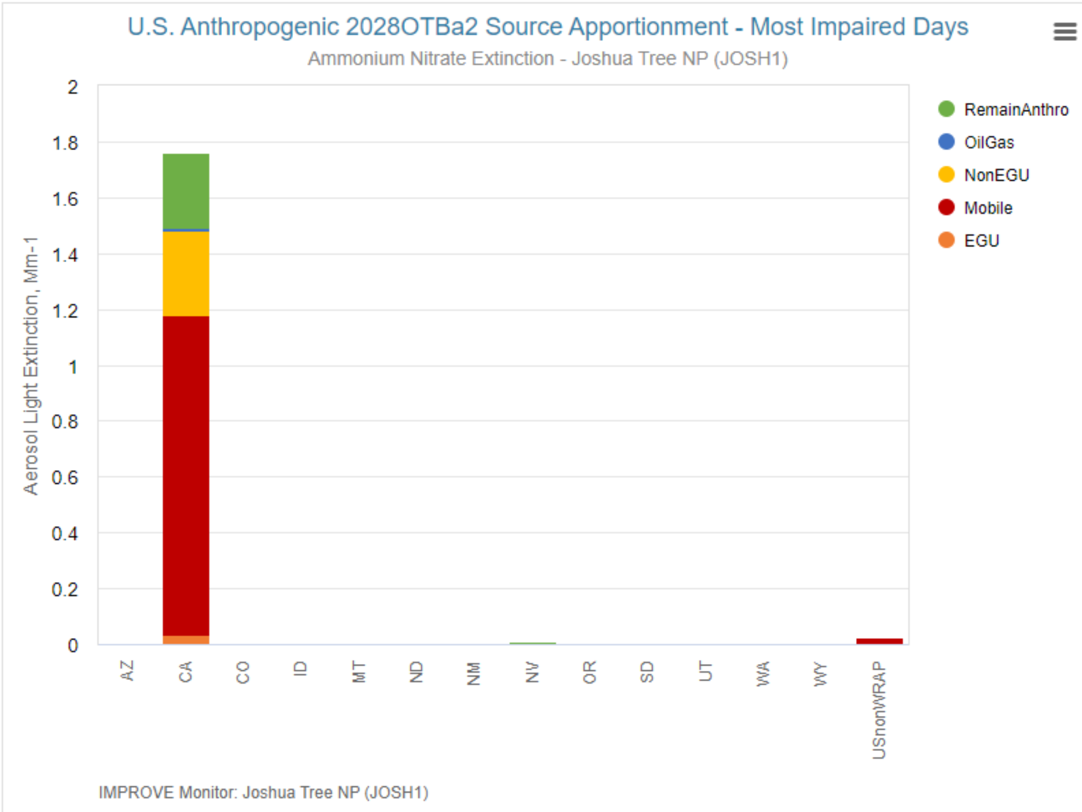
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-25 -- WRAP 2028 state source group contributions source apportionment visibility impairment projections from South Dakota ammonium sulfate-producing sources at Mesa Verde National Park in Colorado



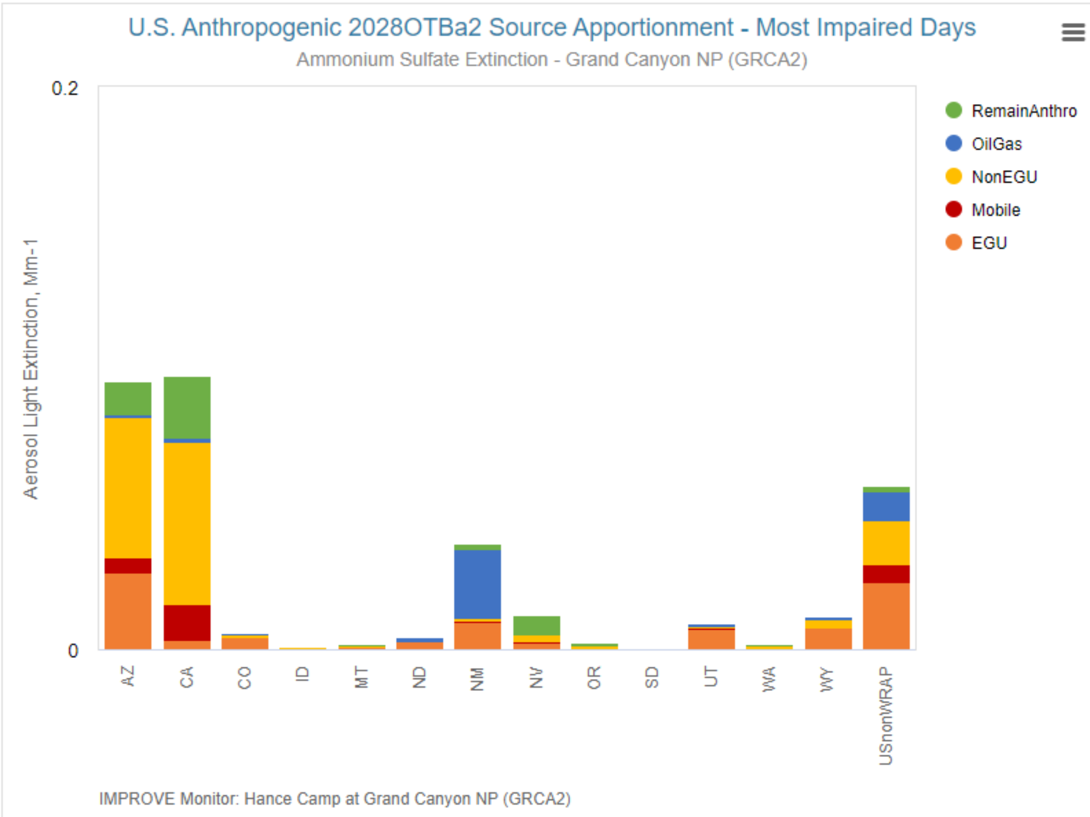
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-26 -- WRAP 2028 state source group contributions source apportionment visibility impairment projections from South Dakota ammonium nitrate-producing sources at Joshua Tree National Park in California



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-27 -- WRAP 2028 state source group contributions source apportionment visibility impairment projections from South Dakota ammonium sulfate-producing sources at Grand Canyon National Park in Arizona



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Also according to the above requirements, South Dakota must select specific sources of emissions to do a subsequent emission reductions control analysis on, which will help set the required reasonable progress goals for the Class I Areas.

South Dakota determined which Class I Areas outside the state are being impacted by emissions emanating from within the state through some of the same methods it used to screen for its anthropogenic sources of visibility impairment, including the Microsoft Excel WEP/ AOI and Q/d spreadsheets created by WRAP's contractor Ramboll Corporation. Both these processes are explained further in following sections.

Not all emission sources within a state are required to be evaluated in this step, only a subset of reasonably selected sources as deemed reasonable by the state. South Dakota also chose sources within their borders that not only significantly affect the visibility of their own Class I Areas, but also those that significantly affect the visibility of other out-of-state Class I Areas.

South Dakota considered major and minor stationary sources and groups of these sources, mobile sources, and area sources within the state. This ensured that a large percentage of emissions which impact the light extinction at any given Class I Area on the 20 percent most impaired days were analyzed and considered for subsequent analysis. DANR worked through WRAP to identify and consider mobile, area, major and minor stationary sources. According to the Clean Air Act, section 169A, U.S. Code 7491(g), 'major stationary source' means the following:

"Types of stationary sources with the potential to emit 250 tons or more of any pollutant: fossil-fuel fired steam electric plants of more than 250 million British thermal units per hour heat input, coal cleaning plants (thermal dryers), kraft pulp mills, Portland Cement plants, primary zinc smelters, iron and steel mill plants, primary aluminum ore reduction plants, primary copper smelters, municipal incinerators capable of charging more than 250 tons of refuse per day, hydrofluoric, sulfuric, and nitric acid plants, petroleum refineries, lime plants, phosphate rock processing plants, coke oven batteries, sulfur recovery plants, carbon black plants (furnace process), primary lead smelters, fuel conversion plants, sintering plants, secondary metal production facilities, chemical process plants, fossil-fuel boilers of more than 250 million British thermal units per hour heat input, petroleum storage and transfer facilities with a capacity exceeding 300,000 barrels, taconite ore processing facilities, glass fiber processing plants, charcoal production facilities."

The following sections in part detail the process South Dakota used to screen its anthropogenic emission sources for further consideration of emission control measures. Again, part of the goal of the following steps is to identify Electric Generating Unit point sources and other source types from within South Dakota that are most likely to significantly impact the visibility in Class I Areas both within and outside of South Dakota. These selected sources are then to be analyzed through a four-factor process which culminates in a determination of whether emission control measures are necessary.

In order to properly conduct this step, South Dakota needed to make some initial decisions, including determining which days to consider, choosing between using a delta Deciviews or light extinction (Mm-1) metric to assess visibility, selecting which emissions information to use and whether to use actual or allowable emissions, and choosing the most appropriate emission inventory year.

An important metric used to track visibility progress in the second implementation period is the 20% most anthropogenically impaired days at any given Class I Area. South Dakota elected to use the 20% most impaired days in its analysis, as these days are required to be used to set reasonable progress goals and therefore for tracking visibility progress. Regarding the appropriate visibility metric, South Dakota used the light extinction in inverse megameters metric. An equation is used to convert light extinction in inverse megameters to Deciviews, however to simplify the process by one step.

Selecting appropriate sources of emissions information for the purpose of determining visibility impacts of sources in the determination of which sources should be selected for an emissions reduction control measure analysis is also important. South Dakota used actual, not allowable emissions projected to 2028 which were determined using reasonable methods provided through WRAP. Finally, the most appropriate emission inventory year must be chosen. South Dakota used National Emission Inventory information in its source selection process. This requirement is dictated by Section 51.308(f)(2)(iii) of the Regional Haze Rule, which requires states to include emissions from a year at least as recent as the most recent year for which the state has submitted emission inventory information to EPA as part of the triennial National Emissions Inventory process.

3.2.1 Estimating Visibility Impacts: Emissions Over Distance (Q/d) Analysis

To know which South Dakota visibility impairing emission-producing facilities are of most concern, South Dakota first needed to identify which Class I Areas its facilities impact, and to what degree. The first of two methods South Dakota used in its source selection process was the Emissions Divided By Distance (Q/d) technique, developed by the Regional Haze Planning Workgroup (RHPWG) Control Measures Subcommittee (CMS) and also by Ramboll Corporation. Although it is relatively simple and lacks important considerations including transport direction, dispersion processes, and photochemical processes, the Q/d metric nevertheless serves as a surrogate for visibility impacts, and provides a good quantitative starting point in the source screening process. The Q/d analysis helps determine what the potential impact South Dakota's emissions have on given Class I Areas inside and outside the state, and can be considered part of the weight of evidence in South Dakota's process for selection of its sources for a subsequent four factor analysis. Many other states in the WRAP region are also using this analysis, which thus again, serves as a regionally-consistent source screening tool to determine which emission sources might require reasonable progress controls.

Ramboll Corporation, a contractor hired by WRAP, developed a Microsoft Excel spreadsheet tool for the WRAP states to utilize. This tool examines sources of emissions and allows users to filter through and determine those sources' impacts on all the nearby Class I Areas. The spreadsheet displays permitted point source facilities, and allows users to rank them by their Q/d values. Emissions data ("Q") are summed in tons per year at each facility for the most recent emissions for nitrogen oxides (NOx), sulfur dioxide (SO2), and particulate matter less than 10 microns in diameter (PM10). These emissions are then divided by distance ("d") to various Class I Areas. The Q/d values were therefore calculated by taking the total of all emissions of sulfur dioxide, nitrogen oxides, and particulate matter (less than 10 microns in diameter) from a facility, divided by that facility's distance in kilometers to various Class I Areas. The analysis breaks down Q/d values by total Q/d, NOx Q/d, SO2 Q/d, and PM10 Q/d. Emissions data comes from the 2014 NEIv2 and as applied in the WRAP 2014 Shakeout v1 Modeling Platform. The emissions data includes facilities with emissions of one ton per year or greater of combined SO2, NOx, and PM10; any facility that emits less than this threshold was deemed as insignificant. The analysis also included ammonia (NH3) and volatile organic compound (VOC) emissions for informational purposes. Also, an analysis was not conducted on sources and Class I Areas that were greater than 400 kilometers from a Class I Area-- only facilities which are within 400 kilometers of at least one Class I Area were included. Facilities in states not part of the WRAP region were therefore considered, including facilities and Class I Areas in Iowa, Kansas, Oklahoma, Texas, Iowa, Missouri, Minnesota, and Wisconsin. South Dakota would like to emphasize, that the Q/d analysis is only one of its source screening tools, and therefore if any emission source happens to fall outside the 400 kilometer range, South Dakota has other means for assessing the impacts of those sources. Therefore, no source is being categorically excluded from this source selection analysis step solely due to its proximity to Class I Areas.

According to the analysis, given a threshold of 25 tons per year of total combined emissions of NOx, SO2 and PM10 per facility, 97.99% of South Dakota's total emissions are screened in for, including 98.26% of South Dakota's NOx emissions, 99.22% of South Dakota's SO2 emissions, and 95.48% of South Dakota's PM10 emissions. These percentages were found by taking the sum of all facility Q (or specific NOx, SO2, or PM10 Q) with total Q above the Q threshold, and dividing it by the emissions of all facilities in the state. These percentages confirm that the vast majority of emissions from within the state are being taken into consideration in the analysis.

The established Q/d threshold used by most WESTAR-WRAP states is a value of 10. According to the analysis, given a threshold of Q/d of 10, with the "d" portion of the equation determined by measuring the distance from the location of the point source to the nearest boundary of any given Class I Area, the following percentages of Q/d values have been screened in for the Badlands: 79.66% of the total Q/d values, 76.25% of the NOx Q/d values, 93.65% of the SO2 Q/d values, and 43.05% of the PM10 Q/d values. Looking at the Wind Cave National Park, the following percentages of Q/d values have been screened in: 69.06% of the total Q/d values, 63.23% of the NOx Q/d values, 84.55% of the SO2 Q/d values, and 52.63% of the PM10 Q/d values.

South Dakota initially screened for all sources affecting its two Class I Areas, Wind Cave National Park and Badlands National Park, using a total Q/d threshold of 10 or greater. This analysis amounted to only one South Dakota source meeting the criteria. Therefore, South Dakota opted to consider a more stringent threshold.

The Q/d threshold of 2 of all its facilities was also analyzed by South Dakota. According to the analysis, with the "d" portion of the equation determined by measuring the distance from the location of the point source to the nearest boundary of any given Class I Area, the following percentages of Q/d values have been screened into the analysis at the Badlands: 91.74% of the total Q/d values, 89.66% of the NOx Q/d values, 97.57% of the SO2 Q/d values, and 79.09% of the PM10 Q/d values. Regarding the Wind Cave National Park, the following percentages of Q/d values have been screened into the analysis: 88.32% of the total Q/d values, 82.48% of the NOx Q/d values, 98.00% of the SO2 Q/d values, and 82.99% of the PM10 Q/d values.

South Dakota used a threshold of a total Q/d value of greater than 2, in order that an adequately large number of sources would be identified for a potential subsequent review. Using this threshold, the South Dakota facilities that were screened in for further review were: 1) Pete Lien And Sons Inc with a Q/d value of 5.62 at Wind Cave National Park in South Dakota, and 4.92 at Badlands National Park in South Dakota. 2) GCC Dacotah with a Q/d value of 22.63 for Wind Cave National Park in South Dakota, 16.71 for Badlands National Park in South Dakota, and 3.76 for Theodore Roosevelt National Park in North Dakota.

Furthermore, South Dakota used the Ramboll Q/d analysis to compare the Q/d values from South Dakota facilities to Q/d values from facilities outside the state. The comparison shows how many other out of state facilities have higher Q/d values at South Dakota Class I Areas than facilities that are in-state. These facilities are listed and ranked by Class I Area and by pollutant in the tables below.

Regarding Tables 3-1 through 3-6, it is quite apparent that other facilities outside of South Dakota negatively affect visibility at South Dakota Class I Areas more than facilities inside the state. Of South Dakota facilities, GCC Dacotah is the sole facility that impacts South Dakota's Class I Areas at all. For total Q/d, NOx Q/d, and SO2 Q/d at Badlands National Park, GCC Dacotah ranks 13th, 11th, and 13th respectively, indicating roughly a dozen other facilities may be obligated to reduce their emissions before GCC Dacotah should be expected to reduce theirs. Significant visibility impairing emissions come from almost all of South Dakota's neighboring states, including Nebraska, Montana, Wyoming, and North Dakota. For total Q/d, NOx Q/d, and SO2 Q/d at Wind Cave National Park, GCC Dacotah ranks 7th, 6th, and 7th respectively. Significant visibility impairing emissions come from almost all of South Dakota's neighboring states, including Nebraska, Montana, Wyoming, and North Dakota.

Regarding Table 3-7, the same overall picture is seen. Of South Dakota's neighboring states' Class I Areas, the largest total Q/d values from South Dakota facilities are: 3.75 from GCC Dacotah at Theodore Roosevelt National Park in North Dakota, 1.35 from Williston Basin Interstate Pipeline Company at Theodore Roosevelt National Park in North Dakota, 1.018 from Pete Lien And Sons Inc at Theodore Roosevelt National Park in North Dakota, and 0.76 from Williston Basin Interstate Pipeline Company at the Medicine Lake Class I Area. All four of these values are substantially below the total Q/d threshold of 10, thus indicating they are not major sources of visibility impairment at these Class I Areas.

Table 3-1 -- A ranking of facilities with a total Q/d threshold of 10 or greater which affect the Badlands Class I Area

Rank	Facility Name	Facility State	Total Q/d
1	Nppd Gerald Gentleman Station	NE	107.16
2	Colstrip Steam Electric Station	MT	69.72
3	Laramie River Station	WY	68.34
4	Coyote Station	ND	66.74
5	Coal Creek Station	ND	62.89
6	Antelope Valley Station	ND	57.32
7	Dave Johnston	WY	52.91
8	Milton R. Young Station	ND	29.97
9	Wyodak Plant	WY	24.24
10	Leland Olds Station	ND	22.22
11	Great Plains Synfuels Plant	ND	20.74
12	Black Thunder Mine	WY	19.35
13	Gcc Dacotah	SD	16.71
14	Rm Heskett Station	ND	13.87
15	Stanton Station	ND	11.77

Table 3-2 -- Of the facilities with a total Q/d threshold of 10 or greater which affect the Badlands Class I Area, a ranking of NOx Q/d values

Rank	Facility Name	Facility State	NOx Q/d	Total Q/d
1	Colstrip Steam Electric Station	MT	39.25	69.72
2	Laramie River Station	WY	34.86	68.34
3	Coyote Station	ND	30.75	66.74
4	Nppd Gerald Gentleman Station	NE	26.59	107.16

5	Dave Johnston	WY	23.38	52.91
6	Antelope Valley Station	ND	23.3	57.32
7	Milton R. Young Station	ND	22.66	29.97
8	Coal Creek Station	ND	20.15	62.89
9	Leland Olds Station	ND	17.16	22.22
10	Wyodak Plant	WY	13.23	24.24
11	Gcc Dacotah	SD	11.83	16.71
12	Great Plains Synfuels Plant	ND	8.4	20.74
13	Black Thunder Mine	WY	5.11	19.35
14	Stanton Station	ND	4.36	11.77
15	Rm Heskett Station	ND	3.74	13.87

Table 3-3 -- Of the facilities with a total Q/d threshold of 10 or greater which affect the Badlands Class I Area, a ranking of SO2 Q/d values

Rank	Facility Name	Facility State	SO2 Q/d	Total Q/d
1	Nppd Gerald Gentleman Station	NE	79.8	107.16
2	Coal Creek Station	ND	39.92	62.89
3	Coyote Station	ND	34.53	66.74
4	Antelope Valley Station	ND	32.35	57.32
5	Laramie River Station	WY	29.33	68.34
6	Dave Johnston	WY	26.52	52.91
7	Colstrip Steam Electric Station	MT	25.45	69.72
8	Great Plains Synfuels Plant	ND	9.91	20.74
9	Wyodak Plant	WY	9.91	24.24
10	Rm Heskett Station	ND	9.42	13.87
11	Stanton Station	ND	6.77	11.77
12	Milton R. Young Station	ND	5.73	29.97
13	Gcc Dacotah	SD	4.35	16.71
14	Leland Olds Station	ND	3.75	22.22
15	Black Thunder Mine	WY	0.68	19.35

Table 3-4 -- A ranking of facilities with a total Q/d threshold of 10 or greater which affect the Wind Cave Class I Area

Rank	Facility Name	Facility State	Total Q/d
1	Nppd Gerald Gentleman Station	NE	99.22
2	Laramie River Station	WY	96.32
3	Colstrip Steam Electric Station	MT	78.91
4	Dave Johnston	WY	77.31
5	Wyodak Plant	WY	34.71
6	Black Thunder Mine	WY	31.44

7	Gcc Dacotah	SD	22.63
8	Public Service Co Pawnee Plt	CO	20.03
9	Antelope Mine	WY	14.1
10	North Antelope Rochelle Mine	WY	13.15
11	Cordero Rojo Complex	WY	10.79

Table 3-5 -- Of the facilities with a total Q/d threshold of 10 or greater which affect the Wind Cave Class I Area, a ranking of NOx Q/d values

Rank	Facility Name	Facility State	NOx Q/d	Total Q/d
1	Laramie River Station	WY	49.13	96.32
2	Colstrip Steam Electric Station	MT	44.42	78.91
3	Dave Johnston	WY	34.17	77.31
4	Nppd Gerald Gentleman Station	NE	24.62	99.22
5	Wyodak Plant	WY	18.94	34.71
6	Gcc Dacotah	SD	16.02	22.63
7	Black Thunder Mine	WY	8.3	31.44
8	North Antelope Rochelle Mine	WY	7.54	13.15
9	Public Service Co Pawnee Plt	CO	4.86	20.03
10	Antelope Mine	WY	3.98	14.1
11	Cordero Rojo Complex	WY	1.47	10.79

Table 3-6 -- Of the facilities with a total Q/d threshold of 10 or greater which affect the Wind Cave Class I Area, a ranking of SO2 Q/d values

Rank	Facility Name	Facility State	SO2 Q/d	Total Q/d
1	Nppd Gerald Gentleman Station	NE	73.89	99.22
2	Laramie River Station	WY	41.33	96.32
3	Dave Johnston	WY	38.76	77.31
4	Colstrip Steam Electric Station	MT	28.81	78.91
5	Public Service Co Pawnee Plt	CO	15.03	20.03
6	Wyodak Plant	WY	14.2	34.71
7	Gcc Dacotah	SD	5.89	22.63
8	Black Thunder Mine	WY	1.11	31.44
9	North Antelope Rochelle Mine	WY	0.22	13.15
10	Cordero Rojo Complex	WY	0.18	10.79
11	Antelope Mine	WY	0.03	14.1

Table 3-7 -- Q/D values attributed to South Dakota emissions of over 0.5 at all neighboring states Class I Areas

CIA Name	CIA State	Facility Name	Facility State	Distance (km)	All Q (tpy)	Q/d

Theodore Roosevelt	ND	Gcc Dacotah	SD	311.02	1168.3	3.75
Theodore Roosevelt	ND	Williston Basin Interstate Pipeline Company	SD	215.34	290.98	1.35
Theodore Roosevelt	ND	Pete Lien And Sons Inc	SD	308.44	314.1	1.01
Lostwood	ND	N/A	N/A	N/A	N/A	N/A
Medicine Lake	MT	Williston Basin Interstate Pipeline Company	SD	382.25	290.98	0.76
UL Bend	MT	N/A	N/A	N/A	N/A	N/A
Boundary Waters	MN	N/A	N/A	N/A	N/A	N/A
Voyageurs	MN	N/A	N/A	N/A	N/A	N/A
Bridger	WY	N/A	N/A	N/A	N/A	N/A
North Absaroka	WY	N/A	N/A	N/A	N/A	N/A
Mount Zirkel	CO	N/A	N/A	N/A	N/A	N/A
Rocky Mountain	CO	N/A	N/A	N/A	N/A	N/A

More information about the Regional Haze Planning Workgroup (RHPWG) Control Measures Subcommittee (CMS) can be found at the following URL: https://views.cira.colostate.edu/tssv2/Emissions/QDAnalysis.aspx

More information about the WAQS 2014 Modeling Platform can be found at the following URL: http://views.cira.colostate.edu/wiki/wiki/9194/waqs-2014-modeling-platform

The WRAP Q/D Threshold Analysis Microsoft Excel and Access files can be found at the following URL: https://views.cira.colostate.edu/tssv2/Emissions/QDAnalysis.aspx

Ramboll also created a separate Q/d analysis as part of their WEP/ AOI analysis. These Ramboll Rank Point Q/d results are different than the Regional Haze Planning Workgroup (RHPWG) Control Measures Subcommittee (CMS) Q/d results because the Ramboll Rank Point Q/d uses future projected 2028 emissions from the 2028OTBa2 emissions scenario, whereas the RHPWG CMS Q/d results use 2014 emissions. The Ramboll Rank Point Q/d analysis was also calculated differently because it focused on the location of the CIA itself instead of the geographic location of each IMPROVE monitor—“D” in the equation being instead the distance from the facility to the IMPROVE monitor.

More information about Ramboll’s Rank Point Q/d analysis can be found at the following URL: https://views.cira.colostate.edu/tssv2/WEP-AOI/

The projected 2028 Q/d values from the Ramboll Rank Point analysis are shown in the below tables.

Regarding Tables 3-8 through 3-11, similar results can be seen to the 2014 emissions analysis. South Dakota does not have any facilities that produce a Q/d value above the threshold of 10 for either NOx or SO2 at Badlands National Park, indicating none of the state’s facilities significantly impair visibility at that location. At Wind Cave National Park, South Dakota has one facility that produces a Q/d value above the threshold of 10 for NOx, and none for SO2. For

NOx, GCC Dacotah ranks 9th with a Q/d value of 13.49, just slightly above the threshold, indicating potentially noticeable visibility impairment may be attributed to that facility.

Table 3-8 -- A comparison of facilities with a total Q/d threshold of 10 or greater for NOx for the Badlands Class I Area

Rank	Facility Name	State	QoverD_NOX
1	NPPD Gerald Gentleman Station	NE	28.93
2	Laramie River Station	WY	27.26
3	Milton R. Young Station	ND	24.51
4	Coyote Station	ND	19.02
5	COLSTRIP STEAM ELECTRIC STATION	MT	17.95
6	Coal Creek Station	ND	14.71
7	Leland Olds Station	ND	13.23
8	Jim Bridger Plant	WY	13.14
9	WALTER SCOTT JR ENERGY CTR	IA	12.89
10	Wyodak Plant	WY	12.86
11	North Antelope Rochelle Mine	WY	12.24
12	PacifiCorp- Hunter Power Plant	UT	11.03

Table 3-9 -- A comparison of facilities with a total Q/d threshold of 10 or greater for SO2 for the Badlands Class I Area

Rank	Facility Name	State	QoverD_SO2
1	NPPD Gerald Gentleman Station	NE	85.89
2	Coyote Station	ND	33.55
3	Antelope Valley Station	ND	31.22
4	Laramie River Station	WY	23.04
5	HARRINGTON STATION POWER PLANT	TX	21.09
6	OPPD Nebraska City Station	NE	20.49
7	TOLK STATION	TX	16.85
8	Jim Bridger Plant	WY	15.35
9	LIMESTONE ELECTRIC GENERATION STATION	TX	14.83
10	KREMLIN	OK	14.53
11	WA PARISH ELECTRIC GENERATING STATION	TX	13.46
12	Coal Creek Station	ND	13.39
13	Xcel Energy - Sherburne Generating Plant	MN	13.09
14	Great Plains Synfuels Plant	ND	11.28
15	COLSTRIP STEAM ELECTRIC	MT	10.72

	STATION		

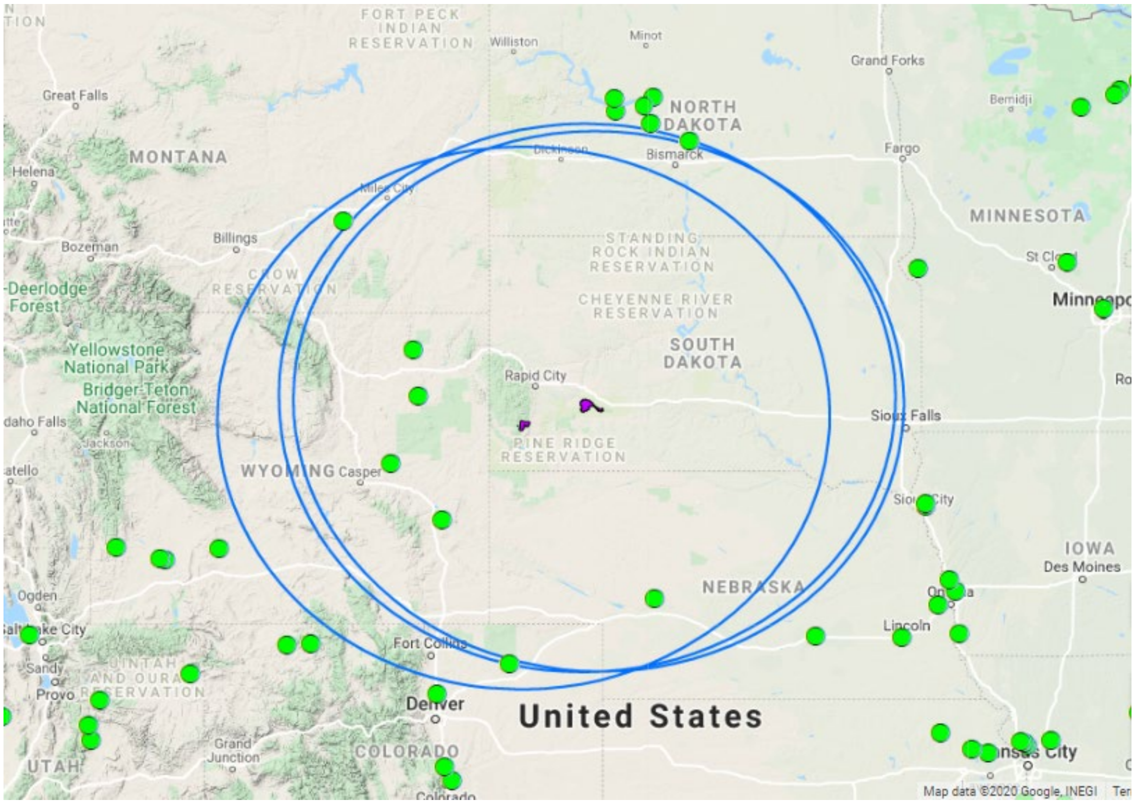
Table 3-10 -- A comparison of facilities with a total Q/d threshold of 10 or greater for NOx for the Wind Cave Class I Area

Rank	Facility Name	State	QoverD_NOX
1	Laramie River Station	WY	41.53
2	NPPD Gerald Gentleman Station	NE	26.11
3	North Antelope Rochelle Mine	WY	22.93
4	COLSTRIP STEAM ELECTRIC STATION	MT	22.01
5	Milton R. Young Station	ND	21.38
6	Wyodak Plant	WY	21.06
7	Coyote Station	ND	17.20
8	Jim Bridger Plant	WY	16.53
9	GCC Dacotah	SD	13.49
10	Coal Creek Station	ND	13.02
11	PacifiCorp- Hunter Power Plant	UT	12.63
12	Leland Olds Station	ND	11.73
13	WALTER SCOTT JR ENERGY CTR	IA	10.90

Table 3-11 -- A comparison of facilities with a total Q/d threshold of 10 or greater for SO2 for the Wind Cave Class I Area

Rank	Facility Name	State	QoverD_SO2
1	NPPD Gerald Gentleman Station	NE	77.53
2	Laramie River Station	WY	35.09
3	Coyote Station	ND	30.35
4	Antelope Valley Station	ND	28.43
5	HARRINGTON STATION POWER PLANT	TX	21.29
6	Jim Bridger Plant	WY	19.31
7	OPPD Nebraska City Station	NE	17.64
8	TOLK STATION	TX	17.15
9	LIMESTONE ELECTRIC GENERATION STATION	TX	14.50
10	Wyodak Plant	WY	14.29
11	KREMLIN	OK	13.86
12	WA PARISH ELECTRIC GENERATING STATION	TX	13.22
13	COLSTRIP STEAM ELECTRIC STATION	MT	13.15
14	Coal Creek Station	ND	11.85
15	Xcel Energy - Sherburne Generating Plant	MN	11.02
16	Great Plains Synfuels Plant	ND	10.27

Figure 3-28 -- The geographic distribution of facilities with 4,000 tons of emissions per year or greater, and a 250 mile radius around each of South Dakota's two Class I Areas



3.2.2 Estimating Visibility Impacts: Weighted Emissions Potential/ Area Of Influence (WEP/AOI) Analysis

The second of two methods South Dakota used in its source selection process is the Weighted Emissions Potential (WEP)/ Area Of Influence (AOI) analysis. The analysis was provided by WESTAR-WRAP contractor Ramboll, and the results better enable South Dakota to determine which facilities to select for the subsequent emission control measures selection step. The analysis assesses the contributions of various emissions sources to anthropogenic visibility impairment at any given Class I Area. This includes Class I Areas outside South Dakota which are affected by South Dakota's emission sources on the 20 percent Most Impaired Days. Data used comes from Interagency Monitoring of Protected Visual Environments (IMPROVE) program monitors located at Class I Areas, emissions inventories (including inventories from Canada and Mexico, and from states outside the WRAP region like Texas, Oklahoma, and Nebraska), and a back-trajectory model. WEP was calculated using facility level point source and gridded area emissions of the precursors to light extinction, including SO2 and NOx, from the WRAP 2028 On The Books (OTB) emissions scenario. The NEI is a comprehensive estimate of air emissions of criteria and other hazardous pollutants and their precursors. Visibility impairment data was obtained from the IMPROVE program. The latest Regional Haze Rule Summary Data of daily impairment values include PM2.5, coarse PM, visibility impairment parameters, and light extinction information, and can be found at the IMPROVE website: http://vista.cira.colostate.edu/Improve/rhr-summary-data/. The analysis used the 20% most anthropogenically impaired days for each year of the second implementation period's baseline period (2014-2018) for each of the IMPROVE sites in the WRAP region, including the two IMPROVE sites in South Dakota located at Wind Cave National Park and Badlands National Park. The Hybrid Single-Particle Langrangian Integrated Trajectory (HYSPLIT) model is used in this analysis, which is a commonly used atmospheric dispersion and transport model within the atmospheric sciences. Back-trajectory analyses use the most likely path of air masses that arrive at a given location at a given time, starting at a selected Class I Area, and then go back in time in order to determine exactly how emissions arrived there. NAMS Hybrid hourly sigma-pressure meteorological data was used. Because the analysis uses meteorological data, the back-trajectory analyses can account for the effects of wind direction and speed on emissions as they're transported. However, the analysis does not account for dispersion or chemical transformation of those emissions. The results are calculated for the 12WUS2 modeling domain, aggregated to 36km resolution. In all, 76 IMPROVE sites and 116 Class I Areas in the WESTAR-WRAP region and neighboring states were included in the analysis.

More succinctly, the WEP analysis specifies grid cells that have the highest emissions shown to impact specific Class I Areas through transport, helping to determine the potential for each source to impact visibility at any given Class I Area. Those sources within the state of South Dakota that have a high potential of impacting both in and out of state Class I Areas can then be screened out and analyzed more closely in subsequent steps.

A more detailed description of the data and methods provided by WRAP can be found at this webpage https://views.cira.colostate.edu/tssv2/WEP-AOI/#_ftn3, from the NOAA Air Resources Laboratory FTP server found here, ftp://arlftp.arlhq.noaa.gov/nams, and from two published papers: 1) Stein, A.F., Draxler, R.R, Rolph, G.D., Stunder, B.J.B., Cohen, M.D., and Ngan, F., (2015). NOAA's HYSPLIT atmospheric transport and dispersion modeling system, Bull. Amer. Meteor. Soc., 96, 2059-2077, http://dx.doi.org/10.1175/BAMS-D-14-00110.1. 2) Rolph, G., Stein, A., and Stunder, B., (2017). Real-time Environmental Applications and Display System: READY. Environmental Modelling & Software, 95, 210-228, https://doi.org/10.1016/j.envsoft.2017.06.025

Four main types of products resulted from the WEP/AOI analysis: residence time (RT) plots, extinction weighted residence time (EWRT) plots, weighted emissions potential (WEP) plots, and a rank point file. Again, these were calculated for the 2014-2018 2^{nd} implementation baseline period's 20% Most Impaired Days. These are provided for viewing at the following website: http://views.cira.colostate.edu/tssv2/ImageBrowser/?pathid=WrapWEPAOIImages&csfid=MetadataSet1&csid=WRAP_2014_WEP_AOI_Image_Browser

Associated with the product plots are the underlying emissions, which are also available for viewing at the above website. After clicking on the "WEP/AOI Image Browser" hyperlink, you can then click on "emissions" and then choose from NOx, primary elemental carbon, primary organic aerosols, or SOx. The resulting plots show the emissions source sectors used for the WEP analysis: 1) TOTAL_ANTHRO – All anthropogenic emissions 2) PT_EGU – Electric generating unit emissions 3) PT_NON-EGU – Point source emissions from industrial activities 4) OG AREA_POINT – Oil and Gas area and point sources (Upstream and Midstream) 5) NON-POINT – Low-level area source emissions (non-point, agricultural, residential wood combustion, fugitive dust) 6) ON-ROAD – On-road mobile source emissions 7) NON-ROAD – Off highway mobile source (non-road, airport, commercial marine (C1, C2, and C3), and rail sources)

Residence time (RT) plots display which areas are potentially contributing to visibility extinction, according to modeled estimates of where air parcels traveled 72 hours back in time (the parcels' back trajectories) in order to arrive at a given IMPROVE monitor on the 20% Most Impaired Days. Residence time is defined as the total cumulative time that trajectories spend in a specific geographic area. To accomplish an analysis of this nature, Ramboll used the HYSPLIT back trajectory model to calculate how the air was traveling backwards through time to determine where it came from in order to arrive at any given IMPROVE monitor on the 20% Most Impaired Days. The residence time plots only where the air parcels traveled on the 20% MIDs, and don't account for emissions or for extinction, just simply where the air parcels traveled based on the inputted meteorology data.

This Residence Time (RT) analysis produces Area of Influence (AOI) plots. These show, through the HYSPLITv4 modeling, the likelihood that during a 72-hour back-trajectory, a parcel of air from any geographic area arrived at the selected Class I Area on the 20% Most Impaired Days during the five year period from 2014 through 2018. The modeling calculates the 72-hour back-trajectories four times each day (6:00, 12:00, 18:00, and 24:00 local standard time), and at different trajectory ending heights above the IMPROVE monitors including 100 meters, 1000 meters, or a combination of all heights. The composite of all trajectory height plot shows the count of all the endpoints of all the trajectories Ramboll calculated across the 5 year second implementation baseline period (2014-2018) on the 20% most impaired days. The plots are on the WRAP modeling grid, therefore the analysis determines the percentage of time each back trajectory spends in each grid cell. Any grid cell the back trajectories spent more than 2% of the total time in is indicated as a purple shade in the plot, between 1-2% is indicated in red, between 0.5-1% is in orange, 0.2-0.5% is in green, 0.1-0.2% is in blue, and 0.05-0.1% is in navy.

In all cases the back trajectories spent most their time closest to the IMPROVE monitor site because they all needed to travel to that site in order to arrive there. As the distance increases away from the site, the back trajectories start revealing more information about where geographically large emission sources exist, as an uneven distribution around the site starts to become more apparent, and the original spherical shape becomes more oddly and unevenly shaped. The back trajectories may for example be reaching out to areas where oil and gas development exist, or to a large point source like a power plant, or out to where a large metropolitan area exists. The orientation of the area of influence is also influenced by which direction air masses typically come from, as often times at a specific location at a specific time of year winds are more prevalent from one direction as opposed to another. Finally, orientations of area of influences may also vary based on the elevation above the IMPROVE monitor used; air parcels that arrive 100m above the IMPROVE monitor may have a greater chance at arriving from areas and sources nearer the monitor compared to air parcels that arrive 1000m above the IMPROVE monitor.

The Residence Time equation is shown below:

Equation 3-1 -- The residence time equation

$$\tau_{ij} = \frac{1}{NT}\sum_{k=1}^{N} \tau_{ijk}$$

where τijk is the residence time of the kth trajectory at the grid cell (i, j).

South Dakota decided not to select a specific cutoff (e.g., >0.5%) to identify a specific area of influence of most concern. The Residence Time charts for a combination of all heights for the Badlands and Wind Cave Class I Areas are found below.

Regarding Figures 3-29 and 3-30, the greatest probability of where the air parcels came from extend outward over a small distance in a circular pattern, indicating the facilities that are geographically closest to each of South Dakota's Class I Areas are the ones most likely to impact those Class I Areas. As the probability of an air parcel affecting each Class I Area decreases, the initial circular pattern takes on a more ellipse-like shape, oriented with its long axis extending from the north west to the south east directions. This orientation is likely because of the predominant yearly wind direction at these Class I Area locations—namely winds tend to come out of the northwest in the winter months, and out of the southeast during the summer months. The geographic extent of the probabilities also indicate the typical speed of the winds during those times as well. Because of this natural orientation, facilities from Montana and Nebraska may provide more visibility impairment than otherwise expected when considering their purely geographic positions. This observation may also indicate which South Dakota facilities may produce the most visibility impairment at Class I Areas outside the state.

Figure 3-29 -- The residence time chart for Badlands National Park for the 20% Most Impaired Days

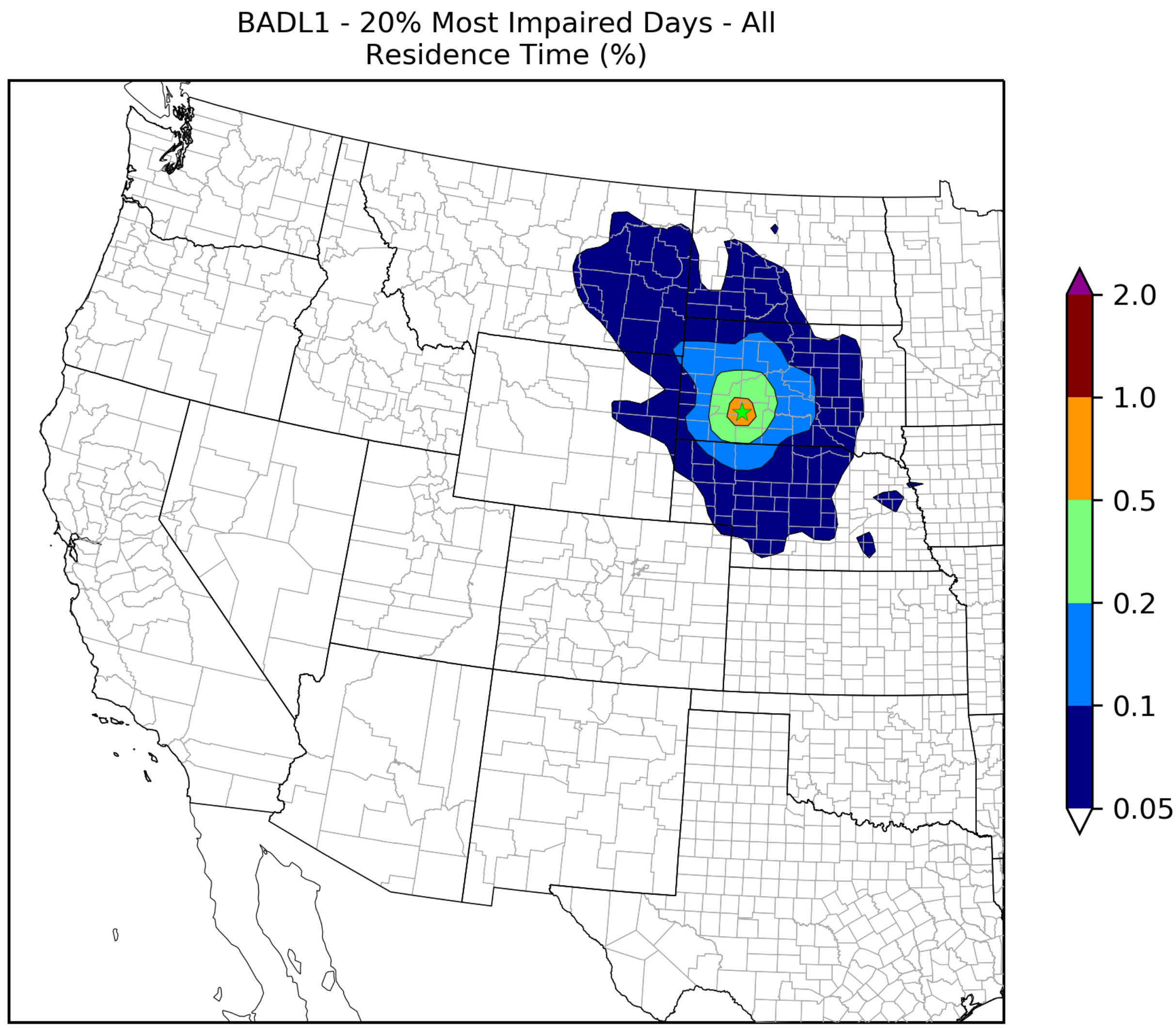
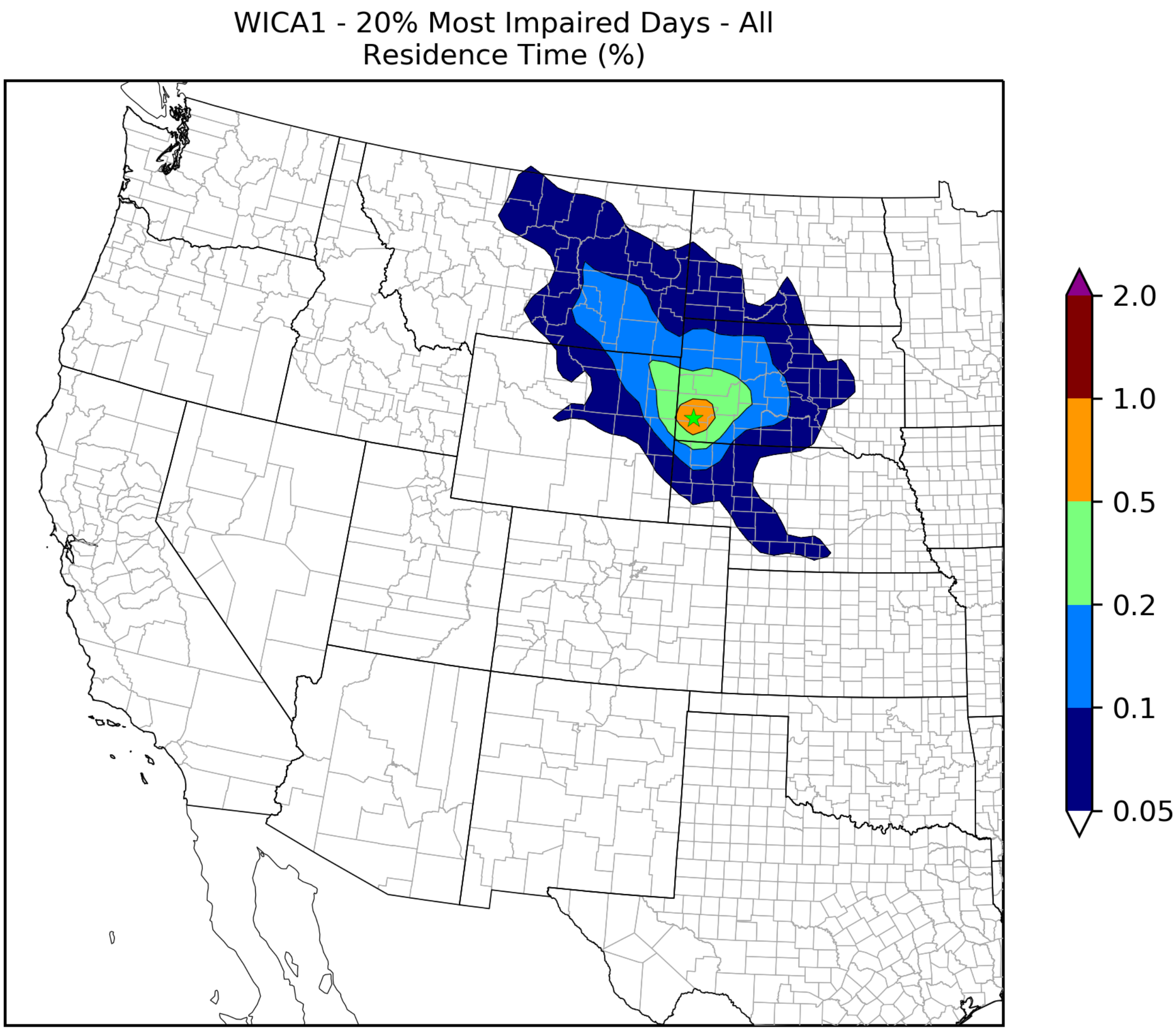


Figure 3-30 -- The residence time chart for Wind Cave National Park for the 20% Most Impaired Days



Extinction Weighted Residence Time (EWRT) plots were also provided, and are analyzed next. These plots were created in order to be able to account for not only where the air parcels traveled, but also the measured light extinction attributed to those air parcels due to sulfate, nitrate, elemental carbon, or organic aerosol. The plots are calculated by weighting the HYSPLIT Residence Time Trajectories by the monitored light extinction measured at any given IMPROVE site, on each of the 20% Most Impaired Days from 2014 through 2018. Weighting is performed so that not all the 20% Most Impaired Days are considered equal, since some of the 20% Most Impaired Days produced much more visibility impairment than other 20% Most Impaired Days, even though all 20% of the days are considered part of the "Most Impaired Days" group. Light extinction is weighted for sulfate, nitrate, organic aerosol, and elemental carbon at either 100m above the ground, 1000m above the ground, or both heights combined. Therefore, the analysis helps define areas with greater chances of negatively influencing visibility due to specific pollutants. Instead of only counting where all the back trajectories went in each of the grid cells of the analysis grid as was the case with the Residence Time plots, the EWRT plots are weighting the back trajectories based on the measured extinction so that the MIDs with higher extinction of a given pollutant are weighted more heavily than those days with lower extinction of the same pollutant. In other words, in addition to what the Residence Time plots display, the Extinction Weighted Residence Time plots ensure that areas which contributed to the 20% MIDs with the highest extinction are weighted more heavily than any other area. To see the effects of the weighting procedure on the Area of Influence geographic distributions, simply compare between the unweighted Residence Time plots and Extinction Weighted Residence Time plots. Results should vary slightly, and may vary for predictable reasons. For example, comparing between the RT plot and the NOx EWRT plot may show a larger area of influence concentrated towards a large metropolitan area or oil and gas fields. Or, if sulfate were compared instead, the area of influence distribution may be pulled more strongly towards a different area where more SO2 is being generated. In other cases a comparison between the plots may look very similar—this all just depends on how each specific IMPROVE site is potentially being impacted by each specific and unique area.

The extinction weighted residence time charts were created using the following equation:

Equation 3-2 -- The extinction weighted residence time equation

$$EWRT_{ij} = \sum_{k=1}^{N} b_{ext\,k} \tau_{ijk}$$

Where bextk is the extinction coefficient for the pollutant (either NO3 or SO4) measured at the arrival of the kth trajectory at the given IMPROVE site. The gridded EWRT values are also normalized in order to show the percentage of the domain total EWRT.

Once again, nitrate (NO3) is a major visibility impairing substance. Certain processes, including high-temperature combustion and certain soil microbe life processes, emit nitrogen oxides. Nitrogen oxides, NO and NO2, which are collectively referred to as NOx, then get converted to nitrate (NO3) in the atmosphere. Nitrate particulate matter mainly exists in the atmosphere as ammonium nitrate, which is a major contributor of visibility impairment in the form of light extinction. The primary manmade source of nitrate is motor vehicle exhaust. A secondary manmade source is the oxidation of nitrogen oxides produced from fossil fuel combustion, prescribed burning, and motor vehicle exhaust. A secondary natural source of nitrate is the oxidation of nitric oxides that are produced from lightning, forest fires, and soils from microbes.

Sulfate (SO4) is another major visibility impairing substance. Sulfates form when sulfur gases like SO2 and hydrogen sulfide oxidize to sulfuric acid, and then later combine with ammonia, creating ammonium sulfate particulate matter in the atmosphere. In the atmosphere, sulfates most often exist as ammonium bisulfate and ammonium sulfate, and lesser so as sulfuric acid. Once sulfate particles exist in the atmosphere, they are relatively stable, and can be removed through precipitation and also through settling. The primary natural source of sulfate is sea spray, and the secondary natural source is the oxidation of sulfur gasses emitted by forest fires, wetlands, oceans, and volcanoes. The primary manmade source is fossil fuel combustion (mainly coal), and the secondary manmade source is the oxidation of sulfur dioxide created from fossil fuel combustion. The ammonia which combines with the sulfate to create the particulate matter can come from wild animals, microbial processes, animal husbandry, dairy operations, ammonia slip during selective catalytic reduction control of NOx, sewage treatment, and through the application of fertilizers.

Extinction weighted residence time charts for both heights combined, for both nitrate (NO3) and sulfate (SO4), for both the Badlands and Wind Cave Class I Areas can be found below.

Regarding Figures 3-31 through 3-34, the same general observations can be seen as with the residence time plots, with a few exceptions. The first exception is when looking at the NO3 Extinction Weighted Residence Time plot for both Badlands and Wind Cave National Parks, the orientation isn't as northwest to southeast as before, but instead stretches a little further towards the northeast as well. A possible reason for this could be due to the location of the Baaken Oil Field. The second exception is that the EWRT plot probability areas seem to be slightly more expansive than the Residence Time plot probability areas, which may be attributed to the fact that large NO3 and SO4 emitting sources are further away; the weighting takes that into account whereas the purely meteorological data doesn't.

Figure 3-31 -- The ammonium nitrate extinction weighted residence time chart for Badlands National Park for the 20% Most Impaired Days

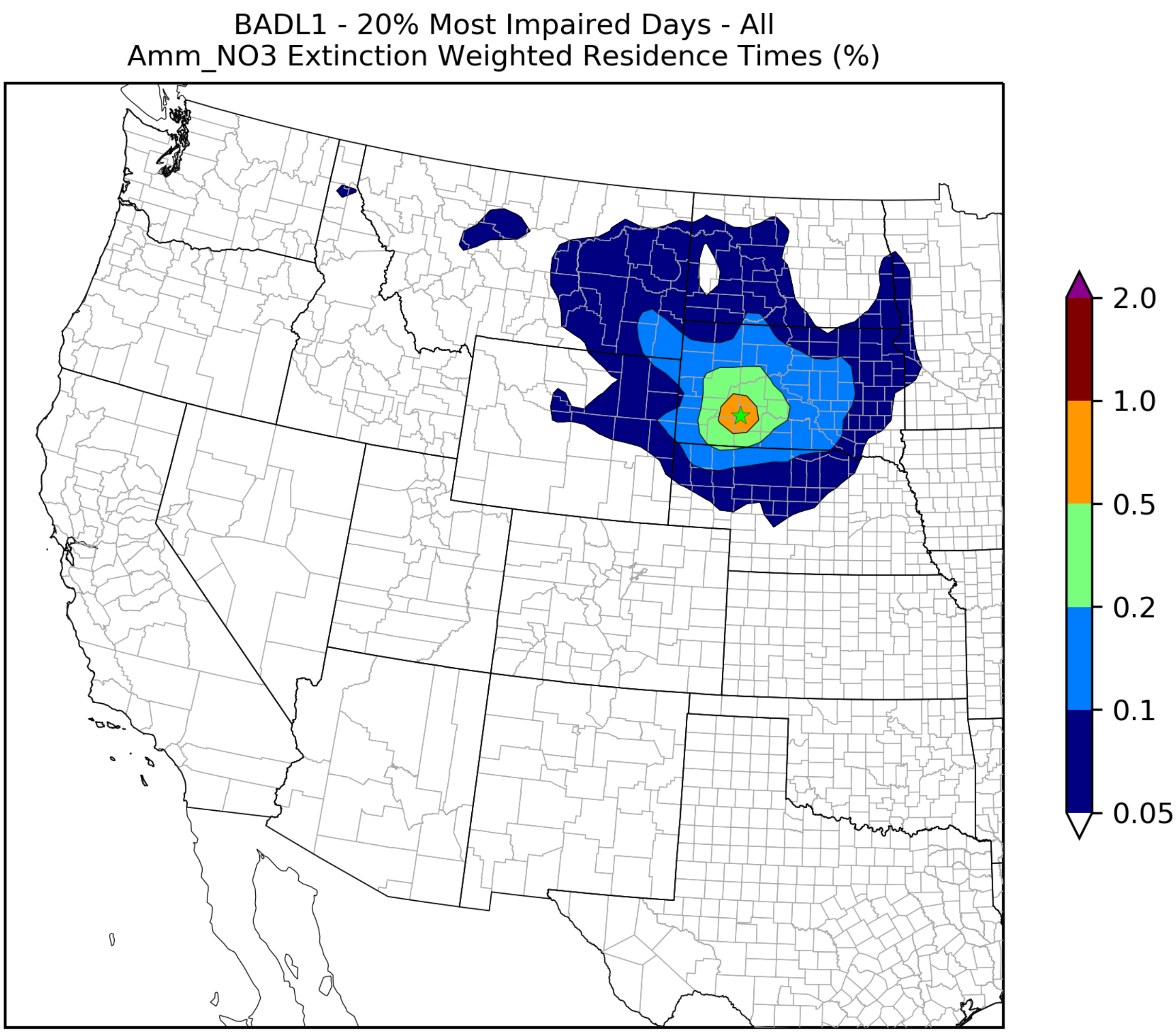


Figure 3-32 -- The ammonium sulfate extinction weighted residence time chart for Badlands National Park for the 20% Most Impaired Days

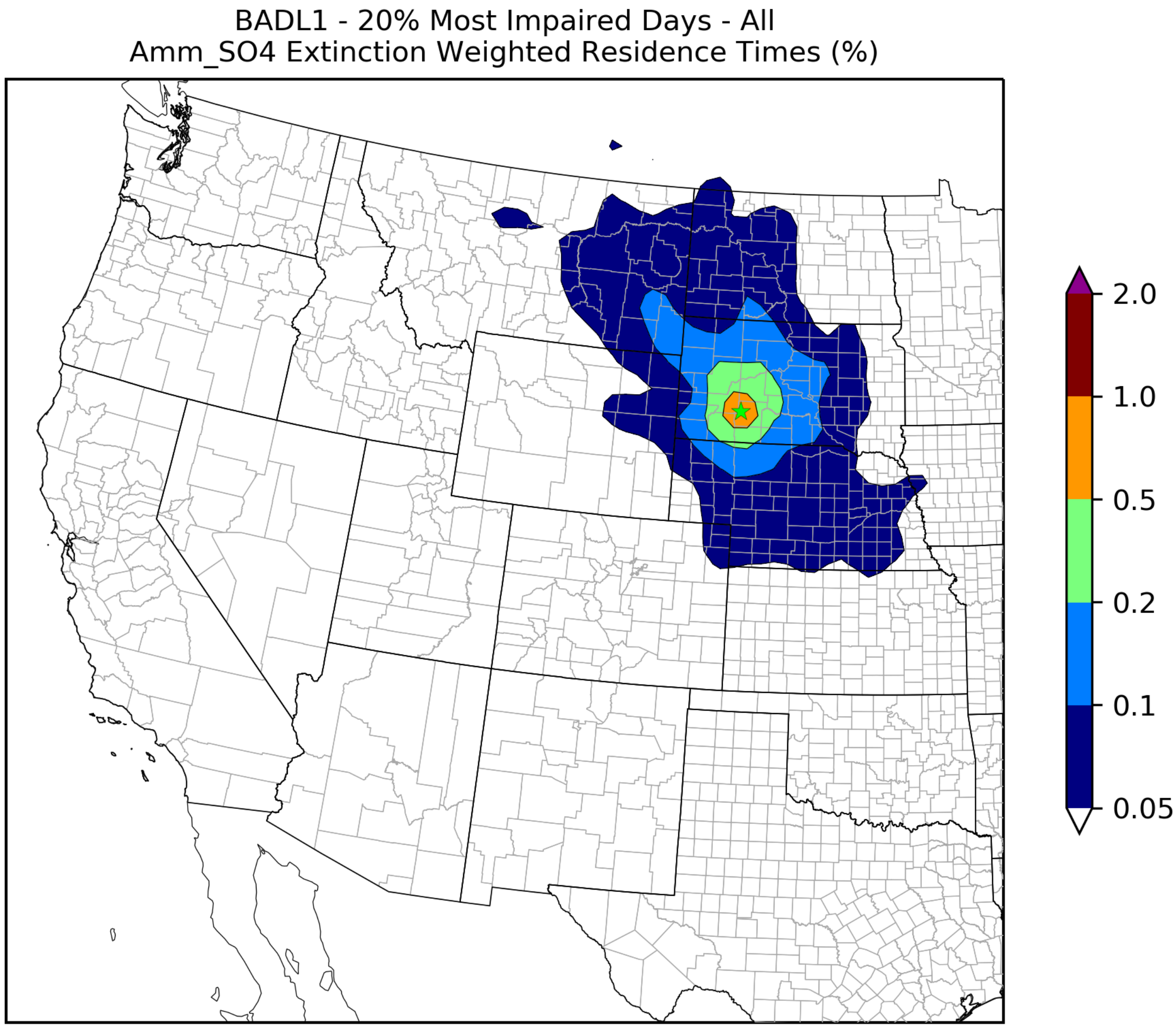


Figure 3-33 -- The ammonium nitrate extinction weighted residence time chart for Wind Cave National Park for the 20% Most Impaired Days

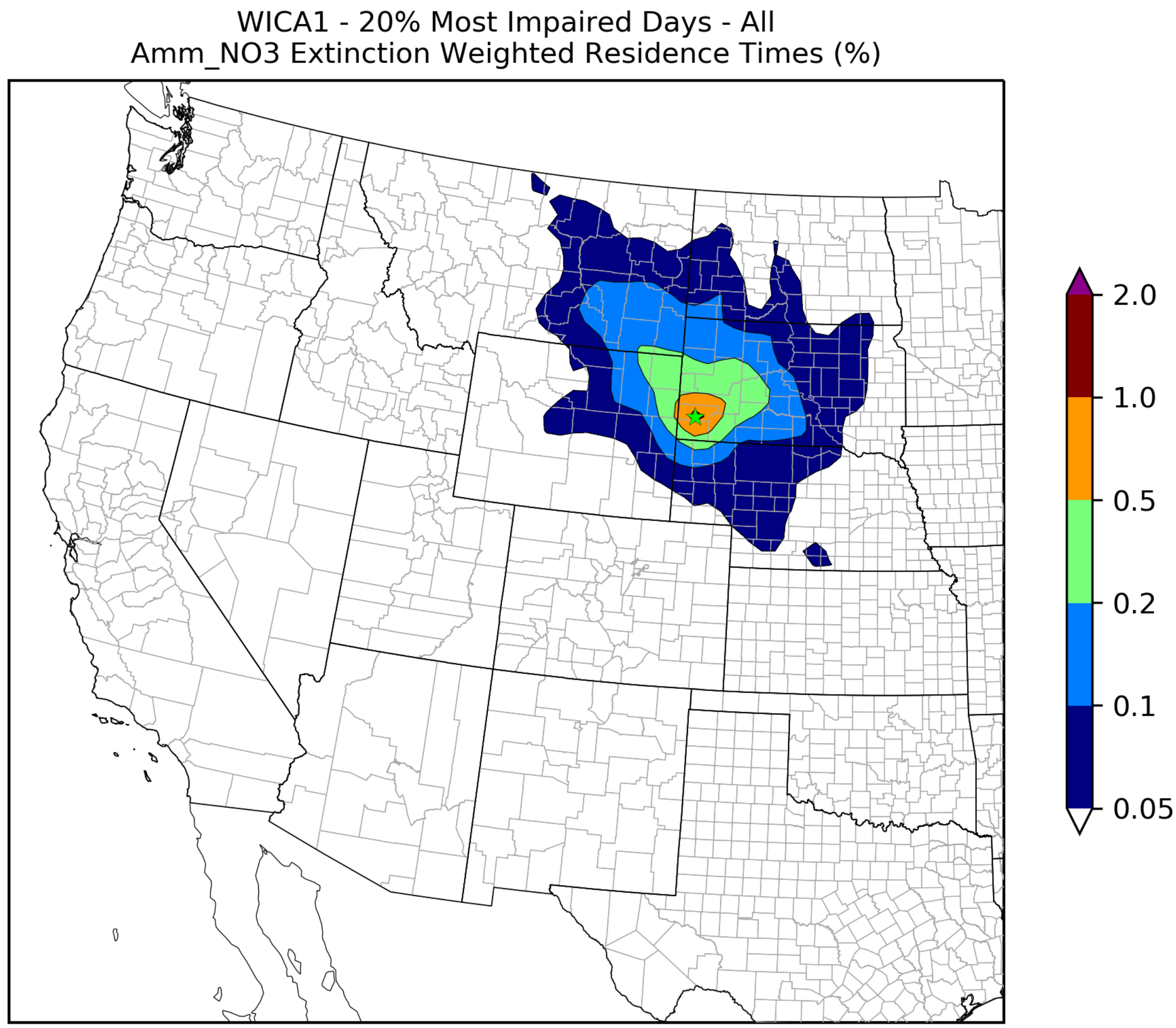
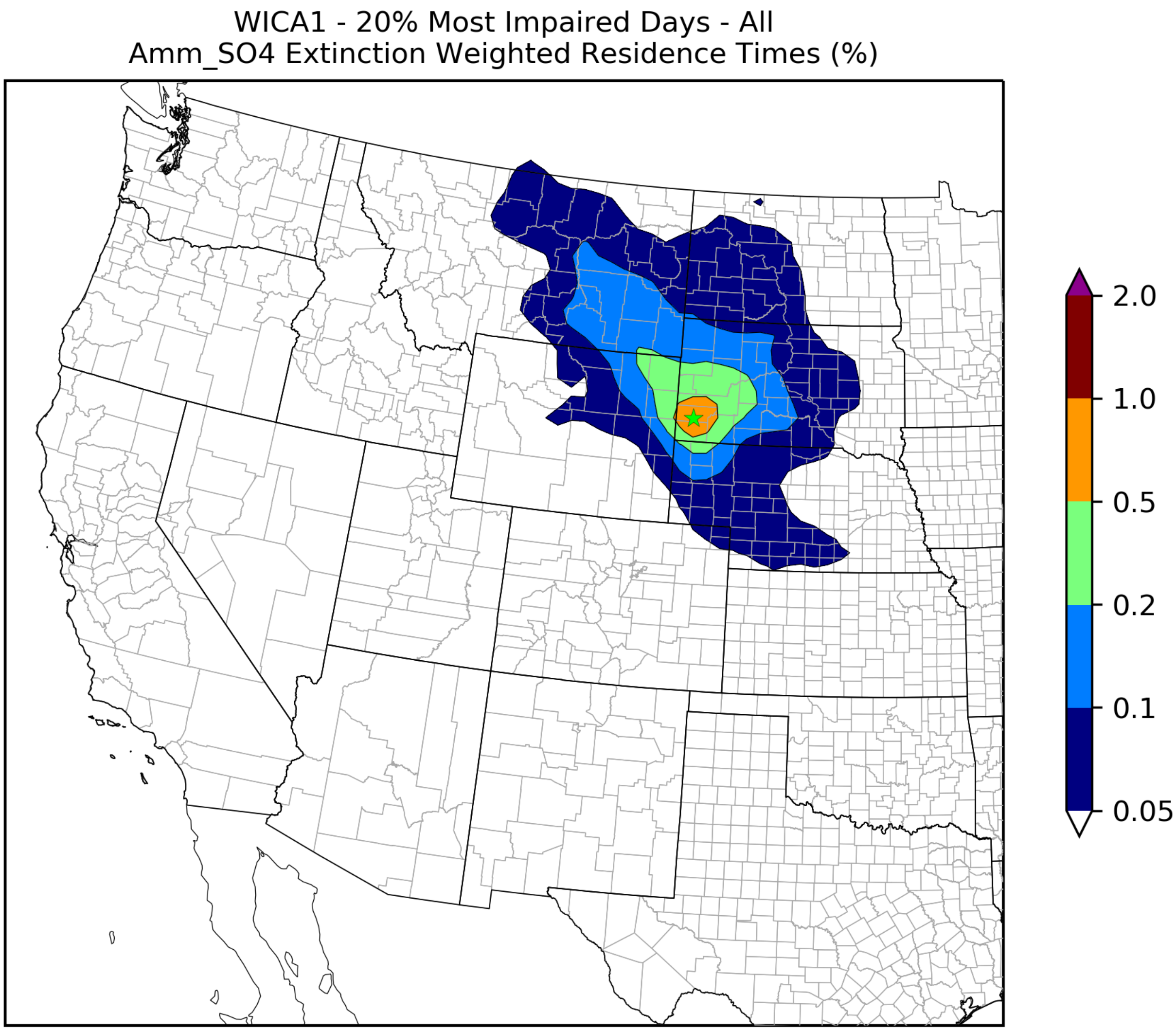


Figure 3-34 -- The ammonium sulfate extinction weighted residence time chart for Wind Cave National Park for the 20% Most Impaired Days



The Weighted Emissions Potential (WEP) analysis is next, and it combines the EWRT and the Q/d of a given pollutant, thus accounting for not only where the air parcels traveled, the emissions, and the measured extinction on the Most Impaired Days, but also the emission location and distance from the IMPROVE monitor. It overlays the EWRT results with the projected 2028 emissions of light extinction precursors from all the source sectors. These plots visually represent the geographic areas and sources which have the highest probability of causing visibility impairment at the specified Class I Area(s) during the 20% Most Impaired Days. The WEP analysis is available for the analyzed precursor emissions for the four major components of light extinction of ammonium nitrate (NOx), ammonium sulfate (SOx), elemental carbon (EC), and organic aerosol (POA), and for the air parcel trajectory arrival heights of 1000m, 100m, and all combined heights. Different emission source groups can also be compared to see how each group may be potentially impacting or contributing to light extinction visibility impairment on the MIDs.

Light green and dark green contours, or isopleths, exist on the WEP plots. These are the definition of the "Area of Influence," and integrate measured IMPROVE visibility extinction and air mass residence times—the same integration as in the EWRT plots. So they outline the areas of high EWRT. The light green isopleth corresponds to the 0.1 percent frequency from the corresponding EWRT plot, and thus matches the outline of the light blue area of the equivalent EWRT plot, and the darker green isopleth corresponds to the 0.5 percent frequency from the corresponding EWRT plot, and thus matches the outline of the orange area of the equivalent EWRT plot.

The WEP plots can identify many localized and other impacts from sources including large metropolitan areas, oil and gas fields, and even specific electric generating units, as the underlying grid cells show the gridded emissions data. This is calculated by combining the EWRT from the EWRT plots and the emissions of each grid cell, and also the distance of that grid cell to the IMPROVE monitor. In other words, the plots combine the Q/d with the EWRT which is again based on the calculated back trajectories. The analysis takes gridded emissions and weighs them by both distance from Class I Areas and by gridded residence times, and then normalizes them. The grid cell values are normalized by the total weighted emissions potential across all the grid cells in the domain (by the sum of the total anthropogenic WEP). Which means, the total WEP in each grid cell from electric generating units for example is being divided by the total anthropogenic WEP across the entire domain. Therefore the values are percentages, making comparing across source sectors possible. The grid cell color scale goes from purple, representing 10% of the entire WEP for the entire domain, to maroon representing 5%, to orange representing 3%, to yellow representing 1%, to indigo representing 0.5%, to blue representing 0.1%, to navy representing 0.05% of the entire WEP for the entire domain. Using electric generating units as an example, the plots account for the electric generating unit emissions in that WEP analysis, but the results are normalized by the total anthropogenic WEP so that the percentages displayed on the electric generating unit plot can be compared directly to the total anthropogenic plot or to any other source category. The total anthropogenic plot is the sum of all the individual plots. These plots thus are able to show the relative contribution of each area and each source category to potential visibility extinction for any selected pollutant at any given IMPROVE monitor on the MIDs.

Also to note, most emissions sources displayed and represented by the grid cells will likely be in or very near the displayed light green isopleth, but other grid cells may appear further away. The difference is that although both groups of sources have the potential to contribute to visibility impairment at the given Class I Area, the group closer to the IMPROVE monitor has a high EWRT but likely less significant emissions, whereas the group further away has more significant emissions but a lower EWRT.

The WEP plots are all available for viewing on the main TSS WEP page found at this URL: http://views.cira.colostate.edu/tssv2/WEP-AOI/ . The plots can also be downloaded via the shapefiles section on the same page. More information about the plots are also available on the same page.

The Weighted Emissions Potential analysis plots for aggregated trajectory heights for each of the four major components of light extinction and for the emissions from all seven source sectors plus total emissions during the 20% Most Impaired Days at both the Badlands and the Wind Cave Class I Area IMPROVE monitoring sites can be found below.

Regarding Figures 3-35 and 3-36, a wide geographic distribution of NOx emission sources are potentially affecting Badlands National park. Although the Area of Influence primarily includes areas within the state of South Dakota, many grid cells are lit up outside of that Area of Influence, including many yellow and orange cells. Therefore many of South Dakota's neighboring states may also be contributing to visibility impairment due to NOx emissions. Regarding the SOx chart, again, the Area of Influence outlined in the light green isopleth primarily encloses areas inside South Dakota, however not many grid cells are lit up within that area. Instead, the only three purple grid cells that exist are located in neighboring states, indicating at least 30% of the estimated visibility impacts are coming from those sources instead.

Regarding Figures 3-37 and 3-38, the majority of NOx emissions that affect Wind Cave National Park seem to be emanating from the Black Hills area in South Dakota, and also from eastern Wyoming, as both the light green isopleth Area of Influence and the majority of the yellow and orange grid cells are at those locations. The few exceptions are a yellow grid cell located in southeast Wyoming, and another yellow grid cell located in Nebraska. Regarding the SOx plot, a much different story can be seen. Here, although the Area of Influence still includes mainly western South Dakota, northeast Wyoming and southeast Montana, not many grid cells are lit up within that area. Instead, the majority of the orange, yellow, and purple grid cells are located outside the Area of Influence, and all in the neighboring states of North Dakota, Nebraska, and Wyoming. Another interesting observation is the prominent cluster of blue, yellow, and navy grid cells in the western part of North Dakota, within the Baaken Oil Field. This would indicate that that Baaken Oil Field activity is also potentially negatively impacting visibility at Wind Cave National Park.

Figure 3-35 -- The NOx Weighted Emissions Potential map for the 20% Most Impaired Days at Badlands National Park

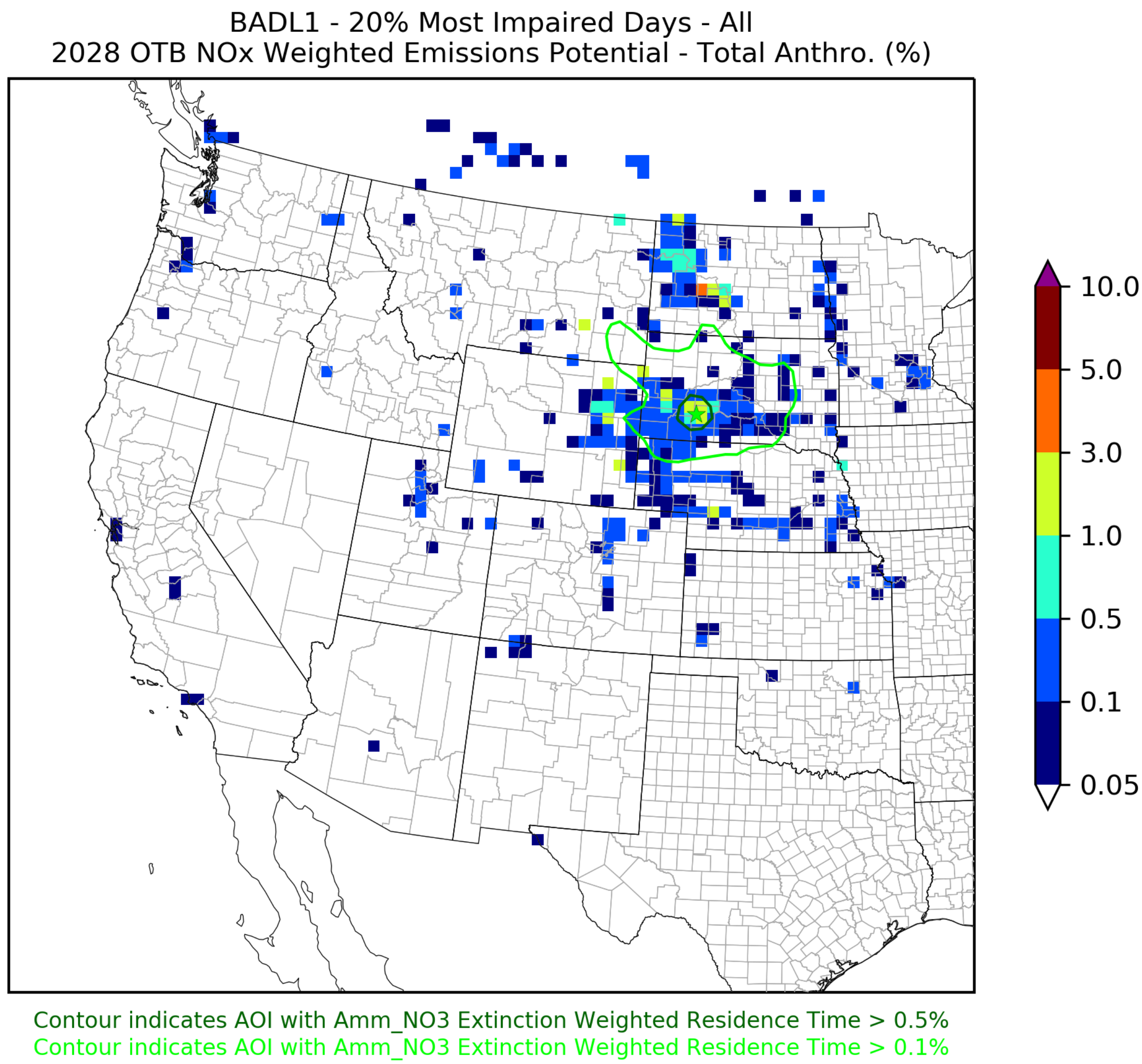


Figure 3-36 -- The SOx Weighted Emissions Potential map for the 20% Most Impaired Days at Badlands National Park

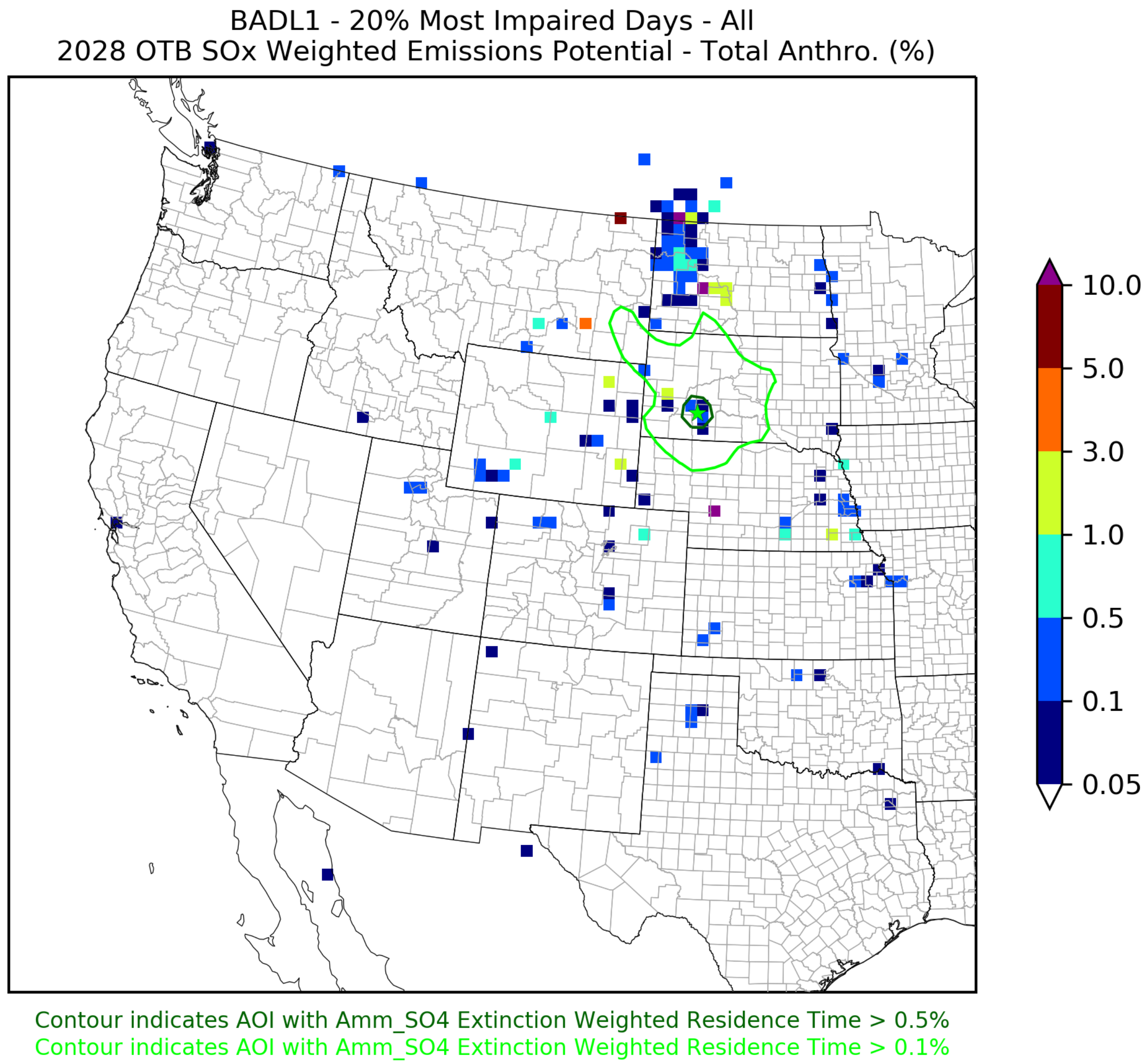


Figure 3-37 -- The NOx Weighted Emissions Potential map for the 20% Most Impaired Days at Wind Cave National Park

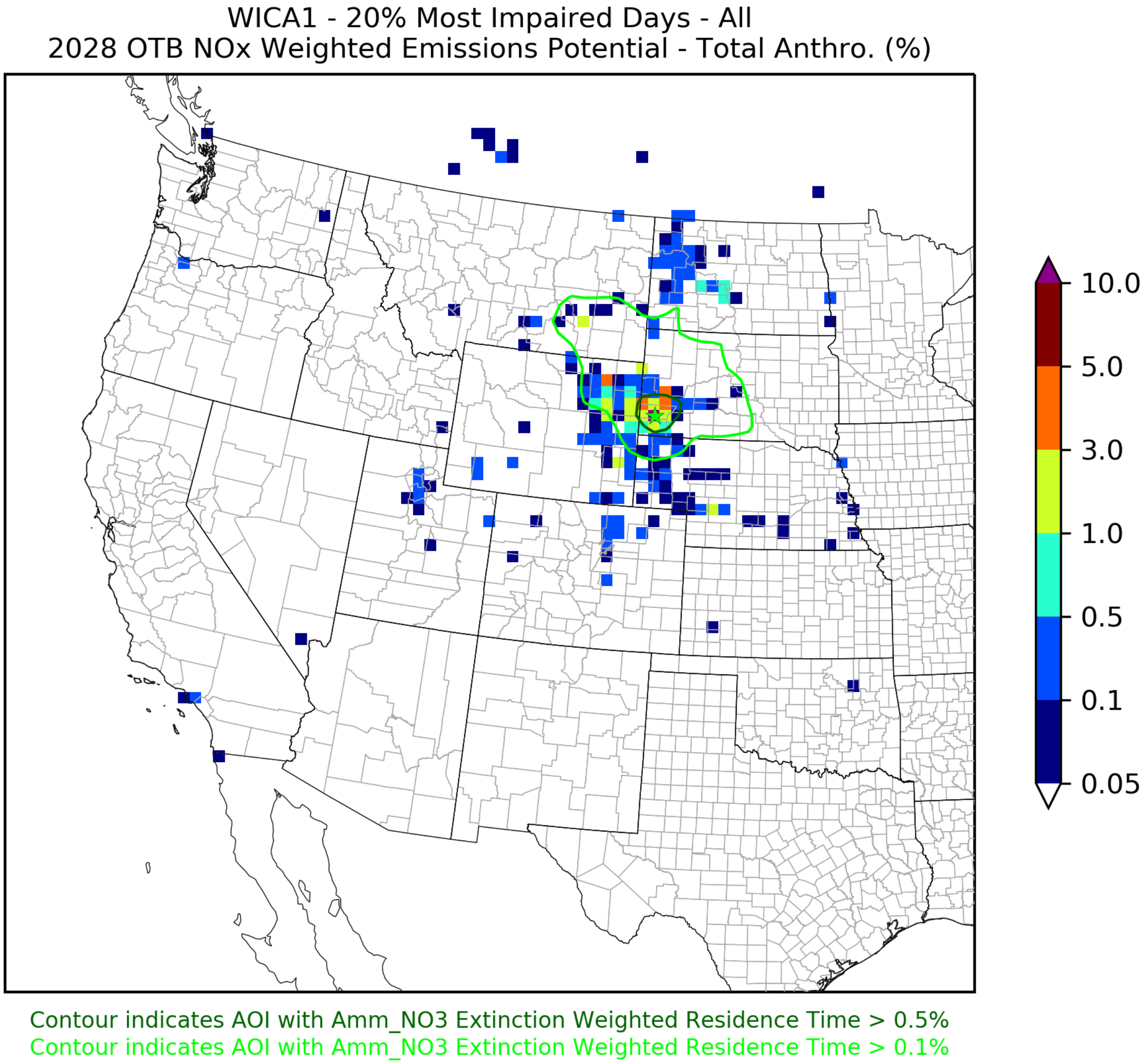
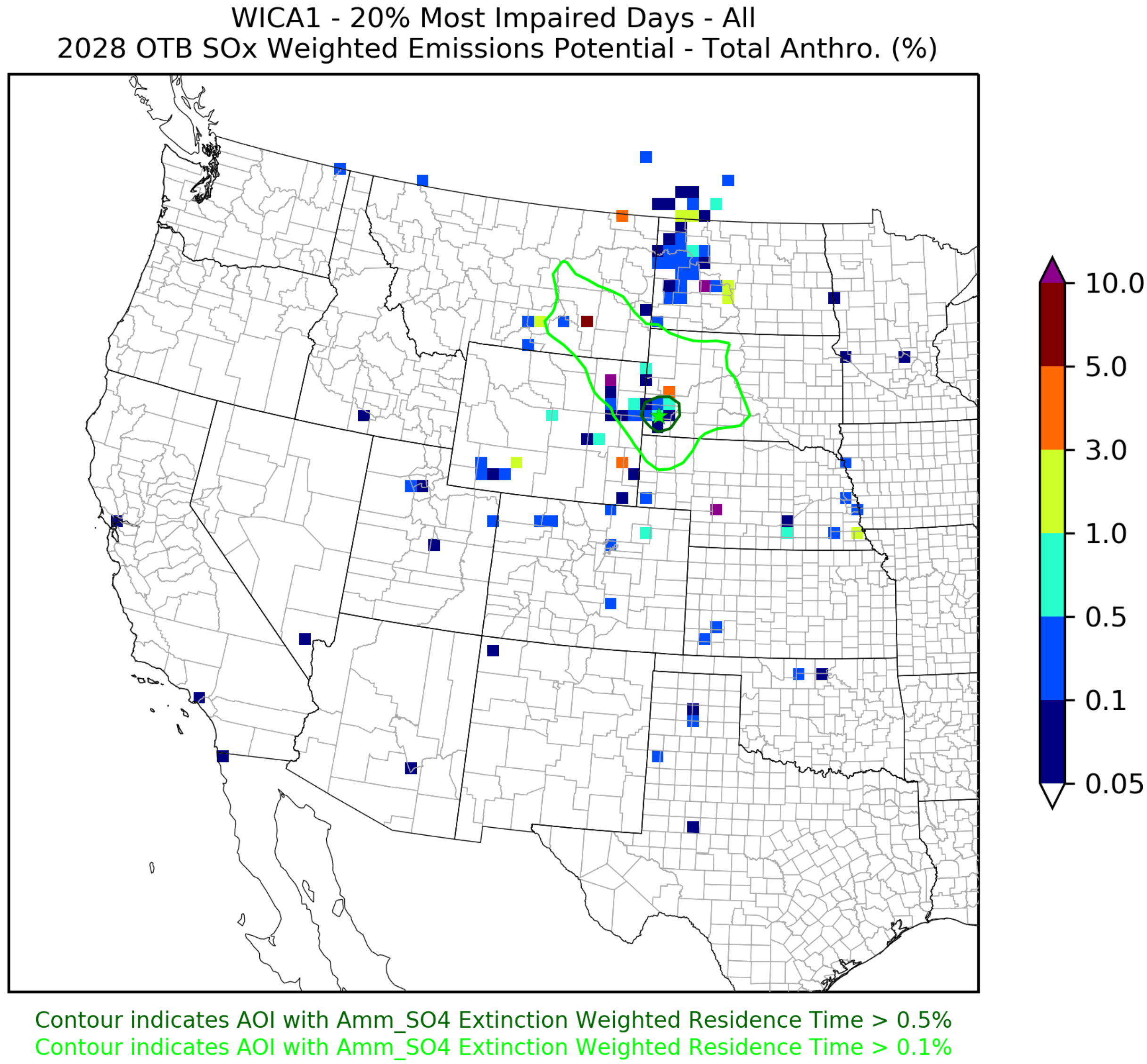


Figure 3-38 -- The SOx Weighted Emissions Potential map for the 20% Most Impaired Days at Wind Cave National Park



Regarding Figures 3-39 through 3-46, these represent a grouping of WEP plots from a representative sample of some of the nearest Class I Areas to South Dakota. An effort was made to determine how much of a potential visibility impact South Dakota sources of NOx and SOx were projected to have on other nearby Class I Areas. Without exception, the plots show that South Dakota's NOx and SOx emissions likely have an insignificant negative visibility impairing effect on other Class I Areas. Theodore Roosevelt National Park is the only Class I Area whose Area of Influence stretches into South Dakota's borders, but only a small portion in the northern and western areas of the state. Furthermore, none of the charts show grid cells lit up in South Dakota, also indicating no significant effects may be coming from sources inside the state. These plots are all in agreement that South Dakota NOx and SOx emission sources likely do not significantly negatively affect the visibility at any neighboring state Class I Areas.

Figure 3-39 -- The NOx Weighted Emissions Potential map for the 20% Most Impaired Days at the Theodore Roosevelt Class I Area in North Dakota

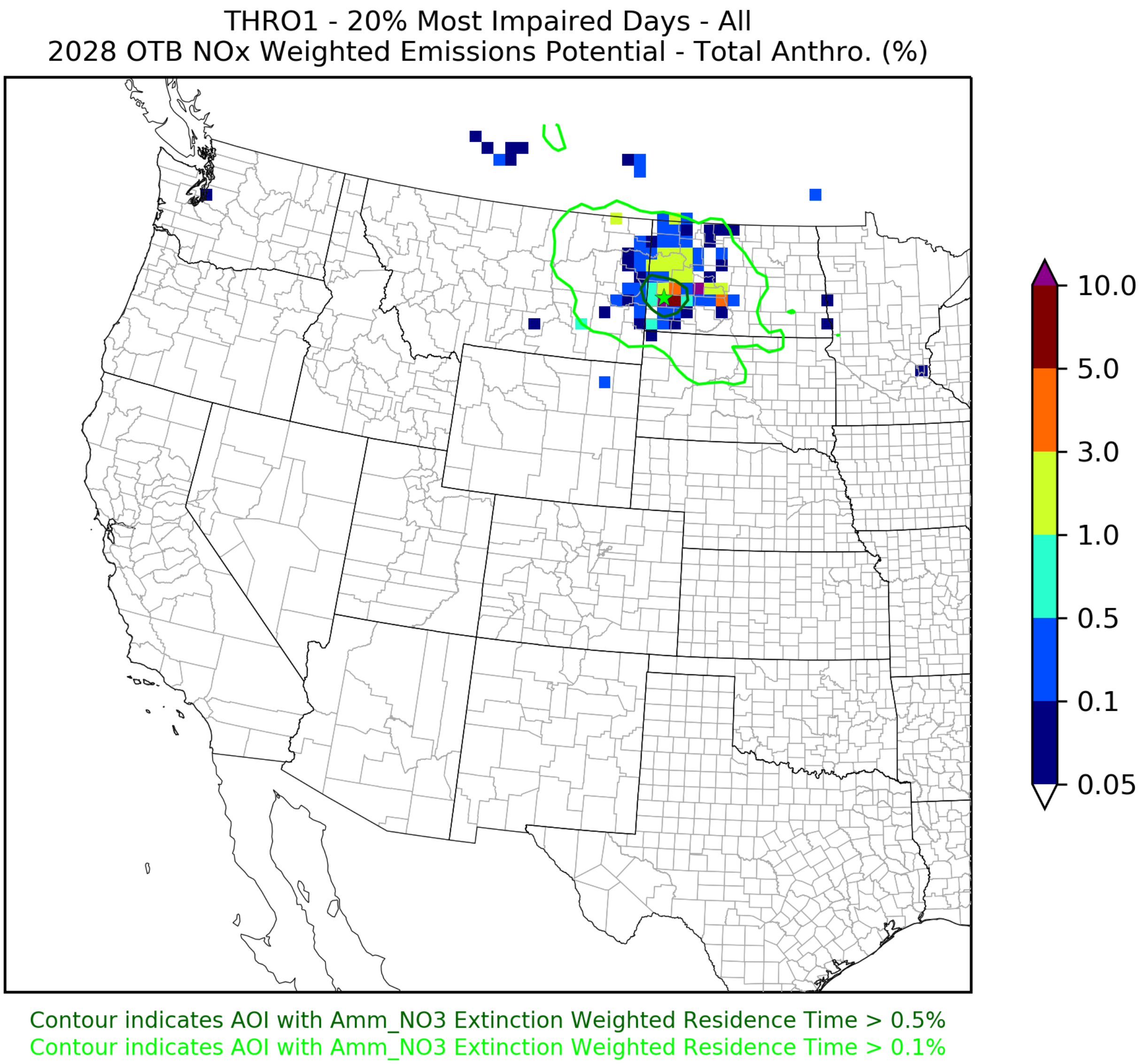


Figure 3-40 -- The SOx Weighted Emissions Potential map for the 20% Most Impaired Days at the Theodore Roosevelt Class I Area in North Dakota

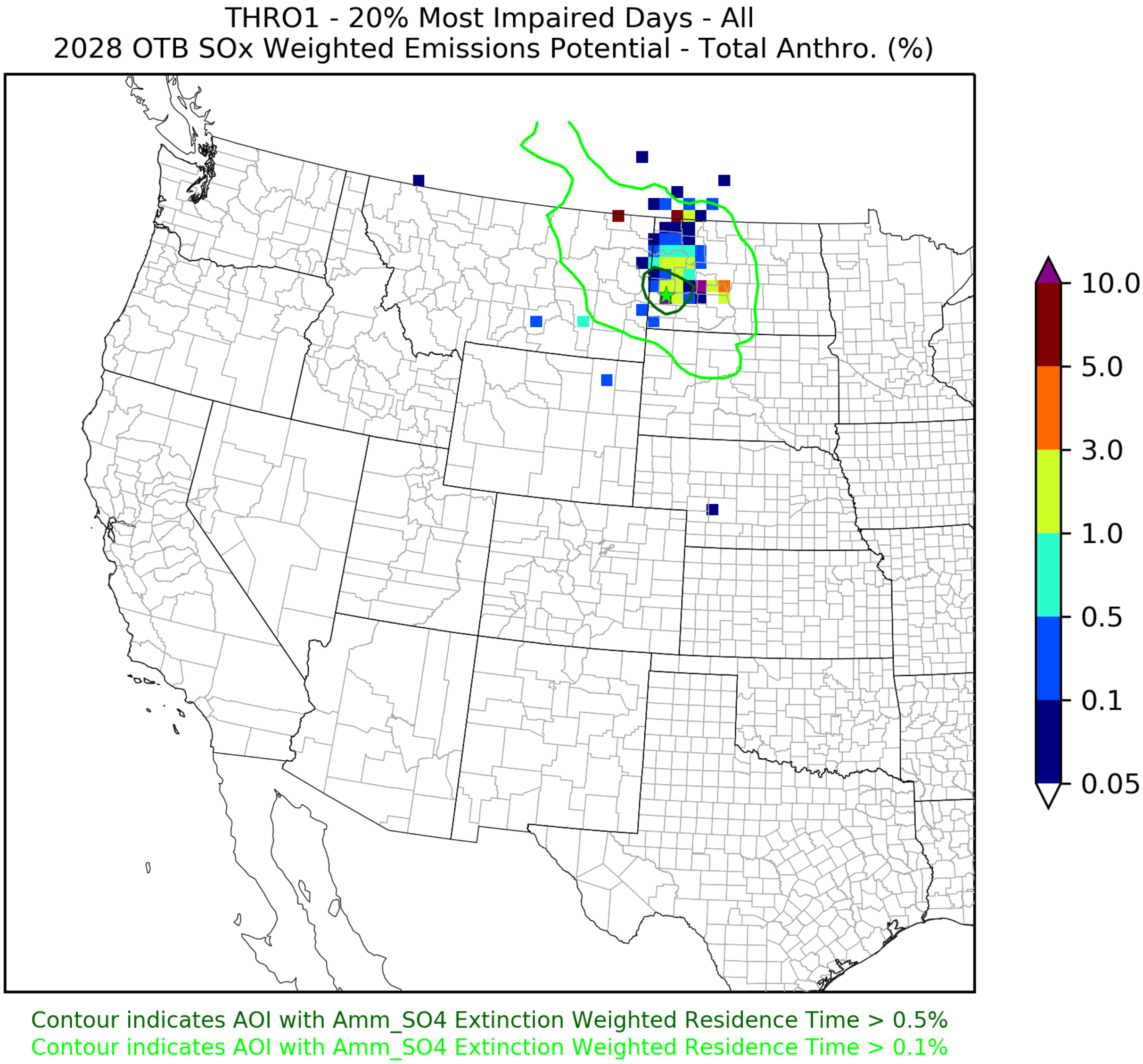


Figure 3-41 -- The NOx Weighted Emissions Potential map for the 20% Most Impaired Days at the Mount Zirkel Class I Area in Colorado

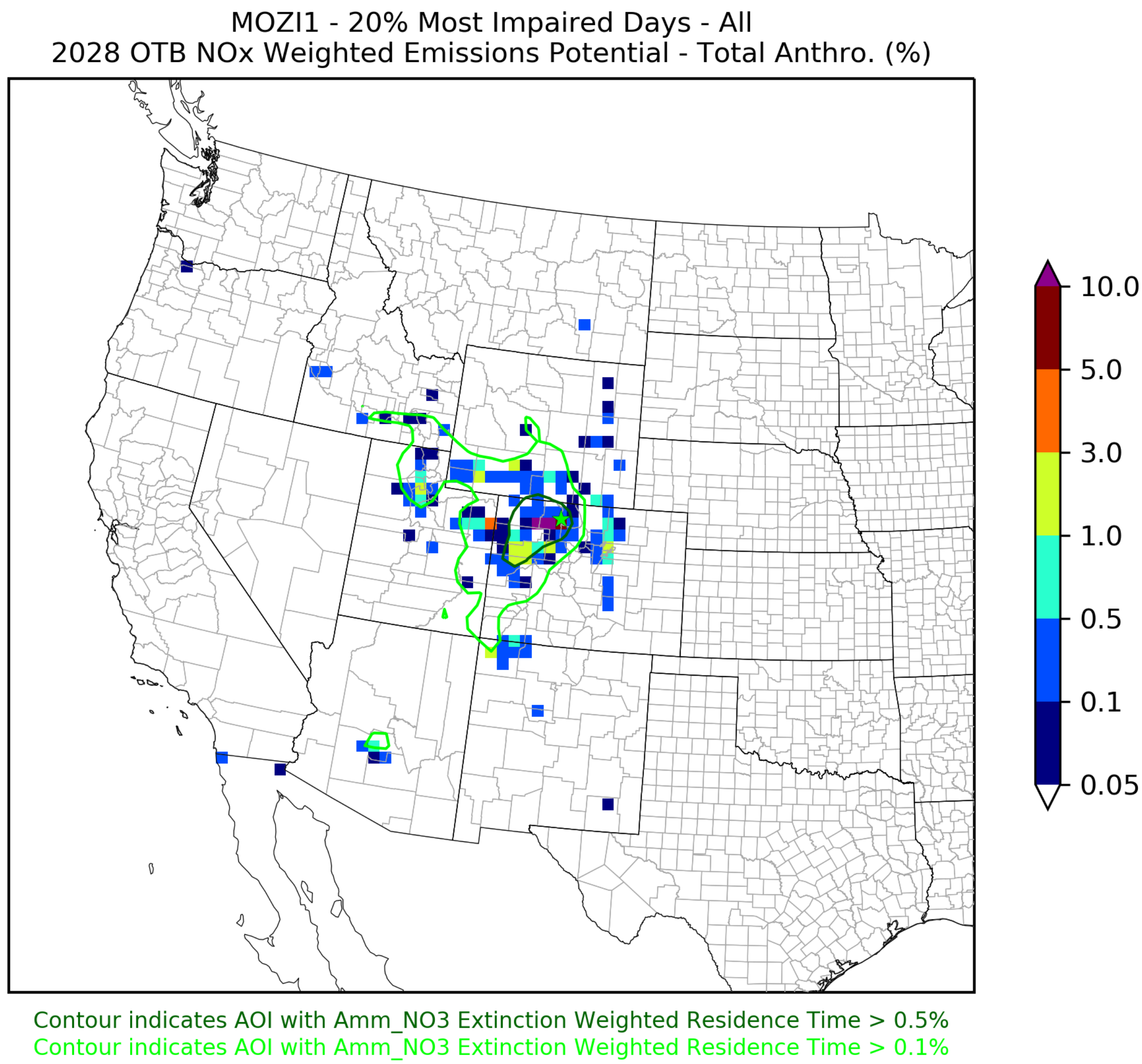


Figure 3-42 -- The SOx Weighted Emissions Potential map for the 20% Most Impaired Days at the Mout Zirkel Class I Area in Colorado

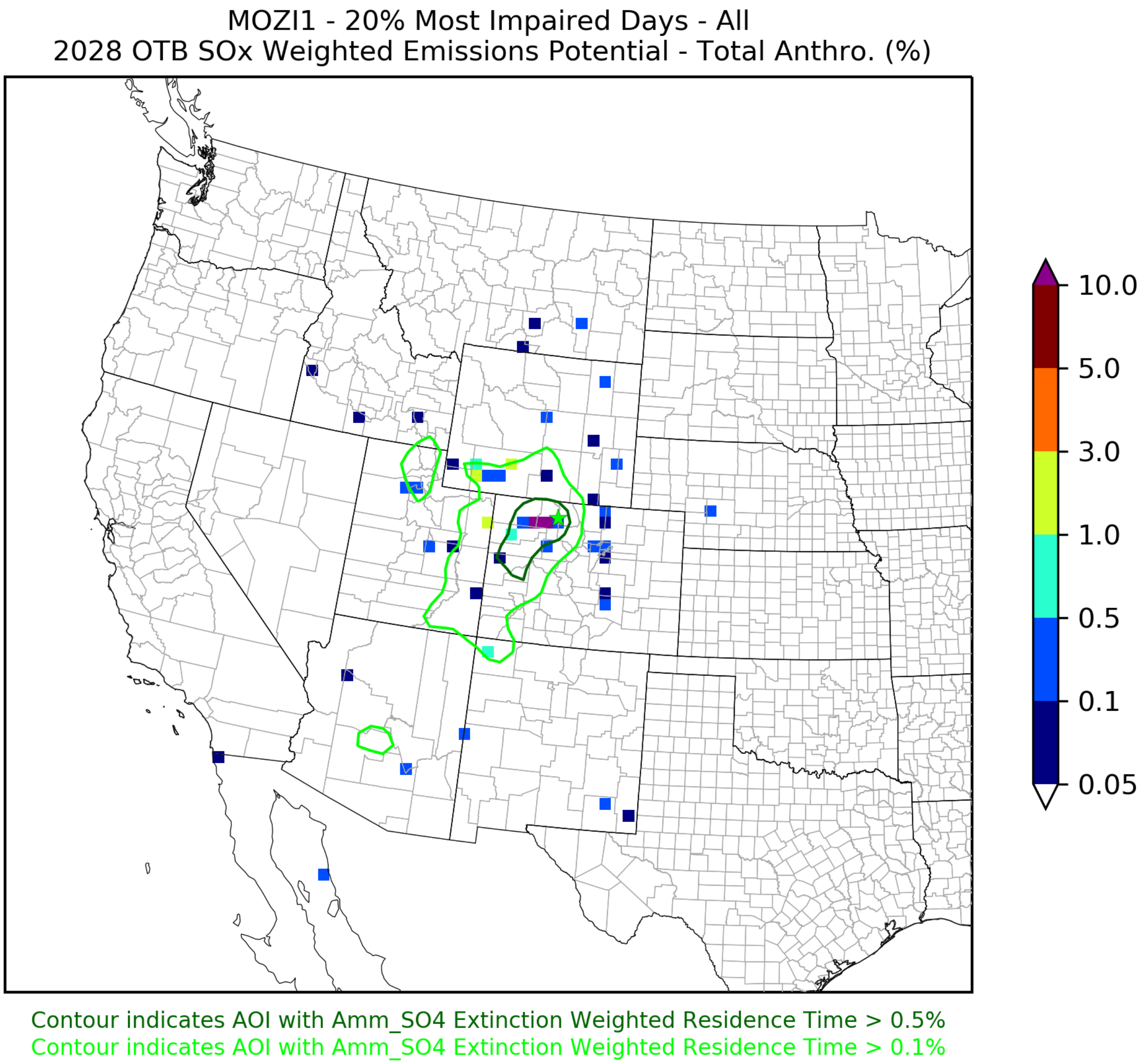


Figure 3-43 -- The NOx Weighted Emissions Potential map for the 20% Most Impaired Days at the Bridger Class I Area in Wyoming

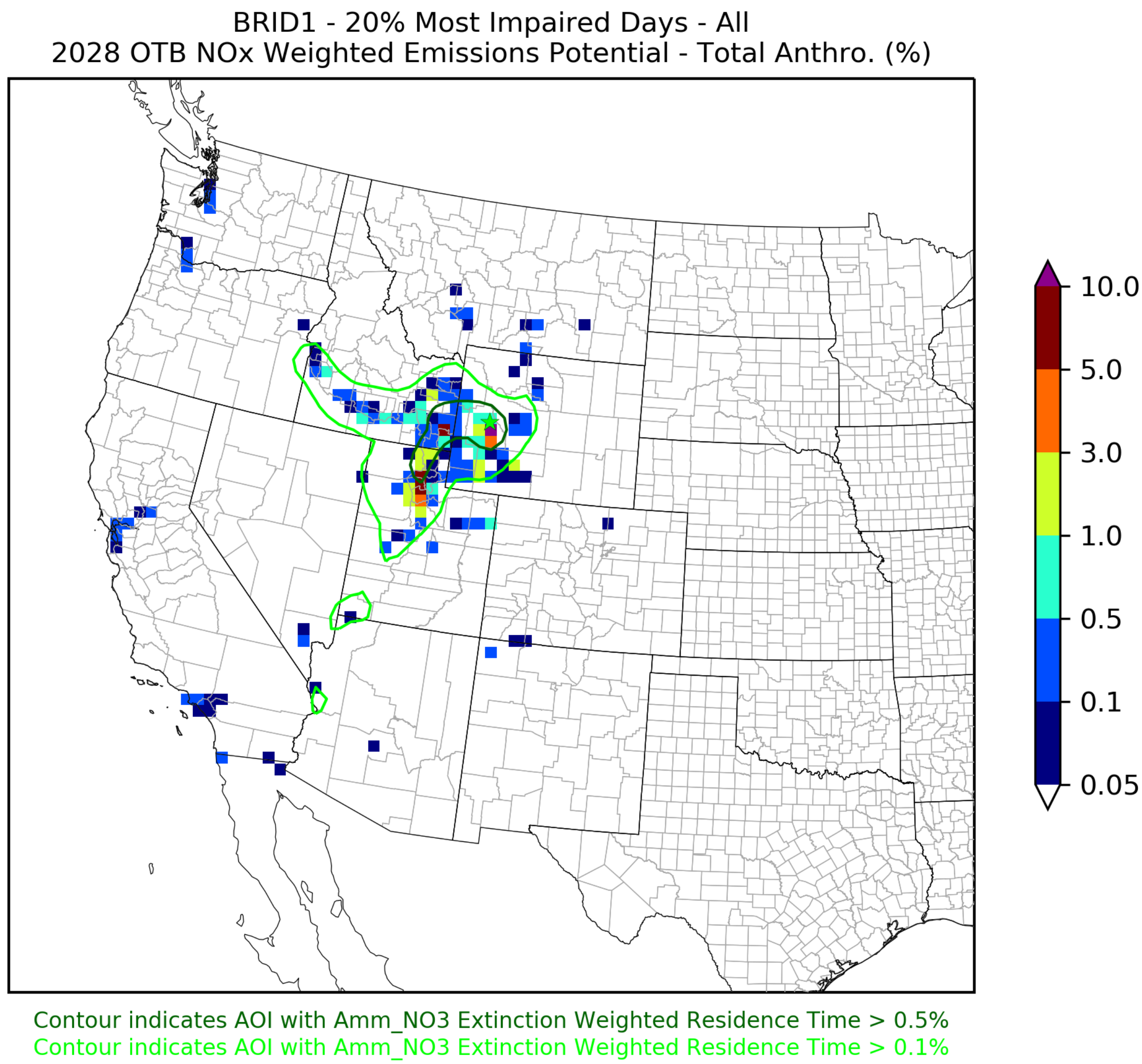


Figure 3-44 -- The NOx Weighted Emissions Potential map for the 20% Most Impaired Days at the Bridger Class I Area in Wyoming

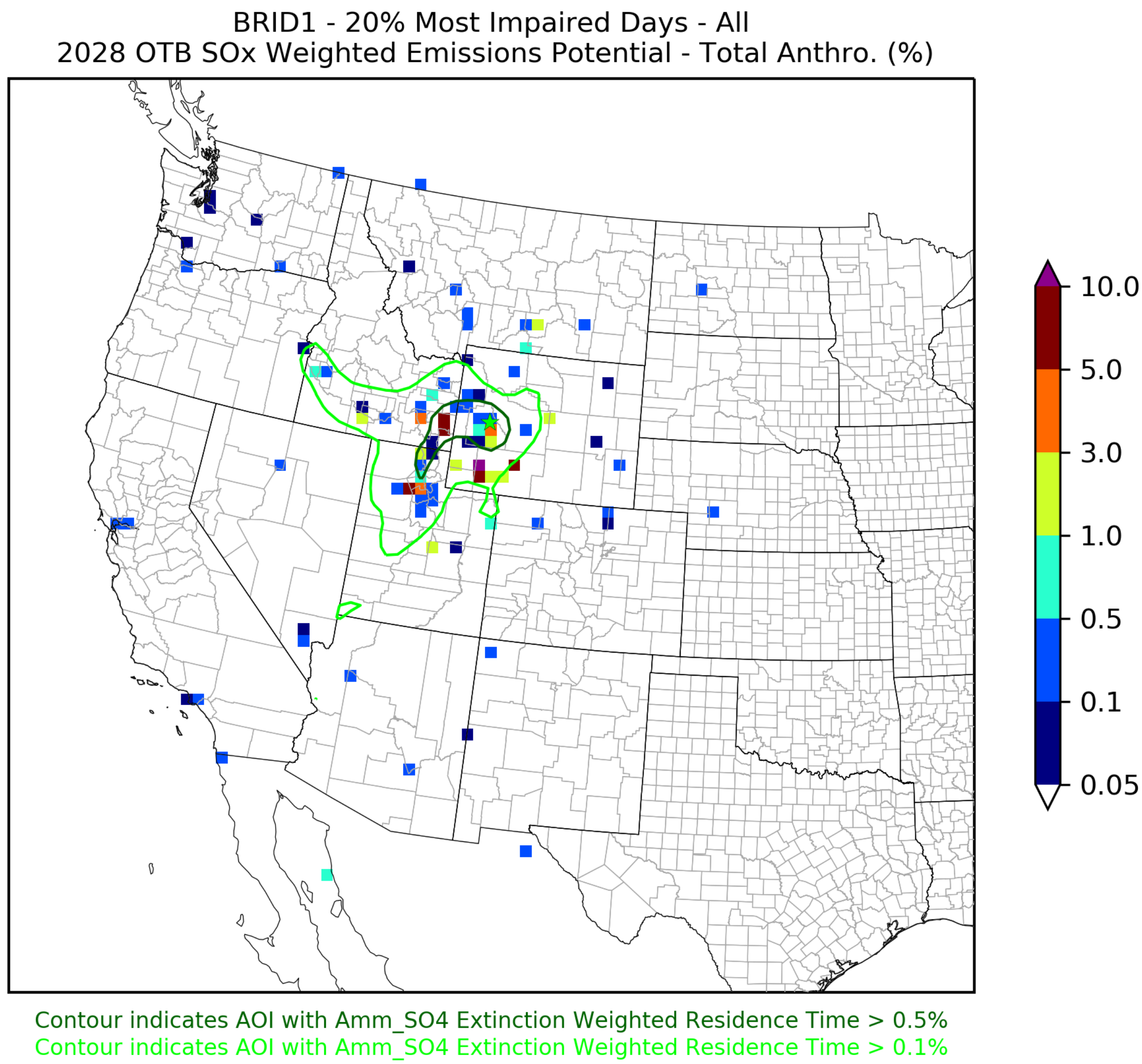


Figure 3-45 -- The NOx Weighted Emissions Potential map for the 20% Most Impaired Days at the UL Bend Class I Area in Montana

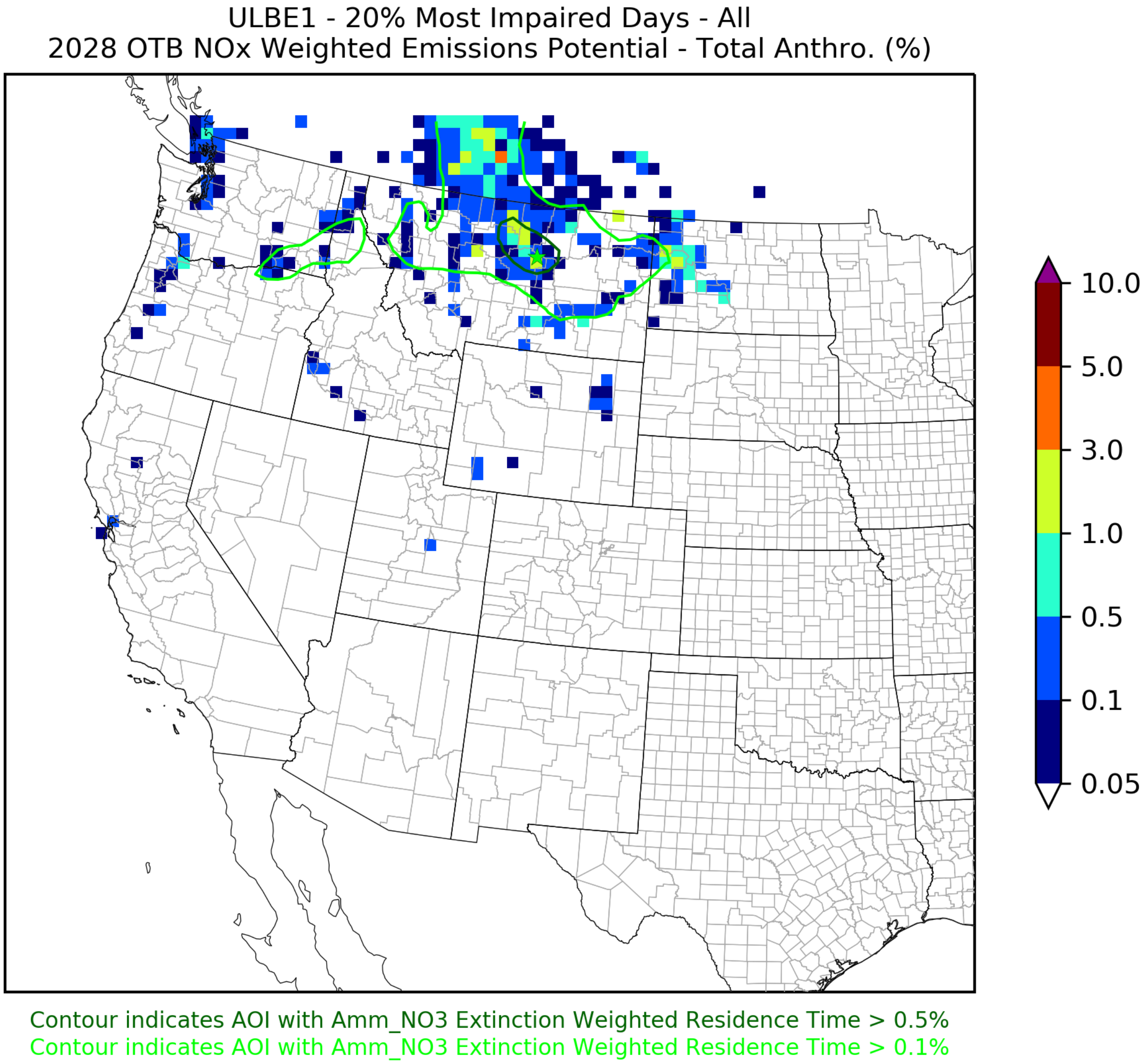
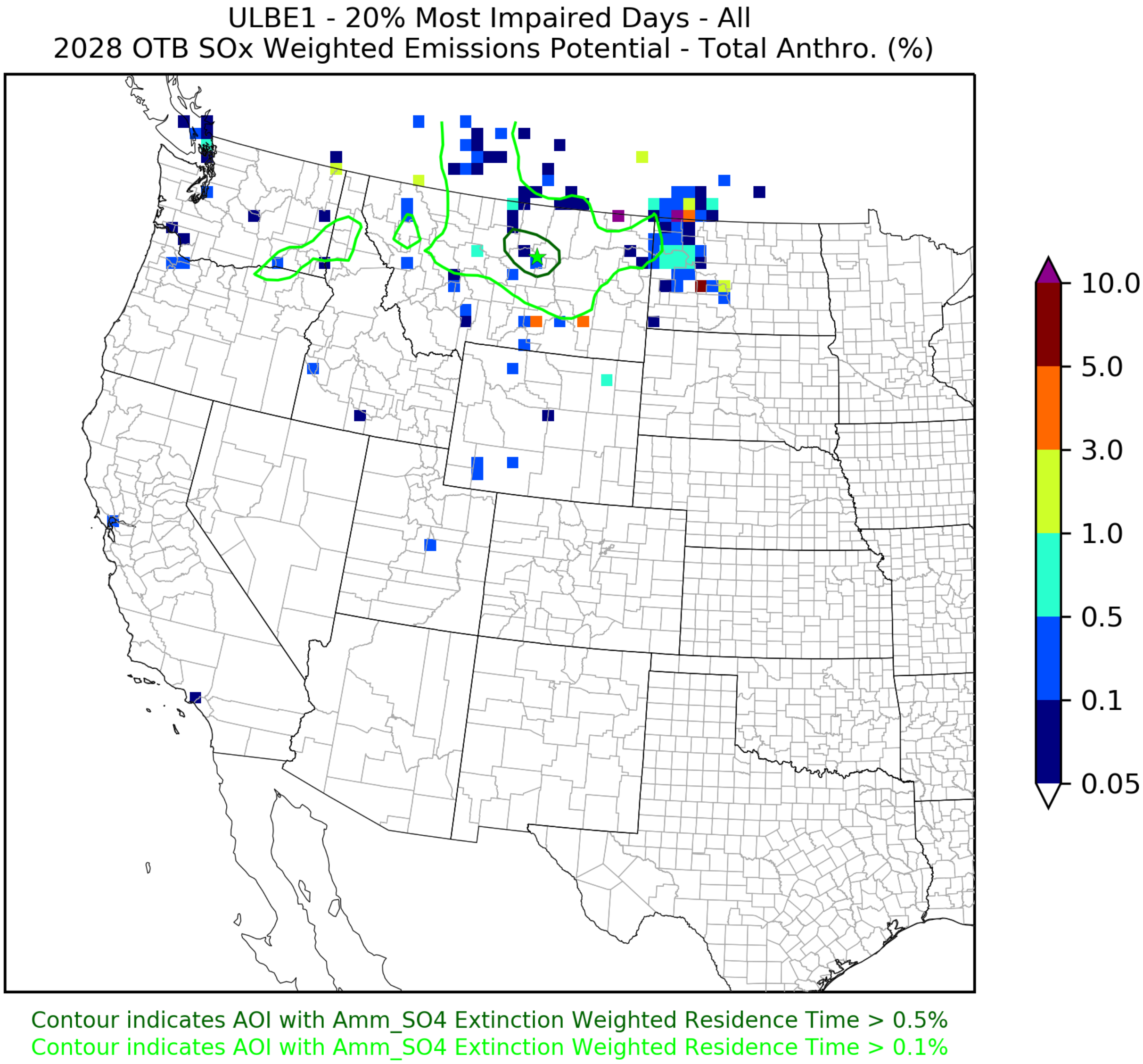


Figure 3-46 -- The SOx Weighted Emissions Potential map for the 20% Most Impaired Days at the UL Bend Class I Area in Montana



Rank point files were also provided through the WEP/AOI analysis conducted by Ramboll, also known as the facility-level WEP analysis. These files show, relatively speaking and on a facility-by-facility level, which facilities have the greatest potential of negatively affecting visibility at Class I Areas through light extinction from projected 2028 NOx and SO2 emissions. These rank point facility WEP values are relative and unitless, which means the values are not probabilities, only rankings—no given number such as 5,000 or 10,000 can be considered "significant" or can be used as a cutoff threshold. There is no quantification regarding what the potential impacts may be, or the probability of impacts, it's just saying the impact to a certain CIA is "X" relative to the other facilities included in the analysis. The relative ranking system can only provide decision makers a better idea about which sources are potentially contributing to visibility impairment at various Class I Areas-- which have higher or lower potential to contribute to visibility extinction on the MIDs. Again, The spreadsheet ranks the facilities by their WEP NO3 or WEP SO4 value, providing a relative comparison between facilities, helping decision makers determine which facilities have the greatest chances of negatively affecting visibility at various Class I Areas.

This analysis combines the EWRT and the facility-level Q/d for a given pollutant. The spreadsheet calculates each of the sources' individual WEPs, not the WEP of each grid cell, which allows for a greater level of detail. The spreadsheets do not show the gridded emissions of each sector (i.e. electric generating units) as was the case with the WEP plots grid cells. And once again, the Rank Point files also don't account for atmospheric chemistry including chemical transformation, or deposition, both important and complex factors, it just accounts for the path the air parcels took.

The Rank point spreadsheet files include the following information for each facility: an ID number, the facility name, latitude and longitude, state location, North American Industry Classification System (NAICS) number, NAICS description, 2014 NOx (tons per year from the projected 2028OTBa2 emissions), SOx (tons per year from the projected 2028OTBa2 emissions), the grid cell of the facility in the 12WUS2 modeling domain (aggregated to 36km resolution) in the format of row (i)*1000 + column (j), distance of each facility to various Class I Areas, EWRT NO3 IJ or EWRT SO4 IJ which is either the ammonium nitrate or ammonium sulfate extinction weighted residence time for the grid cell of the facility—in other words determining which of the grid cells the individual point source is in and then extracting the EWRT, Q/D NOx or Q/D SO2 which is either the facility's NOx or SO2 emissions in tons/year divided by the distance to the IMPROVE monitor in kilometers, EWRT*Q NO3 or EWRT*Q SO4 which is either the ammonium nitrate or ammonium sulfate extinction weighted residence time for the grid cell of the facility (at IJ) multiplied by the facility-level NOx or SO2 emissions (Q), and finally either the WEP NO3 or WEP SO4 which combines the EWRT NO3 or SO2 value and the distance and the NOx or SO2 emissions.

The below tables show the top 30 potentially visibility impairing facilities from the Rank Point spreadsheets for both NO3 and SO4 at both the Badlands and Wind Cave National Parks.

Regarding Table 3-12, of the top 30 WEP NO3 facilities affecting Badlands National Park, four come from within South Dakota's borders, with GCC Dacotah ranking fourth overall, and Pete Lien And Sons Inc. ranking 14th overall. Coyote Station in North Dakota, Milton R. Young Station in North Dakota, and Colstrip Steam Electric Station in Montana each have higher WEP NO3 values than GCC Dacotah, with the NPPD Gerald Gentleman Station in Nebraska ranking fifth overall. Although it is important to reduce the visibility impairing effects of anthropogenic NO3 at Badlands National Park, given these results, it would be unfair to GCC Dacotah if it were expected to incur the costs of additional controls before the three facilities with higher WEP NO3 scores were to do so.

Regarding Table 3-13, of the top 30 WEP SO4 facilities affecting Badlands National Park, two come from within South Dakota's borders, with GCC Dacotah ranking tenth overall. Nine facilities total from Nebraska, North Dakota, Wyoming, and Montana rank higher. Although it is important to reduce the visibility impairing effects of anthropogenic SO4 at Badlands National Park, given these results, it would be unfair to GCC Dacotah if it were expected to incur the costs of additional controls before the other nine facilities with higher WEP SO4 scores were to do so.

Regarding Table 3-14, of the top 30 WEP NO3 facilities affecting Wind Cave National Park, five come from within South Dakota's borders, with GCC Dacotah ranking first overall, and Pete Lien And Sons Inc. ranking seventh overall. Although GCC Dacotah ranks first in potential NO3 visibility impairing impacts according to the WEP results, it is also important to look at the bigger visibility impairment picture at Wind Cave National Park, according to the source apportionment results. Many figures in the above sections show the relative importance of reducing NO3 compared to other pollutants in improving visibility at Wind Cave National Park. It is clear that reducing U.S. prescribed fires would provide most of the visibility improvements. Furthermore, comparing between U.S. anthropogenic NO3 to SO4 visibility impairment, SO4 impairment is just as large of a concern. A concern of South Dakota's is, if NO3-reducing control measures were installed at GCC Dacotah, that the resulting ammonia slip would cause particulate matter (PM) 2.5 and particulate matter (PM) 10 concentrations to increase in the Rapid City area. The Rapid City area has historically had issues attaining the NAAQS (National Ambient Air Quality Standards) for the PM2.5 and PM10 parameters, so adding any extra particulate matter to the ambient air in the vicinity would be detrimental to human health.

Regarding Table 3-15, of the top 30 WEP SO4 facilities affecting Wind Cave National Park, one comes from within South Dakota's borders, GCC Dacotah, ranking sixth in potential impacts overall. Five facilities total from Nebraska, North Dakota, Wyoming, and Montana rank higher. Although it is important to reduce the visibility impairing effects of anthropogenic SO4 at Wind Cave National Park, given these results, it would be unfair to GCC Dacotah if it were expected to incur the costs of additional controls before the other five facilities with higher WEP SO4 scores were to do so.

Regarding Tables 3-16 through 3-41, an effort was made to provide a similar analysis as in tables 3-12 through 3-15, but instead of looking at visibility impairing impacts from South Dakota facilities on Class I Areas in South Dakota, Class I Areas outside the state in neighboring states to South Dakota were analyzed. Specifically, of the top 30 facilities affecting all the nearest Class I Areas outside South Dakota's borders, only one South Dakota facility was shown to negatively impact visibility at all. This facility was Big Stone Power Plant, owned and operated by Otter Tail Power Company, Montana-Dakota Utilities Company, and NorthWestern Energy, and it was shown to negatively affect visibility at both the Voyageurs Class I Area in Minnesota, and the Lost Woods Class I Area in North Dakota. Regarding the Voyageurs Class I Area in Minnesota, Big Stone Power Plant ranks 12th for NO3, and 12th for SO4. Regarding the Lost Woods Class I Area in North Dakota, Big Stone Power Plant ranks 29th for NO3 and 17th for SO4. Because Big Stone Power Plant incurred Best Available Retrofit Technology controls during the first implementation period, it will not be subject to consideration for additional controls during this second implementation period. These tables show very similar results to the preceding WEP AOI charts which analyzed the same concept.

Table 3-12 -- A comparison of the top 30 facilities based on their WEP NO3 value for the Badlands Class I Area

Rank	Facility Name	State	NAICS Description	WEP NO3
1	Coyote Station	ND	Fossil Fuel Electric Power Generation	84098.74

2	Milton R. Young Station	ND	Fossil Fuel Electric Power Generation	73872.75
3	COLSTRIP STEAM ELECTRIC STATION	MT	Fossil Fuel Electric Power Generation	73484.08
4	GCC Dacotah	SD	Cement Manufacturing	65883.83
5	NPPD Gerald Gentleman Station	NE	Fossil Fuel Electric Power Generation	53681.32
6	North Antelope Rochelle Mine	WY	Coal Mining	51715.9
7	Laramie River Station	WY	Fossil Fuel Electric Power Generation	48282.8
8	Leland Olds Station	ND	Fossil Fuel Electric Power Generation	42459.38
9	Antelope Valley Station	ND	Fossil Fuel Electric Power Generation	37315.79
10	Coal Creek Station	ND	Fossil Fuel Electric Power Generation	33696.95
11	Wyodak Plant	WY	Fossil Fuel Electric Power Generation	30734.24
12	Great Plains Synfuels Plant	ND	Natural Gas Distribution	27756.53
13	Colony East and West Plants	WY	Clay and Ceramic and Refractory Minerals Mining	27300.15
14	Pete Lien And Sons Inc	SD	Lime Manufacturing	22259.19
15	MIDAMERICAN ENERGY CO - GEORGE NEAL SOUTH	IA	Fossil Fuel Electric Power Generation	15033.87
16	MIDAMERICAN ENERGY CO - GEORGE NEAL NORTH	IA	Fossil Fuel Electric Power Generation	12833.63
17	Black Thunder Mine	WY	Bituminous Coal and Lignite Surface Mining	10149.11
18	Williston Basin Interstate Pipeline Company	SD	Pipeline Transportation of Natural Gas	9704.07
19	WALTER SCOTT JR ENERGY CTR	IA	Fossil Fuel Electric Power Generation	9499.26
20	Antelope Mine	WY	Bituminous Coal and Lignite Surface Mining	8888.11
21	COLSTRIP ENERGY LTD PARTNERSHIP	MT	Fossil Fuel Electric Power Generation	8183.09
22	Jim Bridger Plant	WY	Fossil Fuel Electric Power Generation	7657.72
23	Dave Johnston	WY	Fossil Fuel Electric Power Generation	7377.39
24	Colony Plant	WY	Clay and Ceramic and Refractory Minerals Mining	6923.37
25	Hilight Gas Plant	WY	Oil and Gas Extraction	6826.94
26	Bonanza	TR	Fossil Fuel Electric Power Generation	6436.4
27	Otter Tail Power Company	SD	Fossil Fuel Electric Power Generation	6346.68
28	NPPD Sheldon Station	NE	Fossil Fuel Electric Power Generation	6272.93
29	Dry Fork Station	WY	Fossil Fuel Electric Power Generation	6121.32
30	Westar Energy - Jeffrey	KS	Fossil Fuel Electric Power Generation	6029.90

Table 3-13 -- A comparison of the top 30 facilities based on their WEP SO4 value for the Badlands Class I Area

Rank	Facility Name	State	NAICS Description	WEP SO4
1	NPPD Gerald Gentleman Station	NE	Fossil Fuel Electric Power Generation	463959.2
2	Coyote Station	ND	Fossil Fuel Electric Power Generation	267211.7
3	Antelope Valley Station	ND	Fossil Fuel Electric Power Generation	248657.9

4	Great Plains Synfuels Plant	ND	Natural Gas Distribution	89846.26
5	COLSTRIP STEAM ELECTRIC STATION	MT	Fossil Fuel Electric Power Generation	71782.79
6	Coal Creek Station	ND	Fossil Fuel Electric Power Generation	71373.47
7	Laramie River Station	WY	Fossil Fuel Electric Power Generation	65221.81
8	Milton R. Young Station	ND	Fossil Fuel Electric Power Generation	47663.53
9	NPPD Sheldon Station	NE	Fossil Fuel Electric Power Generation	45952.71
10	GCC Dacotah	SD	Cement Manufacturing	35783.02
11	Wyodak Plant	WY	Fossil Fuel Electric Power Generation	30067.76
12	Leland Olds Station	ND	Fossil Fuel Electric Power Generation	29251.61
13	Whelan Energy Center	NE	Fossil Fuel Electric Power Generation	22851.64
14	OPPD Nebraska City Station	NE	Electric Power Distribution	21851.02
15	Jim Bridger Plant	WY	Fossil Fuel Electric Power Generation	19137.17
16	Lost Cabin Gas Plant	WY	Crude Petroleum and Natural Gas Extraction	18847.24
17	COLSTRIP ENERGY LTD PARTNERSHIP	MT	Fossil Fuel Electric Power Generation	18475.44
18	PUBLIC SERVICE CO PAWNEE PLT	CO	Fossil Fuel Electric Power Generation	15361.44
19	MIDAMERICAN ENERGY CO - GEORGE NEAL SOUTH	IA	Fossil Fuel Electric Power Generation	13725.92
20	Dave Johnston	WY	Fossil Fuel Electric Power Generation	12855.03
21	Dry Fork Station	WY	Fossil Fuel Electric Power Generation	12245.87
22	MIDAMERICAN ENERGY CO - GEORGE NEAL NORTH	IA	Fossil Fuel Electric Power Generation	10819.4
23	YELLOWSTONE POWER PLANT	MT	Other Electric Power Generation	9344.44
24	WALTER SCOTT JR ENERGY CTR	IA	Fossil Fuel Electric Power Generation	8980.22
25	Green River Works	WY	Potash, Soda, and Borate Mineral Mining	8603.05
26	Otter Tail Power Company	SD	Fossil Fuel Electric Power Generation	8215.44
27	KREMLIN	OK	All Other Petroleum and Coal Products Manufacturing	7884.78
28	Lon D Wright Power Plant	NE	Fossil Fuel Electric Power Generation	7652.88
29	Colony East and West Plants	WY	Clay and Ceramic and Refractory Minerals Mining	7482.16
30	Xcel Energy - Sherburne Generating Plant	MN	Fossil Fuel Electric Power Generation	6837.31

Table 3-14 -- A comparison of the top 30 facilities based on their WEP NO3 value for the Wind Cave Class I Area

Rank	Facility Name	State	NAICS Description	WEP NO3
1	GCC Dacotah	SD	Cement Manufacturing	172502.5
2	Wyodak Plant	WY	Fossil Fuel Electric Power Generation	156326
3	COLSTRIP STEAM ELECTRIC STATION	MT	Fossil Fuel Electric Power Generation	120687.7
4	Laramie River Station	WY	Fossil Fuel Electric Power Generation	95365.15
5	NPPD Gerald Gentleman Station	NE	Fossil Fuel Electric Power Generation	88375.74
6	North Antelope Rochelle Mine	WY	Coal Mining	72840.86

7	Pete Lien And Sons Inc	SD	Lime Manufacturing	56732.86
8	Colony East and West Plants	WY	Clay and Ceramic and Refractory Minerals Mining	53750.41
9	Milton R. Young Station	ND	Fossil Fuel Electric Power Generation	53261.96
10	Black Thunder Mine	WY	Bituminous Coal and Lignite Surface Mining	33498.72
11	Coal Creek Station	ND	Fossil Fuel Electric Power Generation	33178.98
12	Dry Fork Station	WY	Fossil Fuel Electric Power Generation	30126.79
13	Coyote Station	ND	Fossil Fuel Electric Power Generation	27534.38
14	WYGEN Station I	WY	Fossil Fuel Electric Power Generation	25536.71
15	Neil Simpson Two	WY	Fossil Fuel Electric Power Generation	25520.22
16	Hilight Gas Plant	WY	Oil and Gas Extraction	21812.09
17	Rapid City Regional	SD	Airport Operations	21251.74
18	Countertops Inc	SD	Reconstituted Wood Product Manufacturing	19002.08
19	Newcastle Refinery	WY	Petroleum Refineries	18433.88
20	Williston Basin Interstate Pipeline Company	SD	Pipeline Transportation of Natural Gas	17692.75
21	Jim Bridger Plant	WY	Fossil Fuel Electric Power Generation	16748.2
22	Dave Johnston	WY	Fossil Fuel Electric Power Generation	16551.19
23	Caballo Mine	WY	Bituminous Coal and Lignite Surface Mining	14276.58
24	Colony Plant	WY	Clay and Ceramic and Refractory Minerals Mining	13645.47
25	COLSTRIP ENERGY LTD PARTNERSHIP	MT	Fossil Fuel Electric Power Generation	13331.15
26	Leland Olds Station	ND	Fossil Fuel Electric Power Generation	13294.19
27	Antelope Valley Station	ND	Fossil Fuel Electric Power Generation	12298.61
28	Antelope Mine	WY	Bituminous Coal and Lignite Surface Mining	12256.86
29	WYGEN II	WY	Fossil Fuel Electric Power Generation	10722.9
30	MIDAMERICAN ENERGY CO - GEORGE NEAL SOUTH	IA	Fossil Fuel Electric Power Generation	10196.2

Table 3-15 -- A comparison of the top 30 facilities based on their WEP SO4 value for the Wind Cave Class I Area

Rank	Facility Name	State	NAICS Description	WEP SO4
1	NPPD Gerald Gentleman Station	NE	Fossil Fuel Electric Power Generation	461559.2
2	Wyodak Plant	WY	Fossil Fuel Electric Power Generation	146197.9
3	Coyote Station	ND	Fossil Fuel Electric Power Generation	124140.4
4	COLSTRIP STEAM ELECTRIC STATION	MT	Fossil Fuel Electric Power Generation	122524.2
5	Antelope Valley Station	ND	Fossil Fuel Electric Power Generation	116288.7
6	GCC Dacotah	SD	Cement Manufacturing	99424.42
7	Laramie River Station	WY	Fossil Fuel Electric Power Generation	84486.6
8	Dry Fork Station	WY	Fossil Fuel Electric Power Generation	57614.11
9	Great Plains Synfuels Plant	ND	Natural Gas Distribution	42016.47
10	Coal Creek Station	ND	Fossil Fuel Electric Power Generation	38949

11	COLSTRIP ENERGY LTD PARTNERSHIP	MT	Fossil Fuel Electric Power Generation	31280.71
12	OPPD Nebraska City Station	NE	Electric Power Distribution	27290.29
13	Neil Simpson Two	WY	Fossil Fuel Electric Power Generation	24376.32
14	Jim Bridger Plant	WY	Fossil Fuel Electric Power Generation	24313.11
15	WYGEN Station I	WY	Fossil Fuel Electric Power Generation	21989.84
16	YELLOWSTONE POWER PLANT	MT	Other Electric Power Generation	20824.25
17	Milton R. Young Station	ND	Fossil Fuel Electric Power Generation	20524.85
18	Lost Cabin Gas Plant	WY	Crude Petroleum and Natural Gas Extraction	19102.36
19	Newcastle Refinery	WY	Petroleum Refineries	18074.83
20	WYGEN III	WY	Fossil Fuel Electric Power Generation	15873.85
21	MONTANA SULPHUR & CHEMICAL	MT	Industrial Gas Manufacturing	14817.15
22	WYGEN II	WY	Fossil Fuel Electric Power Generation	14384.1
23	Dave Johnston	WY	Fossil Fuel Electric Power Generation	14367.56
24	Whelan Energy Center	NE	Fossil Fuel Electric Power Generation	13321.05
25	PUBLIC SERVICE CO PAWNEE PLT	CO	Fossil Fuel Electric Power Generation	12588.37
26	Colony East and West Plants	WY	Clay and Ceramic and Refractory Minerals Mining	10581.54
27	Leland Olds Station	ND	Fossil Fuel Electric Power Generation	9640.69
28	Green River Works	WY	Potash, Soda, and Borate Mineral Mining	7631.57
29	ROCKY MOUNTAIN POWER	MT	Fossil Fuel Electric Power Generation	7328.65
30	MIDAMERICAN ENERGY CO - GEORGE NEAL SOUTH	IA	Fossil Fuel Electric Power Generation	10196.2

Table 3-16 -- A comparison of the top 30 facilities based on their WEP NO3 value for the Voyageurs Class I Area in Minnesota

Rank	Facility Name	State	NAICS Description	WEP NO3
1	Boise White Paper LLC - Intl Falls	MN	Paper (except Newsprint) Mills	1122373
2	Hibbing Taconite Co	MN	Iron Ore Mining	1014705
3	Minnesota Power Inc - Boswell Energy Ctr	MN	Fossil Fuel Electric Power Generation	432225.3
4	Xcel Energy - Sherburne Generating Plant	MN	Fossil Fuel Electric Power Generation	235185.3
5	Hibbing Public Utilities Commission	MN	Electric Power Distribution	143826.2
6	Specialty Minerals Inc	MN	Other Basic Inorganic Chemical Manufacturing	68764.02
7	American Crystal Sugar - Crookston	MN	Beet Sugar Manufacturing	44071.35
8	Southern Minnesota Beet Sugar Coop	MN	Beet Sugar Manufacturing	41404.52
9	Flint Hills Resources Pine Bend Refinery	MN	Petroleum Refineries	37976.18
10	WALTER SCOTT JR ENERGY CTR	IA	Fossil Fuel Electric Power Generation	37954.63
11	Milton R. Young Station	ND	Fossil Fuel Electric Power Generation	35510.47
12	Otter Tail Power Company	SD	Fossil Fuel Electric Power Generation	33503.15
13	Coal Creek Station	ND	Fossil Fuel Electric Power Generation	33208.33
14	American Crystal Sugar - East Grand Forks	MN	Beet Sugar Manufacturing	28126.42

15	Coyote Station	ND	Fossil Fuel Electric Power Generation	27814.91
16	MIDAMERICAN ENERGY CO - GEORGE NEAL SOUTH	IA	Fossil Fuel Electric Power Generation	27012.64
17	Leland Olds Station	ND	Fossil Fuel Electric Power Generation	24599.74
18	Viking Gas Transmission - Ada	MN	Pipeline Transportation of Natural Gas	24425.33
19	Viking Gas Transmission - Angus	MN	Pipeline Transportation of Natural Gas	24335.98
20	MIDAMERICAN ENERGY CO - GEORGE NEAL NORTH	IA	Fossil Fuel Electric Power Generation	23008.18
21	Anchor Glass Container Corp	MN	Glass Container Manufacturing	21661.4
22	Saint Paul Park Refining Co LLC	MN	Petroleum Refineries	21185.73
23	Hillsboro Plant	ND	Beet Sugar Manufacturing	21045.98
24	Wyodak Plant	WY	Fossil Fuel Electric Power Generation	20304.41
25	American Crystal Sugar - Moorhead	MN	Beet Sugar Manufacturing	19453.76
26	Wahpeton Plant	ND	Beet Sugar Manufacturing	19285.64
27	Drayton Plant	ND	Beet Sugar Manufacturing	18569.58
28	NORTHTOWN	MN	Support Activities for Rail Transportation	17516.15
29	OPPD Nebraska City Station	NE	Electric Power Distribution	16350.83
30	Covanta Hennepin Energy Resource Co LP	MN	Solid Waste Combustors and Incinerators	15408.42

Table 3-17 -- A comparison of the top 30 facilities based on their WEP SO4 value for the Voyageurs Class I Area in Minnesota

Rank	Facility Name	State	NAICS Description	WEP SO4
1	Xcel Energy - Sherburne Generating Plant	MN	Fossil Fuel Electric Power Generation	317209.1
2	Hibbing Public Utilities Commission	MN	Electric Power Distribution	270552.9
3	Hibbing Taconite Co	MN	Iron Ore Mining	176233.9
4	Minnesota Power Inc - Boswell Energy Ctr	MN	Fossil Fuel Electric Power Generation	103268.5
5	Boise White Paper LLC - Intl Falls	MN	Paper (except Newsprint) Mills	40974.69
6	American Crystal Sugar - Crookston	MN	Beet Sugar Manufacturing	37869.85
7	Coyote Station	ND	Fossil Fuel Electric Power Generation	33942.64
8	Antelope Valley Station	ND	Fossil Fuel Electric Power Generation	33011.43
9	OPPD Nebraska City Station	NE	Electric Power Distribution	32547.21
10	American Crystal Sugar - East Grand Forks	MN	Beet Sugar Manufacturing	28272.56
11	Coal Creek Station	ND	Fossil Fuel Electric Power Generation	17855.44
12	Otter Tail Power Company	SD	Fossil Fuel Electric Power Generation	17518.91
13	Gopher Resource	MN	Storage Battery Manufacturing	17004.32
14	Southern Minnesota Beet Sugar Coop	MN	Beet Sugar Manufacturing	13798.3
15	WALTER SCOTT JR ENERGY CTR	IA	Fossil Fuel Electric Power Generation	13721.74
16	Flint Hills Resources Pine Bend Refinery	MN	Petroleum Refineries	12621.81
17	Great Plains Synfuels Plant	ND	Natural Gas Distribution	11899.13
18	UND Heating Plant	ND	Colleges, Universities, and Professional Schools	11270.61
19	Willmar Municipal Utilities	MN	Electric Power Distribution	10926.21

20	Hillsboro Plant	ND	Beet Sugar Manufacturing	10736.38
21	American Crystal Sugar - Moorhead	MN	Beet Sugar Manufacturing	9689.31
22	Advanced Disposal Services Rolling Hills Landfill	MN	Solid Waste Landfill	9331.59
23	NPPD Gerald Gentleman Station	NE	Fossil Fuel Electric Power Generation	8977.62
24	NDSU Heating Plant	ND	Colleges, Universities, and Professional Schools	8297.01
25	Drayton Plant	ND	Beet Sugar Manufacturing	7871.19
26	Milton R. Young Station	ND	Fossil Fuel Electric Power Generation	7505.69
27	Anchor Glass Container Corp	MN	Glass Container Manufacturing	7223.90
28	MIDAMERICAN ENERGY CO - GEORGE NEAL SOUTH	IA	Fossil Fuel Electric Power Generation	7040.57
29	NPPD Sheldon Station	NE	Fossil Fuel Electric Power Generation	6614.63
30	Leland Olds Station	ND	Fossil Fuel Electric Power Generation	6254.59

Table 3-18 -- A comparison of the top 30 facilities based on their WEP NO3 value for the Lost Woods Class I Area in North Dakota

Rank	Facility Name	State	NAICS Description	WEP NO3
1	Tioga Gas Plant	ND	Natural Gas Liquid Extraction	1206796
2	Coyote Station	ND	Fossil Fuel Electric Power Generation	914487.5
3	Leland Olds Station	ND	Fossil Fuel Electric Power Generation	663400.1
4	Coal Creek Station	ND	Fossil Fuel Electric Power Generation	657830.5
5	Milton R. Young Station	ND	Fossil Fuel Electric Power Generation	651530.6
6	Antelope Valley Station	ND	Fossil Fuel Electric Power Generation	468469.4
7	Great Plains Synfuels Plant	ND	Natural Gas Distribution	346483.6
8	MDU - LEWIS & CLARK STATION	MT	Fossil Fuel Electric Power Generation	78449.91
9	COLSTRIP STEAM ELECTRIC STATION	MT	Fossil Fuel Electric Power Generation	74012.77
10	Clark's Creek Compressor Station	ND	Pipeline Transportation of Natural Gas	72747.13
11	Minot AFB	ND	Airport Operations	67315.47
12	Fort Berthold Compressor Project (Stations 1-6)	ND	Pipeline Transportation of Natural Gas	44455.69
13	Lignite Gas Plant	ND	Natural Gas Liquid Extraction	41870.6
14	Mandan Refinery	ND	Petroleum Refineries	35802.69
15	Hawkeye Gas Facility	ND	Crude Petroleum and Natural Gas Extraction	34179.66
16	Fort Buford Compressor Station	ND	Crude Petroleum and Natural Gas Extraction	31454.15
17	SIDNEY SUGAR FACILITY	MT	Beet Sugar Manufacturing	30991.59
18	Compressor Station No. 4	ND	Pipeline Transportation of Natural Gas	23858.32
19	MINOT	ND	Support Activities for Rail Transportation	21466.83
20	Zane Voight Compressor Station	ND	Support Activities for Oil and Gas Operations	20406.7
21	WILLISTON	ND	Support Activities for Rail Transportation	19969.77
22	GAVIN	ND	Support Activities for Rail	19400.87

			Transportation	
23	Targa Badlands Junction Compressor Station	ND	Support Activities for Oil and Gas Operations	18545.47
24	Wyodak Plant	WY	Fossil Fuel Electric Power Generation	17141.01
25	Hillsboro Plant	ND	Beet Sugar Manufacturing	16426.65
26	Grasslands Gas Plant	ND	Crude Petroleum and Natural Gas Extraction	16211.68
27	Blue Buttes Compressor Station and Pump Station	ND	Crude Petroleum and Natural Gas Extraction	15738.1
28	American Crystal Sugar - East Grand Forks	MN	Beet Sugar Manufacturing	13282.18
29	Otter Tail Power Company	SD	Fossil Fuel Electric Power Generation	12067.13
30	Richardton Ethanol Plant	ND	Ethyl Alcohol Manufacturing	11766.72

Table 3-19 -- A comparison of the top 30 facilities based on their WEP SO4 value for the Lost Woods Class I Area in North Dakota

Rank	Facility Name	State	NAICS Description	WEP SO4
1	Antelope Valley Station	ND	Fossil Fuel Electric Power Generation	1553101
2	Coyote Station	ND	Fossil Fuel Electric Power Generation	1445614
3	Tioga Gas Plant	ND	Natural Gas Liquid Extraction	701393.1
4	Coal Creek Station	ND	Fossil Fuel Electric Power Generation	572887.9
5	Great Plains Synfuels Plant	ND	Natural Gas Distribution	557989.7
6	Lignite Gas Plant	ND	Natural Gas Liquid Extraction	223936.8
7	Milton R. Young Station	ND	Fossil Fuel Electric Power Generation	221208.8
8	Leland Olds Station	ND	Fossil Fuel Electric Power Generation	213133.9
9	Hawkeye Gas Facility	ND	Crude Petroleum and Natural Gas Extraction	28038.23
10	COLSTRIP STEAM ELECTRIC STATION	MT	Fossil Fuel Electric Power Generation	24303.75
11	Xcel Energy - Sherburne Generating Plant	MN	Fossil Fuel Electric Power Generation	21091.4
12	Mandan Refinery	ND	Petroleum Refineries	16605.41
13	Little Knife Gas Plant	ND	Crude Petroleum and Natural Gas Extraction	15046.52
14	American Crystal Sugar - East Grand Forks	MN	Beet Sugar Manufacturing	11534.06
15	American Crystal Sugar - Crookston	MN	Beet Sugar Manufacturing	9569.44
16	Hillsboro Plant	ND	Beet Sugar Manufacturing	7778.53
17	Otter Tail Power Company	SD	Fossil Fuel Electric Power Generation	7701.82
18	Grasslands Gas Plant	ND	Crude Petroleum and Natural Gas Extraction	6856.89
19	Wyodak Plant	WY	Fossil Fuel Electric Power Generation	6579.82
20	COLSTRIP ENERGY LTD PARTNERSHIP	MT	Fossil Fuel Electric Power Generation	6444.32
21	SIDNEY SUGAR FACILITY	MT	Beet Sugar Manufacturing	6121.42
22	NPPD Gerald Gentleman Station	NE	Fossil Fuel Electric Power Generation	5960.18
23	Minot AFB	ND	Airport Operations	5806.01
24	YELLOWSTONE POWER PLANT	MT	Other Electric Power Generation	4861.87
25	UND Heating Plant	ND	Colleges, Universities, and Professional	4700.12

			Schools	
26	Hebron Brick Plant	ND	Clay Building Material and Refractories Manufacturing	3702.26
27	MONTANA SULPHUR & CHEMICAL	MT	Industrial Gas Manufacturing	3461.27
28	Richardton Ethanol Plant	ND	Ethyl Alcohol Manufacturing	3438.89
29	American Crystal Sugar - Moorhead	MN	Beet Sugar Manufacturing	3300.66
30	NDSU Heating Plant	ND	Colleges, Universities, and Professional Schools	2864.44

Table 3-20 -- A comparison of the top 30 facilities based on their WEP NO3 value for the Theodore Roosevelt Class I Area in North Dakota

Rank	Facility Name	State	NAICS Description	WEP NO3
1	Coyote Station	ND	Fossil Fuel Electric Power Generation	1846204
2	Milton R. Young Station	ND	Fossil Fuel Electric Power Generation	1012371
3	Coal Creek Station	ND	Fossil Fuel Electric Power Generation	940799.1
4	Antelope Valley Station	ND	Fossil Fuel Electric Power Generation	826317.7
5	Leland Olds Station	ND	Fossil Fuel Electric Power Generation	819875
6	Great Plains Synfuels Plant	ND	Natural Gas Distribution	616253.7
7	COLSTRIP STEAM ELECTRIC STATION	MT	Fossil Fuel Electric Power Generation	197795.5
8	MDU - LEWIS & CLARK STATION	MT	Fossil Fuel Electric Power Generation	156265.5
9	DICKINSON	ND	Support Activities for Rail Transportation	104739.6
10	Richardton Ethanol Plant	ND	Ethyl Alcohol Manufacturing	72670.3
11	SIDNEY SUGAR FACILITY	MT	Beet Sugar Manufacturing	58769.66
12	Mandan Refinery	ND	Petroleum Refineries	56602.77
13	Fort Buford Compressor Station	ND	Crude Petroleum and Natural Gas Extraction	45576.45
14	Compressor Station No. 5	ND	Pipeline Transportation of Natural Gas	45425.95
15	Tioga Gas Plant	ND	Natural Gas Liquid Extraction	44758.19
16	Grasslands Gas Plant	ND	Crude Petroleum and Natural Gas Extraction	36532.32
17	Clark's Creek Compressor Station	ND	Pipeline Transportation of Natural Gas	29416.58
18	Zane Voight Compressor Station	ND	Support Activities for Oil and Gas Operations	28439.92
19	WILLISTON BASIN - CABIN CREEK	MT	Pipeline Transportation of Natural Gas	24536.48
20	Wyodak Plant	WY	Fossil Fuel Electric Power Generation	24423.46
21	Fort Berthold Compressor Project (Stations 1-6)	ND	Pipeline Transportation of Natural Gas	23771.98
22	COLSTRIP ENERGY LTD PARTNERSHIP	MT	Fossil Fuel Electric Power Generation	22540.85
23	Little Knife Gas Plant	ND	Crude Petroleum and Natural Gas Extraction	21272.31
24	Compressor Station No. 4	ND	Pipeline Transportation of Natural Gas	20386.79
25	Compressor Station No. 6	ND	Pipeline Transportation of Natural Gas	13599.28
26	WILLISTON BASIN - BAKER COMPRESSOR STA	MT	Natural Gas Distribution	12782.49
27	Dickinson Muni	ND	Airport Operations	11106.28

28	MDU - GLENDIVE	MT	Construction Sand and Gravel Mining	10978.46
29	Laramie River Station	WY	Fossil Fuel Electric Power Generation	9749.59
30	Targa Badlands Junction Compressor Station	ND	Support Activities for Oil and Gas Operations	9728.51

Table 3-21 -- A comparison of the top 30 facilities based on their WEP SO4 value for the Theodore Roosevelt Class I Area in North Dakota

Rank	Facility Name	State	NAICS Description	WEP SO4
1	Coyote Station	ND	Fossil Fuel Electric Power Generation	3906409
2	Antelope Valley Station	ND	Fossil Fuel Electric Power Generation	3666815
3	Great Plains Synfuels Plant	ND	Natural Gas Distribution	1328393
4	Coal Creek Station	ND	Fossil Fuel Electric Power Generation	765931.3
5	Leland Olds Station	ND	Fossil Fuel Electric Power Generation	362724.9
6	Little Knife Gas Plant	ND	Crude Petroleum and Natural Gas Extraction	280229.1
7	Milton R. Young Station	ND	Fossil Fuel Electric Power Generation	269969.7
8	COLSTRIP STEAM ELECTRIC STATION	MT	Fossil Fuel Electric Power Generation	109622
9	Tioga Gas Plant	ND	Natural Gas Liquid Extraction	48387.95
10	Richardton Ethanol Plant	ND	Ethyl Alcohol Manufacturing	31880.09
11	COLSTRIP ENERGY LTD PARTNERSHIP	MT	Fossil Fuel Electric Power Generation	28873.66
12	Grasslands Gas Plant	ND	Crude Petroleum and Natural Gas Extraction	26738.05
13	Mandan Refinery	ND	Petroleum Refineries	20619.57
14	SIDNEY SUGAR FACILITY	MT	Beet Sugar Manufacturing	20086.98
15	Hebron Brick Plant	ND	Clay Building Material and Refractories Manufacturing	17827.3
16	BAKER PLANT	MT	Pipeline Transportation of Natural Gas	16462.75
17	NPPD Gerald Gentleman Station	NE	Fossil Fuel Electric Power Generation	16303.19
18	Wyodak Plant	WY	Fossil Fuel Electric Power Generation	14880.61
19	YELLOWSTONE POWER PLANT	MT	Other Electric Power Generation	11772.54
20	Hawkeye Gas Facility	ND	Crude Petroleum and Natural Gas Extraction	9767.84
21	Xcel Energy - Sherburne Generating Plant	MN	Fossil Fuel Electric Power Generation	9400.74
22	MONTANA SULPHUR & CHEMICAL	MT	Industrial Gas Manufacturing	8380.93
23	MDU - LEWIS & CLARK STATION	MT	Fossil Fuel Electric Power Generation	7534.44
24	American Crystal Sugar - East Grand Forks	MN	Beet Sugar Manufacturing	6691.46
25	Elk Basin Gas Plant	WY	Natural Gas Liquid Extraction	6517.61
26	Laramie River Station	WY	Fossil Fuel Electric Power Generation	6484.45
27	Dry Fork Station	WY	Fossil Fuel Electric Power Generation	6390.29
28	OPPD Nebraska City Station	NE	Electric Power Distribution	5327.19
29	ROCKY MOUNTAIN POWER	MT	Fossil Fuel Electric Power Generation	4595.18
30	HARRINGTON STATION POWER PLANT	TX	Electric Power Generation	4240.40

3.2.3 Comparison Between Q/d And WEP/AOI Analysis And Conclusions

A weight of evidence concept must be taken into consideration when determining which source selection methods to consider more or less strongly. Each piece of evidence must be considered and weighed based on its strengths and weaknesses. Both the Q/d and WEP/ AOI approaches have advantages and disadvantages. The advantages of using the WEP/ AOI approach results over the Q/d results is it accounts for geography and transport paths to Class I Areas on the Most Impaired Days, and it uses extinction weighting. Disadvantages of the WEP/ AOI approach results compared to the Q/d results are that inherent uncertainties exist in the HYSPLIT back trajectories, it is not a quantitative analysis, and it's difficult to compare rankings across CIAs.

Other advantages of using the WEP/ AOI results in regional haze planning include the following: It is significantly less costly than PGM modeling. It provides an independent check of some of the PGM modeling result aspects. The HYSPLIT trajectory model is widely used and well-tested regarding air pollution transport analysis. It uses species extinction weighting. It also isolates different U.S. anthropogenic source categories' potential contributions. Finally, it focuses on 2028 potential impact projections which is useful for planning purposes.

Other disadvantages of using the WEP/ AOI results include the following: The analysis is qualitative, meaning it integrates inherent uncertainties that are present in the HYSPLIT back trajectories and the estimated 2028 emissions projections. It also assumes that the IMPROVE chemical species in 2028 will happen at the same times as the 2014-2018 measurements, and that the 2028 chemical species will have the same proportional contributions to the total visibility extinction as in the 2014-2018 measurements. The analysis also assumes a linear relationship of NOx, SO2, and other emissions to NO3, SO4, and other measured secondary aerosol species.

According to the above Q/d and WEP/AOI analysis, South Dakota determined that the South Dakota facilities which should be selected for the subsequent four-factor analysis were both GCC Dacotah and Pete Lien And Sons. Each of these facilities were above South Dakota's determined Q/d threshold of 2. Specifically, GCC Dacotah had a total Q/d value of 21.9, a NOx Q/d value of 16.0, and an SO2 Q/d value of 5.9. Pete Lien and Sons Inc had a total Q/d value of 5.2, a NOx Q/d value of 5.2, and an SO2 Q/d value of less than 0.1. Also, each showed relatively high WEP scores for either NO3 or SO4.

Furthermore, sources selected for a subsequent analysis are not required to have emission reduction control measures placed on them. Instead, those identified sources are only contenders for possible future emission control measures, pending the results of the subsequent analysis.

As a result of the above Q/d and WEP AOI analyses, the only facilities within South Dakota that contribute to visibility impairment beyond established thresholds at Class I Areas, and which haven't already incurred control measures during the first implementation period, are Pete Lien And Sons Inc which affects the Badlands and Wind Cave Class I Areas, and GCC Dacotah which affects the Badlands, Wind Cave, and Theodore Roosevelt Class I Areas. Therefore, DANR recommends a four factor analysis at GCC Dacotah for both NOx and SO2, and a four factor analysis for only NOx for Pete Lien and Sons, Inc.

3.2.4 Considering Sources With Emission Control Technologies Already In Place

When considering sources that currently have effective emission control technologies in place, South Dakota concluded it was not reasonable to select any already effectively controlled source.

South Dakota referenced the Regional Haze Source Control Assessment Considerations Memo (found here: http://views.cira.colostate.edu/data/tss/ramboll/WRAP_Q_Over_D_Analyses/Task6_RH_Source_Control_Assessment_Considerations_Memo_FINAL.pdf) to aid in determining which permitted sources with existing controls have controls that are stringent enough to allow those sources to be disregarded for this second State Implementation Plan submittal period. The memo identifies several federal emissions control programs with regulatory basis in the Clean Air Act, including the National Ambient Air Quality Standards (NAAQS) and New Source Review (NSR), the Best Available Retrofit Technology (BART), the New Source Performance Standards (NSPS), and the Mercury and Air Toxics Standards (MATS).

South Dakota also considered the Best Available Retrofit Technology federal emission control program. The necessity of the implementation of BART was determined during the first State Implementation Plan submittal. Sources which had BART implemented were those with major visibility impairing emissions. South Dakota's Big Stone Power Plant facility went through the BART eligibility and BART determination process, and was found to need BART control measures. These control measures were implemented in 2016, and still represent the most effective control technology. Due to these modifications, Big Stone Power Plant is no longer emitting large amounts of visibility-impairing emissions according to the source screening procedure outlined above.

South Dakota finally considered the National Ambient Air Quality Standards and New Source Review federal emission control program, non-attainment NSRs, attainment NSRs (Prevention of Significant Deterioration), New Source Performance Standards, and the Mercury and Air Toxics Standards federal emission control program, and determined these were not applicable.

3.2.5 Five Additional Factors Considered

Five additional factors detailed in CFR Section 51.308(f)(2)(iv) were also considered by South Dakota regarding determining its long-term strategy.

3.2.5.1 Emission Reductions Due To Ongoing Air Pollution Control Programs

40 CFR § 51.308(f)(2)(iv) and 40 CFR § 51.308(f)(2)(iv)(A) state: ***"The State must consider the following additional factors in developing its long-term strategy: Emission reductions due to ongoing air pollution control programs, including measures to address reasonably attributable visibility impairment;"***

This factor was necessarily considered because during the first implementation period, one South Dakota source was identified as Best Available Retrofit Technology-eligible and had emissions reduction control measures put in place. South Dakota therefore opted not to select this source, the Big Stone Power Plant facility, again for consideration of additional emission reduction control measures.

Existing air pollution control programs in place which assist in reducing air emissions and help achieve reasonable progress toward the national visibility goal include the following South Dakota air quality rules under Administrative Rules of South Dakota § 74:36 – Air Pollution Control Program are listed below:

1. ARSD § 74:36:01:05 – Applicable requirements of Clean Air Act defined: Subsection (12) states "*Any national ambient air quality standard or increment or visibility requirement under Part C of Title I of the Clean Air Act, but only as it would apply to temporary sources permitted pursuant to § 504(e) of the Clean Air Act*";
2. ARSD § 74:36:01:10 – Modification defined: Subsection (3) states "*The change requires or changes a case-by-case determination of an emission limit or other standard, a source-specific determination for temporary sources of ambient impacts, or a visibility or increment analysis*";
3. ARSD § 74:36:02:01 – Air quality goals: Subsection (3) states one of the goals is "*optimization of visibility*";
4. ARSD § 74:36:04 – Operating permits for minor sources and § 74:36:05 – Operating permits for Part 70 sources: The permits issued under these chapters require sources to meet all applicable emission limits, demonstrate compliance, monitoring, recordkeeping and reporting requirements;
5. ARSD §§ 74:36:06 – Regulated Air Pollutant Emissions; 74:36:07 – New Source Performance Standards; 74:36:08 – National Emission Standards for Hazardous Air Pollutants, and ARSD § 74:36:12 – Control of Visible Emissions: These chapter restricts air emissions from regulated entities that cause visibility impairment and prohibits certain open burning practices such as open burning waste oil, rubber, waste tires, asphalt shingles, railroad ties, etc.;
6. ARSD § 74:36:09 – Prevention of Significant Deterioration: This chapter requires a visibility analysis to prevent sources subject to these requirements from contributing to visibility impairment in Class I Areas;
7. ARSD § 74:36:10 – New Source Review: This chapter requires a visibility analysis to prevent sources subject to these requirements from contributing to visibility impairment in Class I Areas; and
8. ARSD § 74:36:18 – Regulations for State Facilities in the Rapid City Area: This chapter restricts visible emissions from fugitive sources.

In addition, EPA implemented a reasonably attributable visibility impact (RAVI) protection program in 1987 with a Federal Implementation Plan (FIP) for South Dakota to meet the general visibility plan requirements and long-term strategies of 40 CFR § 51.302 and § 51.306, respectively. The existing federal RAVI program is compatible with the regional haze program and no revisions are needed at this time. DANR will coordinate with EPA to conduct joint periodic reviews and revisions of the long-term RAVI strategy as required by 40 CFR § 51.306(c). DANR may consider incorporation of the RAVI program into South Dakota's State Implementation Plan in the future.

It is also expected that for some areas of the country, such as parts of the eastern United States, emission reductions achieved for the acid rain program and for meeting the PM2.5 NAAQS, will lead to substantial improvements in visibility as well.

3.2.5.2 Measures To Mitigate The Impacts Of Construction Activities

40 CFR § 51.308(f)(2)(iv) and 40 CFR § 51.308(f)(2)(iv)(B) state: ***"The State must consider the following additional factors in developing its long-term strategy: Measures to mitigate the impacts of construction activities;"***

South Dakota regulates fugitive emissions by rule in Administrative Rules of South Dakota § 74:36:18 – Regulations for State Facilities in the Rapid City Area. This chapter restricts visible emissions from fugitive sources in the Rapid City area.

In addition, DANR has rules which require new major sources and modifications to major sources conduct a visibility analysis. A new major source or modification to a major source will have to determine what controls will be necessary to maintain emissions at a level that will not cause visible emission equal to or greater than 0.5 Deciviews at a Class I area. The new major source or modification to a major source will be required to install the control equipment, establish emission limits, recordkeeping requirements, and reporting requirements.

3.2.5.3 Source Retirement And Replacement Schedules

40 CFR § 51.308(f)(2)(iv) and 40 CFR § 51.308(f)(2)(iv)(C) state: ***"The State must consider the following additional factors in developing its long-term strategy: Source retirement and replacement schedules;"***

DANR is not aware of any anticipated major source retirements or replacements that would have a significant impact on regional emissions loadings and on a state's ability to achieve reasonable progress. The replacement of existing units at facilities will be managed in conformance with the state's existing State Implementation Plan.

3.2.5.4 Basic Smoke Management Practices

40 CFR § 51.308(f)(2)(iv) and 40 CFR § 51.308(f)(2)(iv)(D) state: ***"The State must consider the following additional factors in developing its long-term strategy: Basic smoke management practices for prescribed fire used for agricultural and wildland vegetation management purposes and smoke management programs;"***

Very little agricultural burning takes place in South Dakota and the majority of agricultural land lies in the eastern two-thirds of the state, while both Class I areas are in the western third. DANR has not observed any impacts from agricultural burning on the 20% most impaired days at Badlands National Park or Wind Cave National Park. DANR will continue to monitor agriculture burning activities throughout the state to determine if changes need to be made in the future.

Over the years the National Park Service and U.S. Forest Service have conducted planned prescribed burns on federal lands at both Class I Areas, which have affected the air quality in both parks. Modeling suggests that prescribed fires have a large visibility impact on both of South Dakota's Class I Areas, as shown by the relatively high levels of elemental carbon and organic carbon detected at each Interagency Monitoring of Protected Visual Environment (IMPROVE) site. South Dakota opted to eliminate the visibility impairing effects of prescribed fires from its 2028 projections by adjusting the 2064 endpoint on the URP glidepath, as allowed in Section 51.308(f)(1)(vi) of the Regional Haze Rule. Despite the significant visibility impairment that these fires cause, prescribed burns were designed to simulate natural conditions, and therefore will not be taken into consideration in the natural 2064 visibility goal.

In response to issues with smoke from prescribed fires impacting the visibility at the class I areas and elevating the PM2.5 concentrations in Rapid City and surrounding towns in the Black Hills region, DANR developed a Memorandum of Understanding for prescribed burning with the Black Hills National Forest, the City of Rapid City and the South Dakota Department of Agriculture's Wildland Fire Division in January 2020. In the time since the Memorandum of Understandings were signed DENR and the Department of Agriculture have merged into one agency, and the Department of Agriculture's Wildland Fire entity has moved to public safety. Regardless of that, the Department of Agriculture and Natural Resources (DANR) will continue working to minimize smoke impacts from prescribed burning. An example of the Memorandum of Understanding can be seen in Appendix F. It should also be noted that the US Forest Service has been in recent communication with South Dakota regarding their foresight about future prescribed burns. The Forest Service indicated that prescribed burns will likely be increasing in the years to come. South Dakota will continue monitoring how these changes in prescribed burns affect public health and the visibility within its two Class I Areas in the years to come.

3.2.5.5 Anticipated Net Effect On Visibility Due To Projected Changes In Point, Area, And Mobile Source Emissions

40 CFR § 51.308(f)(2)(iv) and 40 CFR § 51.308(f)(2)(iv)(E) state: ***"The State must consider the following additional factors in developing its long-term strategy: The anticipated net effect on visibility due to projected changes in point, area, and mobile source emissions over the period addressed by the long-term strategy."***

Projected visibility changes at Class I Areas through the second implementation period as a result of anticipated emissions changes provide insight about what additional visibility impairment progress may need to be made. Visibility conditions at South Dakota's two Class I Areas were projected out to 2028 using the CAMx 2028OTBa2 model and emissions scenarios, provided by Ramboll, a technical contractor hired by WRAP. The 2028OTBa2 model scenarios assume no additional controls in addition to the already adopted "on the books" controls from sources within the state of South Dakota. Other WESTAR-WRAP states either chose the same "on the books" option, or opted to input emissions information into a more emissions-controlled model scenario, the Potential Additional Controls (PAC) model scenario. Information from the "on the books" model run was used to help South Dakota determine if adding additional source controls was necessary during the second implementation period in order to stay on track to achieving natural conditions by 2064.

The following table, Table 3-22, shows the anticipated net effect on visibility due to projected changes in point, area, and mobile source emissions over the period addressed by the long-term strategy, at both of South Dakota's Class I Areas for both the 20% Most Impaired Days and the Clearest Days. Both a comparison between the first implementation period's baseline period to the 2028 projections and a comparison between the second implementation period's baseline period to the 2028 projections can be seen.

Table 3-22 -- The anticipated net effect on visibility in Deciviews due to projected changes in point, area, and mobile source emissions over the period addressed by the long-term strategy at both of South Dakota's Class I Areas

Calendar Year	Badlands National Park		Wind Cave National Park	
	Most Impaired (dv)	Clearest (dv)	Most Impaired (dv)	Clearest (dv)
2000-2004 Average	15	6.9	13.1	5.1
2014-2018 Average	12.3	5.4	10.5	3.5
2028OTBa2 EPA	11.7	5.1	10	3.4
2028OTBa2 EPA w/o Fire	11.6	N/A	9.8	N/A
2028OTBa2 ModMid	11.3	N/A	9.5	N/A
2028OTBa2 Average	11.53	5.1	9.76	3.4
Net Change 2000-2004 to 2028 Average	-3.47	-1.8	-3.34	-1.7
Net Change 2014-2018 to 2028 Average	-0.77	-0.3	-0.74	-0.1

WRAP projected visibility from changes in emissions by point, area and mobile sources throughout the WRAP region through 2028. The anticipated net effect on visibility due to projected changes in point, area, and mobile source emissions over the second implementation period at South Dakota's Class I Areas can be seen in more detail in Chapter 4.

3.3 Emission Control Measure Evaluation And Determination

40 CFR § 51.308(f)(2)(i) states: ***"The State must evaluate and determine the emission reduction measures that are necessary to make reasonable progress by considering the costs of compliance, the time necessary for compliance, the energy and non-air quality environmental impacts of compliance, and the remaining useful life of any potentially affected anthropogenic source of visibility impairment.*** The State should consider evaluating major and minor stationary sources or groups of sources, mobile sources, and area sources. ***The State must include in its***

implementation plan a description of the criteria it used to determine which sources or groups of sources it evaluated and how the four factors were taken into consideration in selecting the measures for inclusion in its long-term strategy. In considering the time necessary for compliance, if the State concludes that a control measure cannot reasonably be installed and become operational until after the end of the implementation period, the State may not consider this fact in determining whether the measure is necessary to make reasonable progress."

South Dakota's selections process has determined a four-factor analysis should be completed for the kilns located at GCC Dacotah and Pete Lien and Sons. As stated above, the Regional Haze Rule requires South Dakota to characterize aspects of emission control measures for those selected sources. Part of the characterization requirement is what is known as the "four factor analysis." The four factors that must be taken into consideration are: 1) the cost of compliance, 2) the time necessary for compliance, 3) the energy and non-air environmental impacts of compliance, and 4) the remaining useful life of the source.

3.3.1 Selection Of All Possible Emissions Control Measures

Before potential emission reduction control measures can be characterized through the four-factor analysis, the set of potentially applicable options should be identified.

The following are examples of emission control measures that may be considered:

1) Retrofits may be considered for sources that have no existing controls.
2) Sources that currently have controls in place may incur upgrades or replacements of those controls that are less effective.
3) Sources with existing controls may operate those controls year-round.
4) Restrictions on operating hours, product output, or fuel input may be considered in order to reduce emissions.
5) Improved work practices may be analyzed to determine if emission reductions are possible.
6) Choosing a different fuel mix which has lower NOx, SO2, or PM emissions.
7) Other renewable energy and energy efficiency measures to reduce emissions from electric generating units.
8) Smoke management practices and programs for wildland prescribed fires and agricultural fires.

Furthermore, according to 51.308(f)(2)(ii)(B), states must also consider emission reduction measures identified by other states for their sources as being necessary to make reasonable progress in mandatory Class I Federal areas. South Dakota conferred with the other nearby WRAP states including North Dakota, Wyoming, Montana, and Colorado, and none of these states identified any specific emission controls to be evaluated at kilns and lime and cement manufacturing facilities.

The following sections detail the sulfur dioxide and nitrogen oxide control technology options identified as possibilities for GCC Dacotah and Pete Lien and Sons. A four-factor analysis was conducted for both sulfur dioxide and nitrogen oxide at GCC Dacotah. A four-factor analysis was conducted for just nitrogen oxide at Pete Lien and Sons.

3.3.1.1 Technically Feasible Sulfur Dioxide Control Technologies

The first step is the identification of all available retrofit control technologies. GCC Dacotah and DANR identified the following control options for sulfur dioxide:

1. Inherent dry scrubbing;
2. Dry sorbent injection;
3. Alternative low sulfur fuels;
4. Wet scrubbing; and
5. Semi-wet/dry scrubbing.

Regarding inherent dry scrubbing, in a kiln with an in-line raw mill, combustion gases pass over the raw material, resulting in a reaction between sulfur dioxide and calcium in the limestone and other raw materials. This in-line raw mill configuration results in a removal efficiency as high as 98.8%. The kiln at the GCC Dacotah plant is equipped with an in-line raw mill, and the combined reduction in sulfur dioxide emissions that would otherwise be emitted from the raw material is assumed to be approximately 90%, resulting from the inherent removal in both the in-line raw mill and the kiln itself. This in-line raw mill is not new to the kiln for the purposes of determining baseline emissions reductions, and the control efficiency is therefore part of the baseline operating conditions. All other identified control technologies were evaluated with inherent dry scrubbing included in the baseline, and inherent dry scrubbing was not evaluated further as an additional available control.

Dry sorbent injection involves spraying a powdered sorbent, typically consisting of lime, sodium bicarbonate, or trona, into the flue gas stream. The sorbent interacts with acid gases (e.g. HCl) or sulfur dioxide and forms larger particles that can be removed using an electrostatic precipitator or dry filter downstream. The kiln at GCC Dacotah was determined to be the best available control technology for sulfur dioxide at the time of the kiln's Prevention of Significant Deterioration permit issuance date, on April 10, 2003. When compared to the permitted emission rates for sulfur dioxide found in the RBLC database, GCC Dacotah's kiln emits sulfur dioxide at a rate comparable to the BACT limits on more recent kiln installations around the country. The GCC Dacotah kiln is already equipped with lime injection. Lime injection is currently installed primarily for hydrogen chloride (HCl) control, and GCC Dacotah is permitted to inject lime to manage hydrogen chloride and sulfur dioxide emissions as needed to meet the existing sulfur dioxide BACT limit. Therefore, dry sorbent injection will not be evaluated further.

Alternative low sulfur fuels may be used as long as they do not adversely affect product quality. Fuels that can be considered for the cement kiln must have sufficient heat content and be dependable and readily available locally in significant quantities so as not to disrupt continuous production. Traditional fuels for cement kilns include natural gas, coal, and petroleum coke. The use of alternative fuels is not considered an available long-term method of sulfur dioxide control for the purposes of regional haze because the availability of individual fuels with known lower sulfur content is not verifiable. Therefore, alternative low sulfur fuels will not be evaluated further.

A wet scrubber is a tailpipe technology that may be installed downstream of the kiln. In a typical wet scrubber, the flue gas flows upward through a reactor vessel that has an alkaline reagent flowing down from the top. The scrubber mixes the flue gas and alkaline reagent using a series of spray nozzles to distribute the reagent across the scrubber vessel. Typically calcium is used as the reagent to react with the sulfur dioxide in the flue gas and form calcium sulfite and/or calcium sulfate. The calcium compounds are then removed with the scrubber sludge and disposed. Most wet scrubber systems use forced oxidation to assure that only calcium sulfate sludge is produced.

A wet scrubbing system utilizes a ground alkaline agent, such as lime or limestone, in slurry to remove sulfur dioxide from the stack. The spent slurry is dewatered using settling basins and filtration equipment. Recovered water is typically reused to blend new slurry for the wet scrubber. A significant amount of makeup water is required to produce enough slurry to maintain the scrubber's design removal efficiency. Water losses from the system occur from evaporation into the stack gas, evaporation from settling basins, and retained moisture in scrubber sludge. With GCC Dacotah's previous operation of wet kilns, the facility has sufficient water rights to obtain the necessary water required to operate a wet scrubber. This technology is considered technically feasible and will be evaluated further.

Semi-wet/dry scrubbing is a method similar to wet scrubbing in principal; however, less water is used. A scrubber tower is installed prior to the baghouse. Atomized hydrated lime slurry is sprayed into the exhaust flue gas. The lime absorbs the sulfur dioxide in the exhaust and turns it into a powdered calcium/sulfur compound. The particulate control device then removes the solid reaction products from the gas stream. This technology is also considered technically feasible and will be evaluated further.

GCC Dacotah provided Table 3-23 below, which ranks the technically feasible options by control effectiveness. The baseline control technology is inherent dry scrubbing with the in-line raw mill. Wet scrubber and semi-wet/dry scrubber reduction efficiencies are determined using the U.S. EPA Air Pollution Control Technology Fact Sheet, Flue Gas Desulfurization (FGD) – Wet, Spray Dry, and Dry Scrubbers.

Table 3-23 -- Ranking of Sulfur Dioxide Technologies by Effectiveness

Control Technology	**Operational Status**	**Potential Control Efficiency**
Baseline – Inherent dry scrubbing	Installed and Operational	90%
Semi-wet/dry scrubbing	Not Installed	90%
Wet scrubbing	Not Installed	90%

3.3.1.2 Technically Feasible Nitrogen Oxide Control Technologies

The first step is the identification of all available retrofit control technologies. GCC Dacotah, Pete Lien and Sons, and DANR identified the following control options for nitrogen oxide:

1. Kiln fuel changes;
2. Low NO_x burner;
3. Flue gas recirculation;
4. Staged combustion air;
5. Good combustion practices;
6. Selective non-catalytic reduction (SNCR); and
7. Selective catalytic reduction (SCR).

Fuels that can be considered for the kilns at GCC Dacotah and Pete Lien and Sons must have sufficient heat content and be dependable and readily available locally in significant quantities so as not to disrupt continuous production. Traditional fuels for the kilns include natural gas, coal, and petroleum coke. Changing the kiln fuel will have only a small effect on calcination nitrogen oxide emissions since this change would only affect the formation of fuel NOx emissions, which is a relatively minor contributor to nitrogen oxide emissions, which are dominated by thermal NOx. Solid fossil fuels, such as coal and petroleum coke, are known to produce significantly lower emissions of nitrogen oxides from kilns than gaseous fuels. The use of alternative fuels is not considered an available long-term method of nitrogen oxide control for the purposes of regional haze, therefore, alternative fuels will not be evaluated further.

Low NO_x burners (LNB) reduce the amount of nitrogen oxide initially formed in the flame. The principle of all low NO_x burners is the same: stepwise or staged combustion and localized exhaust gas recirculation (i.e. at the flame). LNB's are designed to reduce flame turbulence, delay fuel/air mixing, and establish fuel-rich zones for initial combustion. The longer, less intense flames resulting from the staged combustion lower flame temperatures and reduce thermal nitrogen oxide formation. Some of the burner designs produce a low-pressure zone at the burner center by injecting fuel at high velocities along the burner edges. Such a low-pressure zone tends to recirculate hot combustion gas which is retrieved through an internal reverse flow zone around the extension of the burner centerline. The recirculated combustion gas is deficient in oxygen, thus producing the effect of flue gas recirculation. Reducing the oxygen content of the primary air creates a fuel-rich combustion zone that then generates a reducing atmosphere for combustion. Due to fuel-rich conditions and lack of available oxygen, formation of thermal NO_x and fuel NO_x are minimized. LNBs are capable of reducing emissions by 20 to 30% on indirect-fired cement kilns by reducing flame turbulence, delaying fuel/air mixing, and establishing fuel-rich zones for initial combustion.

GCC Dacotah operates a low NO_x burner in its cement kiln, and will use LNB as the baseline emission control technology for its analysis. Pete Lien and Sons operates direct-fired kilns at the lime plant, which does not allow for these burners to be used. Therefore, Pete Lien and Sons did not consider LNBs as a technically feasible control option for the lime kilns.

Flue gas recirculation (FGR) is intended to reduce the oxygen content of the primary combustion air used for the main burner pipe, thereby lowering the peak flame temperature in the burning zone. FGR is frequently practiced in the electric utility industry. In a preheater kiln application, oxygen-deficient gases from the preheater tower would be used as primary combustion air to blow powdered fossil fuel (e.g. a coal/coke blend) into the burning zone. Pete Lien and Sons is not aware of flue gas recirculation ever being used in a lime kiln or cement kiln for a few reasons. The FGR control option would require extensive ducting to bring a relatively small amount of oxygen-deficient gas from the top of the preheater tower to the main burner pipe to serve as primary air. Nearly all of the combustion air in a lime kiln must come from the cooler to maximize energy efficiency of the system and to supply as small a volume of combustion air as possible. The use of oxygen-deficient gas for combustion requires the processing of larger gas volumes and results in unacceptably inefficient equipment design and potential process problems. Implementation of FGR for the main burner pipe will lower the peak flame temperatures and lengthen the flame shape. The longer flame will affect lime quality and produce unstable kiln operations. Localized reducing conditions caused by oxygen deficiency are detrimental to maintaining lime quality. Therefore, Pete Lien and Sons did not consider flue gas recirculation as a technically feasible control option.

FGR relies on cooling the flame and generating an oxygen deficient atmosphere for combustion to reduce nitrogen oxide formations. High flame temperatures and an oxidizing atmosphere are process requirements to produce quality clinker product. Therefore, GCC Dacotah did not consider flue gas recirculation as a technically feasible control option.

Nitrogen oxide is primarily formed due to oxidation of nitrogen in the combustion air at high temperatures. Combustion modifications attempt to reduce nitrogen oxide formation by reducing combustion temperatures or limiting the availability of nitrogen in the high temperature flame to achieve reductions up to 45%. Similar to a cement kiln, a high flame temperature and an oxidizing atmosphere in a lime kiln are process requirements to produce a quality product. Staged combustion air refers to the practice of limiting the amount of available oxygen in the combustion zone to create an oxygen-lean condition. With low levels of oxygen available for combustion, nitrogen oxide formation in the combustion zone is inhibited. However, this oxygen-lean condition also leads to reduced fuel efficiency and higher levels of carbon monoxide. The reduced flame temperatures and reducing condition techniques possible in a boiler are not compatible with lime production. Staged combustion has been used in the cement industry, where initial combustion occurs in a fuel-rich zone and secondary combustion is carried out in a fuel-lean zone. However, lime kilns do not operate in this two-stage manner, so staged combustion will not be effective. Reduction in combustion temperatures in the lime kiln will affect kiln productivity and quality of the lime by increasing carry-over of unburned carbon to the lime product. This unburned fuel would prevent the lime product from being used in many applications. Therefore, Pete Lien and Sons did not consider staged combustion air as a technically feasible control option.

GCC Dacotah operates an indirect fired kiln. As such, GCC Dacotah's kiln already operates with a staged combustion type system. Therefore, this process is already part of the baseline control technology operated by GCC Dacotah.

Good combustion practices refer to a properly designed and operated stone feed processing system, which produces a stone feed material that is uniform in chemical composition and fineness. A uniform kiln stone feed material significantly contributes to smoother kiln operation and more efficient conversion of raw materials to lime (quicklime). Since the generation of nitrogen oxide is directly related to heat input from fuel and the required combustion air, a stone feed requiring less feed input results in lower NO_x emissions. Uniform quality fuels are also important in reducing process variability that tends to increase NO_x emissions. The two lime kilns at Pete Lien and Sons both use currently available practices to reduce NO_x emissions while still maintaining the quality of the lime produced. To minimize fuel consumption and nitrogen oxide emissions, both GCC Dacotah and Pete Lien and Sons try to produce the most uniform and quality product possible. This is a technically feasible control option and is already being implemented by both GCC Dacotah and Pete Lien and Sons.

In selective catalytic reduction (SCR), a reagent, typically ammonia, is injected into the exhaust gas upstream of a catalyst bed. On the catalyst surface, ammonia and nitric oxide or nitrogen dioxide react to form diatomic nitrogen and water. When operated within the optimum temperature range of 480°F to 800°F, the reaction can result in removal efficiencies between 70 and 90 percent. The rate of nitrogen oxide removal increases with temperature, up to a peak optimal temperature. The application of SCR systems is extremely limited in the U.S. cement industry, with only one cement plant known to have installed a selective catalytic reduction system. Therefore, SCR is not considered widely available for use with cement kilns, in large part because high-dust and semi-dust SCR systems rely on site-specific limits. Pete Lien and Sons stated that no lime kilns in the United States operate with a selective catalytic reduction and the exhaust gas characteristics create significant chemical and physical problems for the facility. Therefore, GCC Dacotah and Pete Lien and Sons did not consider SCR as a technically feasible control option.

In selective non-catalytic reduction (SNCR), a reagent is injected into the flue gas within an appropriate temperature window. The nitrogen oxide and reagent, typically ammonia or urea, react to form nitrogen and water. A typical SNCR system consists of reagent storage, multi-level reagent-injection equipment, and associated control instrumentation. Both ammonia and urea SNCR systems require three to four times as much reagent as SCR systems to achieve similar nitrogen oxide reductions. The U.S. EPA Control Cost Manual indicates that SNCR requires a temperature range of between 1,550°F and 1,950°F, with the higher temperature reflecting a lack of a catalyst to lower the activation energies of the reactions. In kilns, SNCR can be applied in certain combustion zones of kilns to facilitate SNCR in a non-tailpipe mode. However, maintaining ammonia injection within the optimal temperature range poses a technical challenge in kilns. At higher than optimal temperatures, the reaction causes ammonia to oxidize and form nitrogen oxide instead of removing it. Furthermore, ammonia slip can occur at temperatures below the required range, with un-reacted ammonia released to the atmosphere to form particulate matter ($PM_{2.5}$), resulting in increased visibility impairment. However, selective non-catalytic reduction under the right conditions is considered technically feasible for GCC Dacotah and likely infeasible for Pete Lien and Sons.

3.3.2 Characterization Of Control Measures

After identifying the set of potential control measures and selecting the best specific options for each source, each control measure undergoes a characterization through the four statutory factors, in order to determine which are feasible for inclusion in South Dakota's long-term strategy. The long-term strategy sets South Dakota's reasonable progress goals for the second implementation period. The characterization process involves collecting and applying data about each control measure to each identified source to make a determination about the feasibility of implementing the control measures at the sources.

After each control measure has been adequately characterized, a determination must be made regarding whether each control measure is necessary to make reasonable progress for the second implementation period. All four statutory factors for each control measure is reviewed in order to determine the necessity of each control measure.

The four factors used to characterize each identified control measure are further detailed as follows.

1) The cost of compliance factor can be measured by the cost-effectiveness threshold per ton of pollutant reduced throughout the state. Each facility estimated the cost of compliance for each control technology based on the capital costs, operating costs, and cost effectiveness.
2) The time necessary for compliance factor is generally defined as the time needed for full implementation of the technically feasible control options. When considering the implementation of new control technology, regulatory authorities must take into account the time needed to comply with the rule. Time may be required to develop new technology, ensure the technology is durable and cost-effective, purchase and install equipment, etc. Therefore, compliance deadlines must be set to provide a reasonable amount of time for the source to implement the control measure.
3) An environmental impact analysis assesses collateral environmental impacts due to control of the regulated pollutant in question. Environmental impacts may include solid or hazardous waste generation, discharges of polluted water from a control device, visibility impacts, increased emissions of other criteria or non-criteria pollutants, increased water consumption, and land use impacts from waste disposal.
4) When developing regulations, it is important to consider the useful life of potentially affected sources. The stringency of air quality regulations results in sources considering the costs of control in comparison to the useful life of the source to determine whether to retire a source or invest in implementing new control requirements.

For this review, GCC Dacotah conducted a four-factor analysis for sulfur dioxide and nitrogen oxides, and Pete Lien and Sons conducted a four-factor analysis for nitrogen oxides.

Table 3-24 below ranks the technically feasible nitrogen oxide technology options considered by GCC Dacotah and Pete Lien and Sons by control effectiveness and that are not currently being operated.

Table 3-24 -- Ranking of Nitrogen Oxide Technologies by Effectiveness

Control Technology	Potential Control Efficiency
Selective non-catalytic reduction (SNCR)	25% to 50%

3.3.2.1 GCC Dacotah

GCC Dacotah conducted a four-factor analysis for its cement dry kiln operating at the facility. This document was submitted to DANR on October 28, 2019. DANR has reviewed the report and determined that the analysis is sufficient to cover the alternative control options for its kiln.

The “Capital Cost ($1000)” column represents the capital investment for purchasing the control equipment. The “Annual Cost ($1000)” is the amortized cost of the capital investment plus the annual cost to operate the control equipment. GCC Dacotah based the amortized cost of the capital investment on the control device and/or dry kiln operating twenty years with a 7% interest rate.

Table 3-25 summarizes the findings of the cost analysis conducted by GCC Dacotah.

Table 3-25 -- Four Factor Analysis for GCC Dacotah

Control Option	Baseline Emission Level (tons)	Emission Reductions (tons)	Capital Cost ($1000)	Annual Cost ($1000)	Cost per Ton
Nitrogen Oxides					
SNCR	1,394	331	$5,360,592	$693,165	$2,094
Sulfur Dioxide					
Wet scrubber	560	453.6	$24,691,500	$3,571,468	$7,874
Semi-wet/dry scrubber	560	453.6	$20,709,000	$3,036,248	$6,694

DANR also added its own values through calculations based on varying interest rates from 6.5% to 3% in 0.5% increments. Costs are based on 2018 dollars and data collected by the facility. The "Cost per Ton" column is based on the "Annual Cost" divided by the "Emission Reductions."

Tables 3-26 and 3-27 summarize the cost effectiveness with different interest rates.

Table 3-26 -- Cost of Compliance Based on Nitrogen Oxides Emissions Reduction

Control Option	Baseline Emission Level (tons)	NOx Reduction (%)	Emission Reduction (tons)	Interest Rate	Control Cost ($/year)	Cost Effectiveness ($/ton removed)
SNCR	1,394	30	331	7%	$693,165	$2,094
				6.50%	$673,671	$2,035
				6%	$654,524	$1,977
				5.50%	$635,734	$1,921
				5%	$617,311	$1,865
				4.50%	$599,265	$1,810
				4%	$581,605	$1,757
				3.50%	$564,340	$1,705
				3%	$547,479	$1,654

Table 3-27 -- Cost of Compliance Based on Sulfur Dioxide Emissions Reduction

Control Option	Baseline Emission Level (tons)	SO2 Reduction (%)	Emission Reduction (tons)	Interest Rate	Control Cost ($/year)	Cost Effectiveness ($/ton removed)
Semi-Dry Scrubber	560	90%	453.6	7%	$3,036,248	$6,694
				6.50%	$2,960,939	$6,528
				6%	$2,886,970	$6,365
				5.50%	$2,814,380	$6,205
				5%	$2,743,208	$6,048
				4.50%	$2,673,493	$5,894
				4%	$2,605,269	$5,744
				3.50%	$2,538,572	$5,596
				3%	$2,473,435	$5,453
Wet Scrubber	560	90%	453.6	7%	$3,571,468	$7,874
				6.50%	$3,481,676	$7,676
				6%	$3,393,482	$7,481
				5.50%	$3,306,933	$7,290
				5%	$3,222,074	$7,103

				4.50%	$3,138,952	$6,920
				4%	$3,057,608	$6,741
				3.50%	$2,978,085	$6,565
				3%	$2,900,421	$6,394

GCC Dacotah identified some collateral environmental impacts due to the noted emission control options. To operate any of the add-on control devices, overall plant efficiency would decrease due to the operation of the add-on controls. At a minimum, decreased efficiency would result in increased electrical usage by the plant with an associated increase in indirect emissions from nearby power stations.

The use of nitrogen oxides reduction methods that incorporate ammonia injection leads to increased health risks and adverse environmental impacts to the local community from ammonia slip emissions, especially through the formation of particulate matter ($PM_{2.5}$). Environmental agencies have acknowledged the significance of ammonia slip and the potential increases in $PM_{2.5}$ that can result. Additionally, there are safety concerns associated with the transport and storage of ammonia, including potential ammonia spills that can have serious adverse environmental and health impacts.

The use of emissions reduction options involving the injection of lime (dry sorbent injection, wet scrubbing, and semi-wet/dry scrubbing) also causes significant energy impacts. The production of lime is an energy-intensive process that can result in increases in nitrogen oxides, particulate matter, and sulfur dioxide emissions. This lime production emissions increase would then be coupled with the energy and emissions impacts resulting from the transportation of lime to the facility.

Both of the add-on sulfur dioxide control options that have been considered in this analysis also have additional non-air quality impacts associated with them. A semi-wet/dry hydrated lime control system will require water to hydrate lime. There will also be additional material collected in the baghouses that will require disposal. A wet scrubber will require a significant quantity of water as well. Wet scrubbing or wet flue gas desulfurization (FGD) has significant negative environmental impacts, particularly in the arid West, where water scarcity is a significant concern. This holds especially true when weighing the benefits of a wet vs. semi-wet or dry control technology.

Selective non-catalytic reduction is assumed to have a remaining useful life of twenty years. The kiln at GCC Dacotah is assumed to have a remaining useful life of at least twenty years as well. The remaining useful life of the kilns at GCC Dacotah do not impact the annualized cost of add-on control technologies because the useful life is anticipated to be at least as long as the capital cost recovery period of twenty years.

The baseline controls on the existing kilns at GCC Dacotah already remove the nitrogen oxides and sulfur dioxide emissions that are created from the process. The control technologies currently installed and operational on the kiln and GCC Dacotah were considered the Best Available Control Technology for this kiln when its Prevention of Significant Deterioration permit was issued in 2003 and are common control technology for kilns recently permitted under the Prevention of Significant Deterioration program.

GCC Dacotah submitted comments on the draft Regional Haze SIP. In those comments, GCC Dacotah indicated the materials and supply chain issues have increased the cost of installation of an SNCR system. The GCC Dacotah's revised cost effectiveness (cost/ton removed) is $4,941, given an annual control cost of $1,636,683, a baseline emission level (tons/year) of 1,394, an expected NOx reduction efficiency of 30%, and an expected emissions reduction of 331 tons/year. A more thorough review of the revisions can be made by viewing the associated formal document supplied by GCC Dacotah, which is provided in Appendix B.

3.3.2.2 Pete Lien and Sons

Pete Lien and Sons conducted a four-factor analysis for its two kilns operating at the facility. This document was received by DANR on November 8, 2019. DANR has reviewed the report and determined that the analysis is sufficient to cover the alternative control options for the lime kilns. Table 3-28 summarizes the findings of the cost analysis conducted by Pete Lien and Sons.

The Capital Cost column represents the capital investment for purchasing the control equipment. The Annual Cost is the amortized cost of the capital investment plus the annual cost to operate the control equipment. Pete Lien and Sons based the amortized cost of the capital investment on the control device and/or kiln operating twenty years with a 5% interest rate. DANR added its own calculations associated with additional interest rates from 4.5% to 5% in 0.5% increments. Costs are based on 2019 dollars and a 25% control of NO_x emissions based on data collected by the facility. The "Cost per Ton" column is based on the "Annual Cost" divided by the "Emission Reductions."

Table 3-28 -- Four Factor Analysis for Pete Lien and Sons

Control Option	Emission Reductions (tons)	Capital Cost	Interest Rate	Annual Cost	Cost Per Ton
SNCR -- Kiln #1	77.6	$2,092,456	5%	$2,704,137	$34,847
			4.50%	$2,697,093	$34,756
			4%	$2,690,200	$34,668
			3.50%	$2,683,461	$34,581
			3%	$2,676,879	$34,496
SNCR -- Kiln #2	51	$2,092,456	5%	$3,001,677	$58,856
			5%	$2,994,633	$58,718
			4%	$2,987,740	$58,583

			3.50%	$2,981,001	$58,451
			3%	$2,974,419	$58,322

Pete Lien and Sons identified some collateral environmental impacts due to the noted emission control options, which were similar to those identified by GCC Dacotah. To operate any of the add-on control devices, overall plant efficiency would decrease due to the operation of the add-on controls. At a minimum, decreased efficiency would result in increased electrical usage by the plant with an associated increase in indirect emissions from nearby power stations.

The use of nitrogen oxides reduction methods that incorporate ammonia injection leads to increased health risks and adverse environmental impacts to the local community from ammonia slip emissions, especially through the formation of particulate matter (PM2.5).

Selective non-catalytic reduction is assumed to have a remaining useful life of twenty years. The kilns at Pete Lien and Sons are assumed to have a remaining useful life of at least twenty years as well. The remaining useful life of the kilns at Pete Lien and Sons do not impact the annualized cost of add-on control technologies because the useful life is anticipated to be at least as long as the capital cost recovery period of twenty years.

3.3.2.3 Four Factor Analysis Summary

DANR now needs to determine if it should or should not recommend the additional controls, in order to finish its long-term strategy, and to create its reasonable progress goals. A four-factor analysis was conducted for the kilns at GCC Dacotah and the lime kilns at Pete Lien and Sons.

DANR reviewed the Regional Haze regulations to determine if there was a specific metric associated with each of the four factors that provided a definitive line or cutoff for this determination.

The Regional Haze Rule encompasses 40 CFR § 51.300-51.309. The following are the sections South Dakota found particularly noteworthy:

A. 40 CFR § 51.301 states, *"Visibility impairment or anthropogenic visibility impairment means any humanly perceptible difference due to air pollution from anthropogenic sources between actual visibility and natural visibility on one or more days. Because natural visibility can only be estimated or inferred, visibility impairment also is estimated or inferred rather than directly measured."*
B. 40 CFR § 51.306(a)(3) states, *"The plan must set forth with reasonable specificity why the long-term strategy is adequate for making reasonable progress toward the national visibility goal, including remedying existing and preventing future impairment."*
C. 40 CFR § 51.308(f)(2)(i) states in part, *"The State must evaluate and determine the emission reduction measures that are necessary to make reasonable progress by considering the costs of compliance, the time necessary for compliance, the energy*

and non-air quality environmental impacts of compliance, and the remaining useful life of any potentially affected anthropogenic source of visibility impairment."

D. 40 CFR § 51.308(f)(2)(ii)(C) states in part, *"In any situation in which a State cannot agree with another State on the emission reduction measures necessary to make reasonable progress in a mandatory Class I Federal area, the State must describe the actions taken to resolve the disagreement. In reviewing the State's implementation plan, the Administrator will take this information into account in determining whether the plan provides for reasonable progress at each mandatory Class I Federal area that is located in the State or that may be affected by emissions from the State."*
E. 40 CFR § 51.308(f)(3)(i) states in part, *"The long-term strategy and the reasonable progress goals must provide for an improvement in visibility for the most impaired days since the baseline period and ensure no degradation in visibility for the clearest days since the baseline period."*
F. 40 CFR § 51.308(f)(3)(ii)(A) states, *"If a State in which a mandatory Class I Federal area is located establishes a reasonable progress goal for the most impaired days that provides for a slower rate of improvement in visibility than the uniform rate of progress calculated under paragraph (f)(1)(vi) of this section, the State must demonstrate, based on the analysis required by paragraph (f)(2)(i) of this section, that there are no additional emission reduction measures for anthropogenic sources or groups of sources in the State that may reasonably be anticipated to contribute to visibility impairment in the Class I area that would be reasonable to include in the long-term strategy. The State must provide a robust demonstration, including documenting the criteria used to determine which sources or groups or sources were evaluated and how the four factors required by paragraph (f)(2)(i) were taken into consideration in selecting the measures for inclusion in its long-term strategy. The State must provide to the public for review as part of its implementation plan an assessment of the number of years it would take to attain natural visibility conditions if visibility improvement were to continue at the rate of progress selected by the State as reasonable for the implementation period."*
G. 40 CFR § 51.308(f)(3)(iii) states, *"The reasonable progress goals established by the State are not directly enforceable but will be considered by the Administrator in evaluating the adequacy of the measures in the implementation plan in providing for reasonable progress towards achieving natural visibility conditions at that area."*
H. 40 CFR § 51.308(f)(3)(iv) states, *"In determining whether the State's goal for visibility improvement provides for reasonable progress towards natural visibility conditions, the Administrator will also evaluate the demonstrations developed by the State pursuant to paragraphs (f)(2) and (f)(3)(ii)(A) of this section and the demonstrations provided by other States pursuant to paragraphs (f)(2) and (f)(3)(ii)(B) of this section."*

The regional haze rules do not specify a specific threshold or bright line for each of the four factors to make this determination. The rules do imply that the four factors are tied to a state's reasonable progress to the rule's goal of natural visibility by 2064. The rules allow the specific circumstances in each state dictate how those four factors will inform that state's decision.

1. DANR considered the cost of compliance. DANR identified the potential cost of the controls for both GCC Dacotah and Pete Lien and Sons on a $ per ton basis. DANR considered if the projected costs of approximately $1,700 per ton of nitrogen oxide emission reduction and approximately $6,500 per ton of sulfur dioxide emission reduction, and $34,500 per ton of nitrogen oxide emission reduction were cost effective at GCC Dacotah and Pete Lien and Sons, respectively. DANR analyzed the specifics of its situation to make this determination.

   The Regional Haze Rule requires states to consider five additional factors when developing long-term strategies and subsequent reasonable progress goals, found at 40 CFR § 51.308(f)(3)(iv)(A)-(E). 40 CFR § 51.308(f)(2)(iv)(E) requires the states to consider "the anticipated net effect on visibility due to projected changes in point, area, and mobile source emissions over the period addressed by the long-term strategy." The 2028 visibility projections and URP glideslope can be used as a tracking metric as part of South Dakota's evidence in its approach to determine the necessity of control measures, and what is considered a reasonable cost of those control measures. After analyzing the 2028 projections, DANR found that for both the Badlands National Park and Wind Cave National Park, the current emissions impacts are either on or below the uniform rate of progress to natural conditions without any adjustments to the glidepath. Also, for Badlands National Park, the current emission impacts would not exceed the adjusted uniform rate of progress until about calendar year 2035. For Badlands National Park, the calendar year 2028 projected emissions impacts would not exceed the adjusted uniform rate of progress until about calendar year 2045. For Wind Cave National Park, the current emission impacts would not exceed the adjusted uniform rate of progress until about calendar year 2055. Finally, for Wind Cave National Park, the calendar year 2028 projected emissions impacts would already meet the goal of natural background by 2064 using the adjusted uniform rate of progress. If the 2028 adjusted projections actually occur, Wind Cave National Park will have met the goal of natural background 30 years ahead of schedule. If the Class I Areas are meeting or projected to meet the natural background visibility goal, South Dakota has met the requirements of the Regional Haze Rule.

   South Dakota's codified law 1-41.3.4 states that DANR may not promulgate a regulation that is more stringent than the corresponding federal law. The United States Supreme Court made a decision regarding the Good Neighbor provision involving the National Ambient Air Standards. The Regional Haze Rule and the Good Neighbor provisions are different, but the concept is similar. In particular, the Court states "……. We agree with the Court of Appeals to this extent: EPA cannot require a State to reduce its output of pollution by more than is necessary to achieve attainment in every downwind State or at odds with the one-percent threshold the Agency has set. If EPA requires an upwind State to reduce emissions by more than the amount necessary to achieve attainment in every downwind State to which it is linked, the Agency will have overstepped its authority, under the Good Neighbor Provision, to eliminate those 'amounts [that] contribute . . . to nonattainment.'" For more information about this, please see Page 521 of the document found at the following link: https://www.supremecourt.gov/opinions/boundvolumes/572BV.pdf

Both South Dakota's statute and the decision of the United States Supreme Court implies that DANR may not require emission controls that go above and beyond the reasonable progress to natural conditions and cannot go beyond what is deemed natural conditions through the Regional Haze regulations. If the 2028 adjusted projections actually occur, Wind Cave National Park will have met the goal of natural background by 2064. Requiring additional controls that go beyond this requirement would be in contrary to South Dakota statutes and the intentions of the United States Supreme Court decision.

Involving a state's attainment status with the National Ambient Air Quality Standard, DANR would consider a higher $ per ton cost as reasonable for a nonattainment area compared to an attainment area. South Dakota is meeting each of the current National Ambient Air Quality Standards.

South Dakota also notes 40 CFR § 51.308(f)(3)(ii)(A) in its approach for its control measure cost effectiveness determination. This requirement provides a series of additional requirements for if the state's Reasonable Progress Goals are projected to be located above the URP glideslope: "If a State in which a mandatory Class I Federal area is located establishes a reasonable progress goal for the most impaired days that provides for a slower rate of improvement in visibility than the uniform rate of progress calculated under paragraph (f)(1)(vi) of this section, the State must demonstrate […]." This proves the Uniform Rate of Progress Glideslope is not merely an informal and insignificant planning tool, but instead clearly a metric necessarily required for the determination of adequacy or inadequacy.

South Dakota also emphasizes the existence of 40 CFR § 51.308(f)(3)(i), which states in part: "The long-term strategy and the reasonable progress goals must provide for an improvement in visibility for the most impaired days since the baseline period and ensure no degradation in visibility for the clearest days since the baseline period." South Dakota has met this requirement as evidenced by Figures 2-5 and 2-6, and therefore believes to be making reasonable progress.

DANR also considered South Dakota's facilities'impacts to visibility at the Class I areas. DANR would consider a higher $ per ton cost as reasonable if South Dakota's facilities are a major contributor to visibility impacts compared to if they are a minor source of impacts. If all South Dakota pollution sources are eliminated, South Dakota is projected to observe a 1% improvement in visibility at its Class I Areas and a 0% improvement in visibility at every other Class I Area in the country. In short, more than 99% of the impacts come from outside of South Dakota.

Considering the above facts and under South Dakota's current situation, DANR does not consider the projected costs of approximately $1,700 per ton of nitrogen oxide emission reduction and approximately $6,500 per ton of sulfur dioxide emission reduction, and $34,500 per ton of nitrogen oxide emission reduction to be cost effective at GCC Dacotah and Pete Lien and Sons, respectively. It is therefore not reasonable to require the additional emission controls at this time.

It should be noted that GCC Dacotah submitted updated information on its cost analysis. Due to the materials and supply chain issues, the cost of the potential control measures has increased the projected cost. DANR has also observed and experienced a significant increase in equipment costs due to material and supply chain issues and expects the costs to continue to rise for the foreseeable future. DANR did not review the increased costs because DANR has already considered a lower cost as not reasonable at this time.

2. DANR considered the time necessary for compliance. DANR identified that Wind Cave National Park is projected to meet the adjusted national background goal in 2064 by 2028 and Badlands National Park will be about 70% of the goal by 2028 and the potential timelines for installation of the control systems.

3. DANR considered the energy and non-air quality environmental impacts of compliance. DANR considered the additional increase in electricity demand, the safety concerns associated with transport and storage of ammonia, and the impact of ammonia slip from the control system. The Rapid City area has high levels of particulate matter (dust). As such, DANR has developed a Natural Events Action Plan for the Rapid City area. This plan is designed to help maintain compliance with the particulate matter National Ambient Air Quality Standard. South Dakota is meeting each of the current National Ambient Air Quality Standards, and DANR is prioritizing maintaining and meeting these standards over the visibility goal of natural background by 2064 that South Dakota is projected to already meet by 2028. As such, the risk ever so slight to a potential violation of the National Ambient Air Quality Standard outweighs the small potential (less than 1%) improvement to visibility. DANR does not consider the risk to Rapid City's attainment of the particulate matter National Ambient Air Quality standard is justified under the current circumstances. South Dakota determined that additional controls would have potential adverse environmental impacts, and as such would not require those controls during this planning period.

4. DANR considered the remaining useful life of both GCC Dacotah and Pete Lien and Sons. Both facilities are expected to operate for the foreseeable future and are expected to operate beyond the projected useful 20-year life of the potential control systems.

Under the specific circumstances in South Dakota, DANR does not consider the cost on a dollar per ton basis is reasonable to require the additional emission controls (factor 1). Since Wind Cave National Park is projected to meet the adjusted background goal by 2028 and Badlands National Park will be about 70% of the goal by 2028, additional controls are not required to meet the requirements of the Regional Haze Program (factor 2). In addition, DANR does not consider the risk to Rapid City's attainment of the particulate matter National Ambient Air Quality standard is justified under the current circumstances (factor 3). As such, DANR does not recommend requiring additional controls at GCC Dacotah and Pete Lien and Sons at this time.

3.3.3 Technical Documentation Used To Determine Control Measures

40 CFR § 51.308(f)(2)(iii) states: ***"The State must document the technical basis, including modeling, monitoring, cost, engineering, and emissions information, on which the State is relying to determine the emission reduction measures that are necessary to make reasonable progress in each mandatory Class I Federal area it affects.*** The State may meet this requirement by relying on technical analyses developed by a regional planning process and approved by all State participants. ***The emissions information must include, but need not be limited to, information on emissions in a year at least as recent as the most recent year for which the State has submitted emission inventory information to the Administrator in compliance with the triennial reporting requirements of subpart A of this part.*** However, if a State has made a submission for a new inventory year to meet the requirements of subpart A in the period 12 months prior to submission of the State Implementation Plan, the State may use the inventory year of its prior submission."

In order to satisfy the technical modeling documentation requirement, South Dakota relied on the modeling information and technical analyses developed by WRAP. DANR relied on the use of WRAP and Ramboll's modeling. DANR will continue to work with WRAP in its effort to run models to determine if South Dakota is meeting its reasonable progress and long term strategy goals.

In order to satisfy the technical monitoring documentation requirement, DANR used the IMPROVE monitoring data available on the IMPROVE website for its Class I areas. South Dakota is a member of WRAP and relied on the monitoring information and technical analyses developed by WRAP to accomplish this requirement.

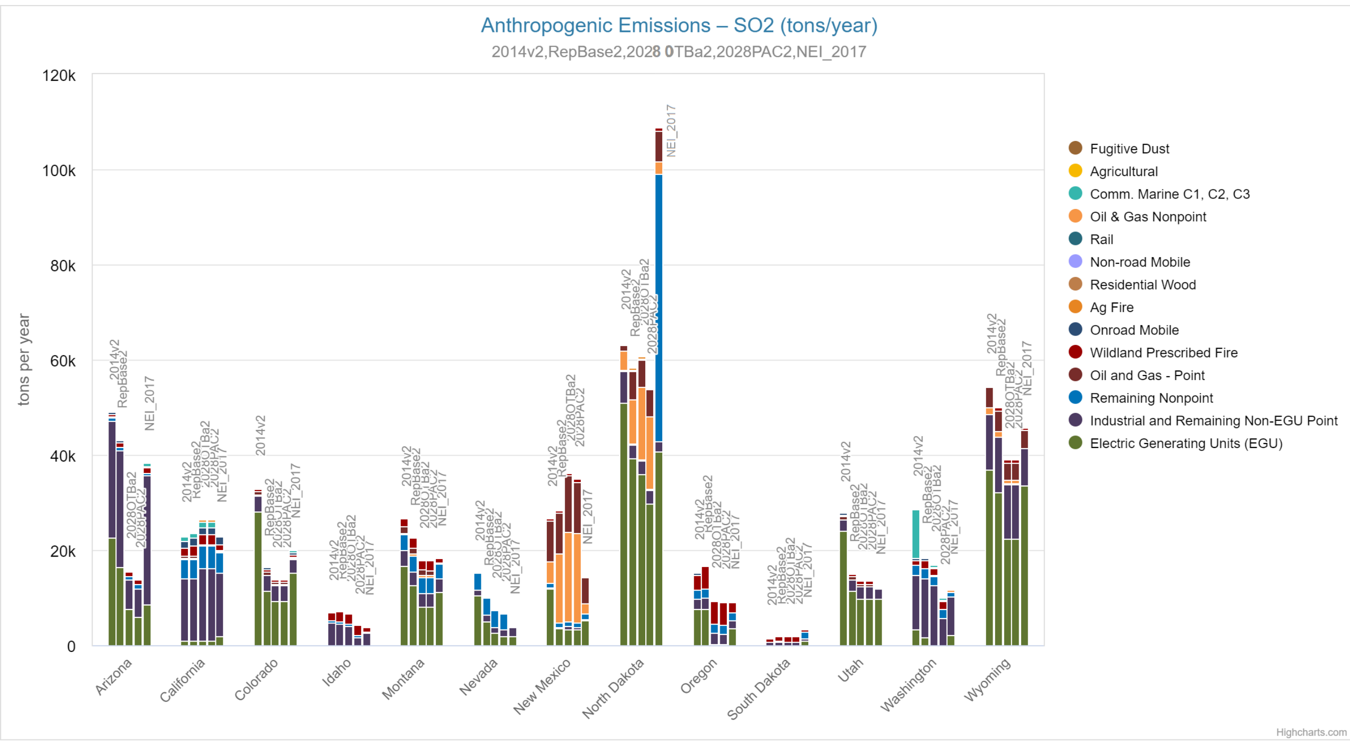
The technical cost documentation requirement is satisfied through the above four factor analysis.

The technical engineering documentation requirement is satisfied through the above four factor analysis.

In order to satisfy the emissions information requirement, South Dakota relied on the emissions information and technical analyses developed by WRAP. DANR used WRAP's emissions inventories for the baseline emissions year 2014 which reflects a composite interpretation of emissions for the base 2014-2018 period, and WRAP's CAMx2028OTBa2 (2028 On The Books Scenario a2) emissions inventory which reflects projected year 2028 emissions. The projected year 2028 emissions represents base period emissions projected to 2028, accounting for estimates of the effect of previously installed controls while also assuming other growth and control factors. DANR will continue to work with WRAP in its effort to update emission inventories to determine if South Dakota is meeting its reasonable progress and long term strategy goals. Currently, WRAP is maintaining this documentation at the following websites:
http://vista.cira.colostate.edu/TSS/Results/HazePlanning.aspx
http://views.cira.colostate.edu/tssv2/

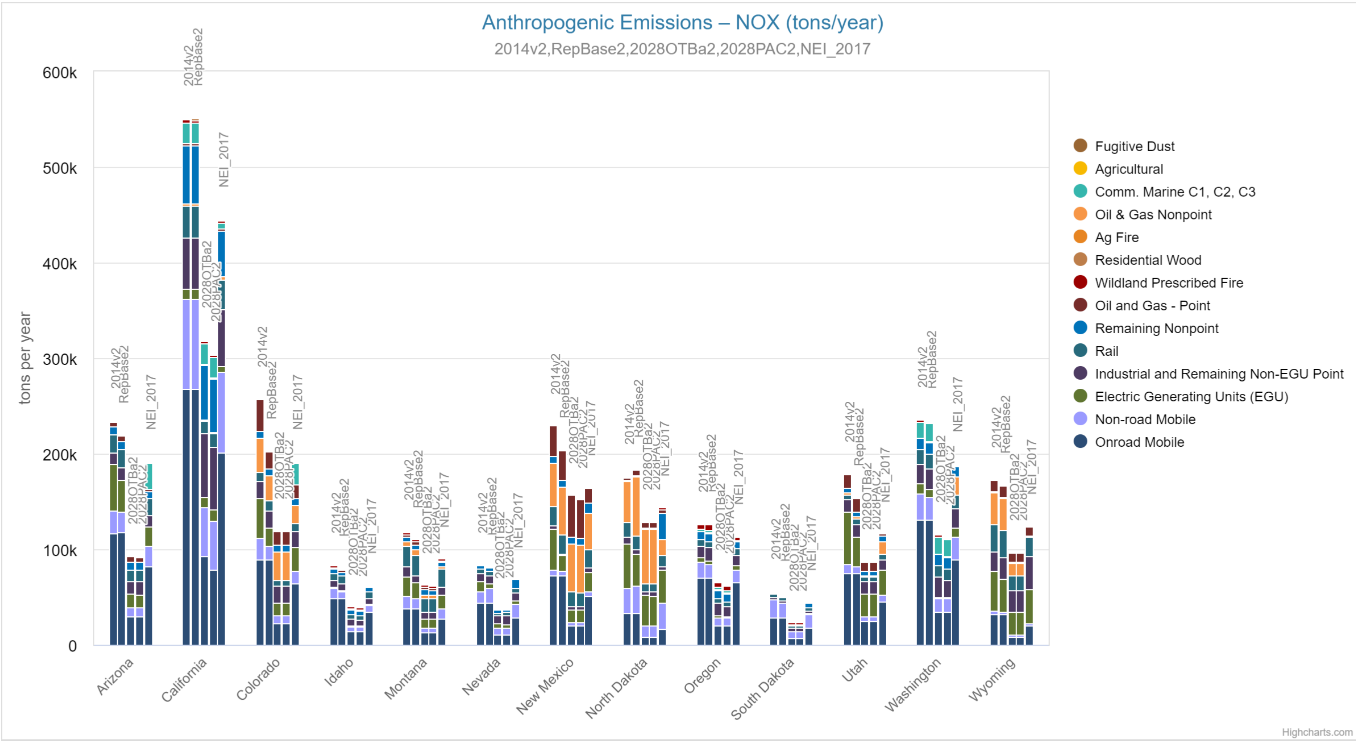
The following group of figures, Figures 3-47 through 3-49 have also been generated from the WESTAR-WRAP emissions scenarios efforts, and show a wider picture view, comparing South Dakota emissions to the rest of the WESTAR-WRAP and contiguous United States. Looking at Figures 3-47 and 3-48, the biggest takeaway is how insignificant South Dakota's anthropogenic emissions of NOx and SO2 are, compared to other states. Figure 3-49 shows a similar picture, as no counties in South Dakota are projected to emit significant amounts of NOx in 2028.

Figure 3-47 -- A comparison of SO2 emissions information between five sources of emissions information, and between the WRAP states



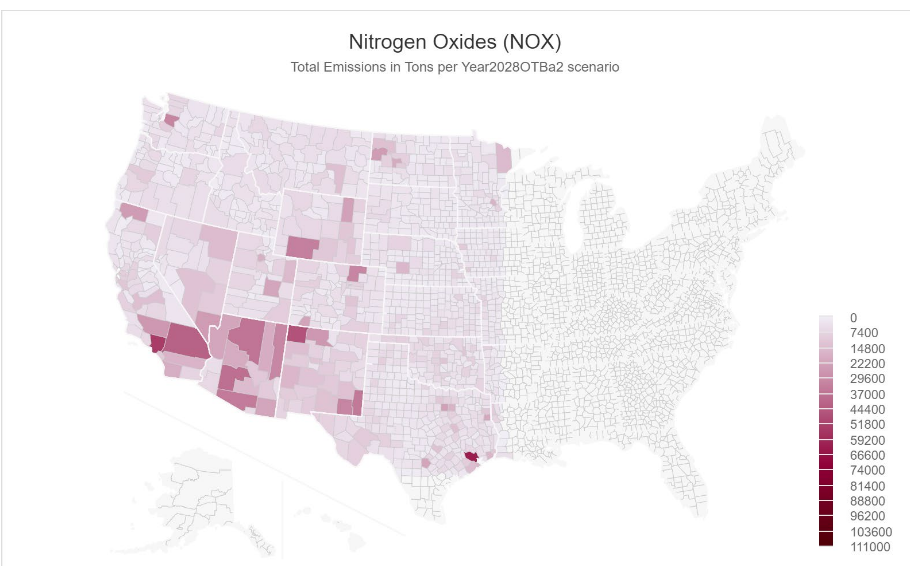
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-48 -- A comparison of NOx emissions informatin between five sources of emissions information, and between the WRAP states



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 3-49 -- A comparison between western United States counties' NOx emissions in the year 2028 according to the 2028OTBa2 scenario



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

3.3.4 Enforceable Emission Limitations And Compliance Schedules To Achieve Reasonable Progress Goals

40 CFR § 51.308(f)(2) states: "Long-term strategy for regional haze. Each State must submit a long-term strategy that addresses regional haze visibility impairment for each mandatory Class I Federal area within the State and for each mandatory Class I Federal area located outside the State that may be affected by emissions from the State. ***The long-term strategy must include the enforceable emissions limitations, compliance schedules, and other measures that are necessary to make reasonable progress,*** as determined pursuant to (f)(2)(i) through (iv). In establishing its long-term strategy for regional haze, the State must meet the following requirements:"

As the final step in completing the long term strategy, South Dakota must address what enforceable emissions limitations, compliance schedules, and other measures are necessary to ensure that any changes made at the source actually happen. These measures address deadlines for implementation, and provisions to ensure the measures are enforceable which include record keeping requirements, reporting requirements, averaging times, and monitoring requirements.

This requirement impacts South Dakota's only Best Available Retrofit Technology (BART)-eligible source (Big Stone Power Plant) from the first implementation period. The BART requirements, BART emission limits, and compliance deadlines for Big Stone Power Plant have been established in South Dakota's rules. The BART emission limits and specific control measures that will be established in Big Stone Power Plant's air quality permit will be open to states, the public, and any interested party for comment and ensure the BART permit requirements are enforceable in a practical matter.

Currently, DANR developed a Title V air quality permit program which is required prior to construction for new sources and modifications to existing sources. DANR established a construction permit program that separates the construction permit from the Title V air quality permit program. The BART emission limits and control measures will be included in a construction permit and eventually in the Title V air quality permit.

Any new future emission limits will be established in South Dakota's rules and adopted into South Dakota's State Implementation Plan. This will allow states, the public, and any interested party to comment on the rules to ensure the BART requirements are enforceable in a practical matter.

4 Reasonable Progress Goals

4.1 Projected Reasonable Progress Goals

40 CFR § 51.308(f)(3)(i) states: ***"A state in which a mandatory Class I Federal area is located must establish reasonable progress goals (expressed in Deciviews) that reflect the visibility conditions that are projected to be achieved by the end of the applicable implementation period as a result of those enforceable emissions limitations, compliance schedules, and other measures required under paragraph (f)(2) of this section that can be fully implemented by the end of the applicable implementation period, as well as the implementation of other requirements of the CAA. The long-term strategy and the reasonable progress goals must***

provide for an improvement in visibility for the most impaired days since the baseline period and ensure no degradation in visibility for the clearest days since the baseline period."

40 CFR § 51.308(f)(3)(iii) states: "The reasonable progress goals established by the State are not directly enforceable but will be considered by the Administrator in evaluating the adequacy of the measures in the implementation plan in providing for reasonable progress towards achieving natural visibility conditions at that area."

40 CFR § 51.308(f)(3)(iv) states: "In determining whether the State's goal for visibility improvement provides for reasonable progress towards natural visibility conditions, the Administrator will also evaluate the demonstrations developed by the State pursuant to paragraphs (f)(2) and (f)(3)(ii)(A) of this section and the demonstrations provided by other States pursuant to paragraphs (f)(2) and (f)(3)(ii)(B) of this section."

The EPA published the *Guidance for Setting Reasonable Progress Goals under the Regional Haze Rule, 2007*, for setting reasonable progress goals. The basic steps include:

1. Establish baseline and natural visibility conditions;
2. Determine the glide path or uniform rate of progress;
3. Identify and analyze the measures aimed at achieving the uniform rate of progress using the following approaches:
   a. Identify the key pollutants, sources and/or source categories that are contributing to visibility impairment at each Class I area. The sources of impairment for the most impaired and least impaired days may differ;
   b. Identify the control measures and associated emission reductions that are expected to result from compliance with existing rules and other available measurements for the sources and source categories that contribute significantly to visibility impairment;
   c. Determine what additional control measures would be reasonable based on the statutory factors and other relevant factors for the sources and/or source categories you have identified;
   d. Estimate through the use of air quality models the improvement in visibility that would result from implementation of the control measures you have found to be reasonable and compare this to the uniform rate of progress; and
4. Establish the reasonable progress goals.

South Dakota's current air quality rules under Administrative Rules of South Dakota (ARSD) article 74:36 – Air Pollution Control Program, currently protects and improves visibility in Class I areas. Examples of existing rules that protect and improve visibility in Class I areas are listed below—these are also included in South Dakota's State Implementation Plan.

1. ARSD § 74:36:01:05 – Applicable requirements of Clean Air Act defined: Subsection (12) states "*Any national ambient air quality standard or increment or visibility requirement under Part C of Title I of the Clean Air Act, but only as it would apply to temporary sources permitted pursuant to § 504(e) of the Clean Air Act*";

2. ARSD § 74:36:01:10 – Modification defined: Subsection (3) states "*The change requires or changes a case-by-case determination of an emission limit or other standard, a source-specific determination for temporary sources of ambient impacts, or a visibility or increment analysis*";
3. ARSD § 74:36:02:01 – Air quality goals: Subsection (3) states one of the goals is "*optimization of visibility*";
4. ARSD § 74:36:04 – Operating permits for minor sources and § 74:36:05 – Operating permits for Part 70 sources: The permits issued under these chapters require sources to meet all applicable emission limits, demonstrate compliance, monitoring, recordkeeping and reporting requirements to ensure compliance with all applicable requirements of the Clean Air Act;
5. ARSD §§ 74:36:06 – Regulated Air Pollutant Emissions; 74:36:07 – New Source Performance Standards; 74:36:08 – National Emission Standards for Hazardous Air Pollutants, and ARSD § 74:36:12 – Control of Visible Emissions: These chapters restrict air emissions from regulated entities that contribute to visibility impairment and prohibits certain open burning practices such as open burning waste oil, rubber, waste tires, asphalt shingles, railroad ties, etc.;
6. ARSD § 74:36:09 – Prevention of Significant Deterioration: This chapter requires a visibility analysis to prevent sources subject to these requirements from contributing to visibility impairment in Class I Areas;
7. ARSD § 74:36:10 – New Source Review: This chapter requires a visibility analysis to prevent sources subject to these requirements from contributing to visibility impairment in Class I Areas; and
8. ARSD § 74:36:18 – Regulations for State Facilities in the Rapid City Area: This chapter restricts visible emissions from fugitive sources.

During the first implementation period, DANR adopted rules that established Best Available Retrofit Technology emission limits, recordkeeping requirements, monitoring requirements, and reporting requirements for Best Available Retrofit Technology-eligible sources that reduce their impacts on Class I areas. In addition, DANR adopted rules that require new major sources and modifications to existing major sources that are not subject to New Source Review to conduct a visibility impact analysis to ensure the proposal will not contribute to adverse impact on visibility in an mandatory Class I area. On the federal side, gains in visibility should have already occurred from the implementation of the Acid Rain Program and future gains will occur from the implementation of federal emission standards established for mobile sources and federal fuel standards.

Modeling the long term strategies to create the Reasonable Progress Goals for each Class I Area is an important part of the second implementation period of the Regional Haze Rule. This process reveals whether the efforts leading up to this point are stringent enough that the projected 2028 visibility at each of South Dakota's two Class I Areas will be on track with the uniform rate of progress glide path. The process also reveals whether or not an improvement in visibility for the most impaired days since the baseline period and no degradation in visibility for the clearest days since the baseline period will occur. Modeling of the long term strategies is conducted for both the 20% most impaired days and the 20% clearest days to thus be able to make this determination. The visibility of the 20% most impaired days and the 20% clearest days at the year 2028 (the end of the second implementation period) is compared to the uniform rate of progress glideslope at the year 2028, which allows South Dakota to determine how the visibility at its two Class I Areas compares to the long-term 2064 natural visibility conditions goal.

The projections of visibility conditions in 2028 at each Class I Area for both the 20% most impaired days and the 20% clearest days are South Dakota's reasonable progress goals, which are determined through the long term strategy. Modeling the long term strategy was able to occur after sources were selected for an emissions reduction control measure analysis, and after the four factor analysis of the selected sources was conducted.

The Regional Haze Rule mandates that the reasonable progress goals are to be based in part on "other measures required under paragraph (f)(2) of this section" which can be implemented in full by the end of the associated implementation period. These "other measures" can be interpreted as all the measures which the other states have deemed are necessary to make reasonable progress at their respective Class I Areas. Information regarding visibility impairment reducing measures taken by other states which jointly affect the visibility at South Dakota's two Class I Areas have been taken into consideration in the modeling conducted by WRAP and its contractor Ramboll. Ramboll's modeling has taken into consideration the long term strategies these other states have used in creating their reasonable progress goals. The inputs to this model are the measures each state has documented in their own State Implementation Plans as necessary for each of their own Class I Areas according to their own long term strategies. Regional cooperation has occurred through WRAP by all the 13 contiguous western US states plus Hawaii and Alaska in modeling the long term strategies and thus in creating the subsequent reasonable progress goals.

The long term strategy is to be projected to create the reasonable progress goals using modeling. Specifications of the model include the specific modeling platform, the base period of air quality data, and the base year of the modeling emissions inventory. The modeling that the WRAP states including South Dakota used to project the long term strategies into the reasonable progress goals was the CAMx air quality model provided by WRAP and WRAP's technical consultant Ramboll. This model not only takes into consideration the inputs from South Dakota, but all the 13 contiguous WRAP states. Inputs include all the emissions from each state which reflect the long term strategies they have determined as reasonable and necessary to make reasonable progress by the year 2028 as required by the Regional Haze Rule and the Clean Air Act. The reasonable progress goal values only reflect either control measures that have already been adopted (on the books controls) or those which will be adopted by the end of the implementation period. Therefore, any additional emissions reductions which a state had been contemplating was not included in the "on the books" model run.

The 2028 CAMxOTBa2 standard model run visibility projections can be seen in the below figures for both the Badlands and Wind Cave National Parks, and are compared again to the

Uniform Rate of Progress for reference. Three 2028 projection methods exist for each graph. The first is the EPA default projection method, which calculates relative change in different aerosol species between the 2028 model run and the baseline period for the 20% most impaired days and for the 20% clearest days, normalized to the 2014 monitoring data. The second and third projection methods aim to remove the effects of fire on the Most Impaired Days, and are the EPA Without Fire Projection and the Modeled MID (ModMid) Projection methods. The EPA Without Fire method uses the CAMx RepBase2 and 2028OTBa2 source apportionment results to eliminate fires from Canada and Mexico, and US wildfires and wildland prescribed fires. The Modeled MID method uses the same source apportionment results to eliminate the fire contributions from the modeled Most Impaired Days. Representative Baseline emissions scenario version 2 (RepBase2) represents emissions from the 2014-2018 period using point source information from the WESTAR-WRAP states. It also includes representative fire emissions developed by the Fire and Smoke Work Group (FSWG). RepBase2 was then modeled. A 2028 On-the-Books emissions scenario was also developed and modeled. Scenario 2028OTBa2 was modeled using point source information from the WESTAR-WRAP states—it also used the FSWG representative baseline fire emissions. The RepBase2 and 2028OTBa2 scenarios provide visibility projection estimates of the states' Reasonable Progress Goals.

The most important use of the 2028 On The Books (2028OTBa2) modeling scenario is comparing its 2028 projected visibility results to the Uniform Rate of Progress (URP) Glidepath. Various 2028 visibility projection approaches exist, including the EPAwoF and ModMID approaches. The modeling scenario is also used to estimate international anthropogenic and prescribed fire effects used in adjusting the URP Glidepath. Furthermore, relative changes in the 2028OTBa2 PM concentration estimates are in part used to create the relative response factors, which are used to project the IMPROVE 2014-2018 PM concentrations to 2028. The following emission estimates are available for use in the 2028OTBa2 modeling scenario: 1) WRAP-2014v2, 2) EPA-2016fh and EPA-2028fh, 3) CARB-2014 and CARB-2028, 4) WRAP-2028-EGU and WRAP-RB-EGU, 5) WRAP-2028-O&G and WRAP-RB-O&G, 6) WRAP-2028-Mobile, 7) WRAP-RB-Fires. The 2028OTBa2 and RepBase2 modeling results are used in a relative fashion to project the observed 2014-2018 visibility to 2028. The 2028OTBa2 anthropogenic emissions are processed using the Spare Matrix Operator Kernel Emissions (SMOKE) processing tool.

The Western Air Quality Study (WAQS) Cooperators and the Western Regional Air Partnership (WRAP) created a 2014 Photochemical Grid Model (PGM) modeling platform. This modeling platform helps support the State Implementation Plan writing process required by the Regional Haze Rule. Reasonable Progress Goals established by the states for the year 2028 are compared to the Uniform Rate of Progress Glidepath at the year 2028 to help states gauge if they are on track to natural visibility conditions by the year 2064. Having modeled 2028 visibility below the Glidepath at any given Class I Area indicates that particular Class I Area is ahead of schedule in attaining natural conditions by 2064. Three approaches exist for making 2028 future year visibility projections for the 20% Most Impaired Days using the WRAP-WAQS 2014 CAMx PGM modeling platform. These approaches are the EPA default projection approach, the EPA without fire (EPAwoF) approach, and the modeled most impaired days (ModMID) approach, and they differ based on the days that are used to develop the Relative Response Factors (RRFs) and based on how modeled fire impact days are handled. The EPA default visibility projection method bases its RRFs off of average modeled concentrations throughout the 2014 IMPROVE MIDs. This is the recommended approach for states to use when comparing their 2028 Reasonable Progress Goals to the URP glideslope. The EPAwoF method eliminates the contributions of fires when compared to the EPA default method. Finally, the ModMID approach removes the contributions of fires from the RepBase modeling results using source apportionment. Both the EPAwoF and ModMID projections use the RepBase2 high level source apportionment results without the contributions from fires. More information about the differences between these three approaches can be found from this URL: http://www.wrapair2.org/pdf/2028_Vis_Proj_WhitePaper_2020-07-24draft.pdf

For more information on the WRAP/ WAQS 2028 On The Books CAMx modeling, see the following model run specification sheet: https://views.cira.colostate.edu/docs/iwdw/platformdocs/WRAP_2014/EmissionsSpecifications_WRAP_RepBase2_and_2028OTBa2_RegionalHazeModelingScenarios_Sept30_2020.pdf

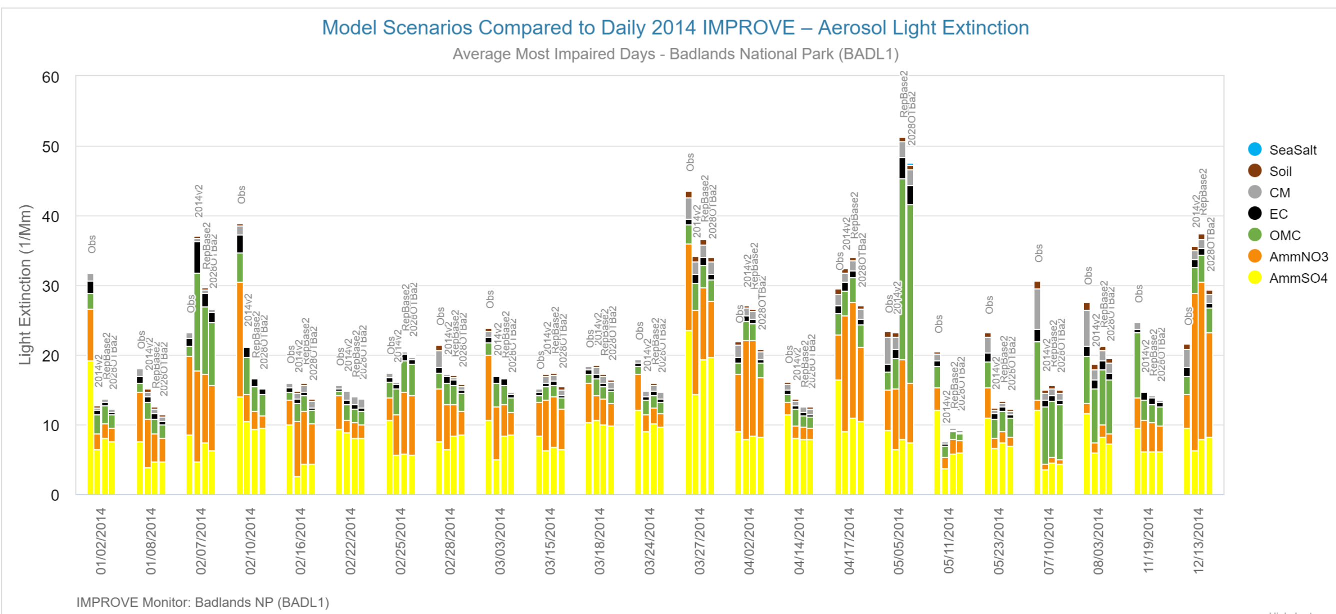
Regarding the first set of figures, Figures 4-1 through 4-4, these compare multiple interesting datasets for each of the seven main pollutant species on both the 20% Most Impaired Days and the Clearest Days at the Badlands and Wind Cave National Parks. Four bars exist for each either Most Impaired Day or Clearest Day, and in this order from left to right: 2014 IMPROVE observations, 2014v2 model scenario results, RepBase model scenario results, and 2028 model scenario results. This tool allows readers to directly compare between observed light extinction and modeled light extinction. Comparing between the observed IMPROVE light extinction and the 2014v2 model scenario allows the reader to evaluate how well the model performed, which provides context for how well the model may perform projecting 2028 light extinction.

Regarding Figure 4-1 and the Most Impaired Days data at Badlands National Park, there are a few important observations that can be made. First, generally speaking, when comparing between the 2014 observed and the 2028 modeled light extinction values for each Most Impaired Day, the 2028 projected value tends to be lower on average. This would agree with the 2064 glideslope chart data, indicating progress is being made through time, and that South Dakota is remaining at or below the 2064 natural conditions goal. Another observation is that when comparing between the 2014 IMPROVE observations and the 2014v2 model scenario run, oftentimes these values are significantly different, often differing by 5-10 light extinction units on average. Therefore, as another reminder, it is important to remember that modeling is not a perfect science, and to not take modeled results as absolute truth. They should instead be used and considered as a part of the total weight of evidence whenever conclusions about the data are determined and whenever decisions regarding the data are being made.

Regarding Figure 4-2 and the Most Impaired Days data at Wind Cave National Park, important observations are also to be pointed out. First, the difference in the y-axis scales between Figures 4-1 and 4-2 is noteworthy. The removal of the 2/25/2014 datapoint would yield almost identical y-axis scales, so it is helpful to think of Figure 4-1 as a blown-up version of Figure 4-2, minus the 2/25/2014 datapoint. Given that perspective, it is interesting to note that the 2014 IMPROVE observed data consistently deviate from the 2014v2 model run data, however the variations appears to differ by the same magnitude either higher or lower than the modeled data, therefore not creating an overall bias in either direction. Another overall trend is that the 2028 modeled data seem to be consistently lower than the 2014 modeled data, suggesting improvements in overall visibility through time, which is in agreement with the 2064 Glideslope charts which show South Dakota is meetings its 2064 natural visibility goals. One interesting datapoint to note again is the 2/25/2014 datapoint. Here, the 2014 observed data is substantially different from any of the modeled data. This might be attributed to a false artifact in the model runs, and not true to reality. Again, modeling is not a perfect science, and modeling results should not be taken as absolute truth.

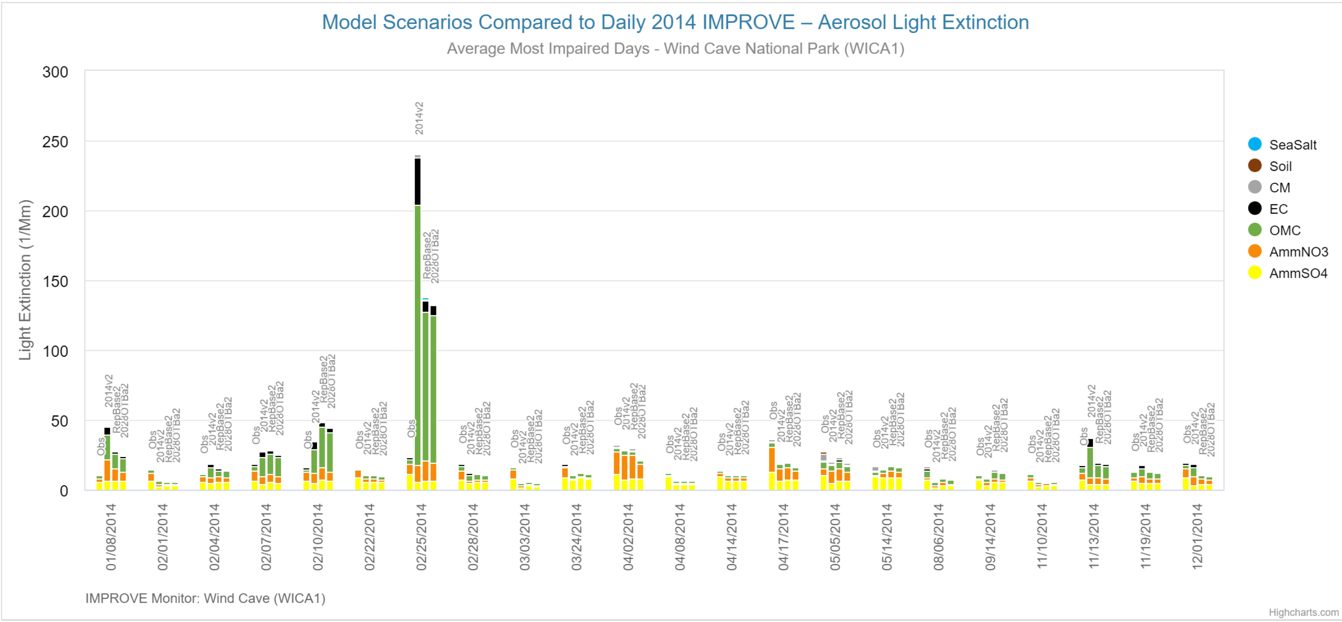
Regarding Figures 4-3 and 4-4 and the Clearest Days data at Badlands National Park and Wind Cave National Park, similar observations can be made to the Most Impaired Days data. However, South Dakota is well below the Clearest Days threshold established in 40 CFR §51.308(f)(3)(i), stated as follows: "[…] The long-term strategy and the reasonable progress goals must provide for an improvement in visibility for the most impaired days since the baseline period and ensure no degradation in visibility for the clearest days since the baseline period." South Dakota has included these charts anyway because the Clearest Days concept is an important concept in the Regional Haze Rule and shouldn't be completely excluded from public viewing and scrutiny.

Figure 4-1 -- Daily 2014 IMPROVE data and model scenarios comparison for the average of the 20% MIDs at Badlands National Park



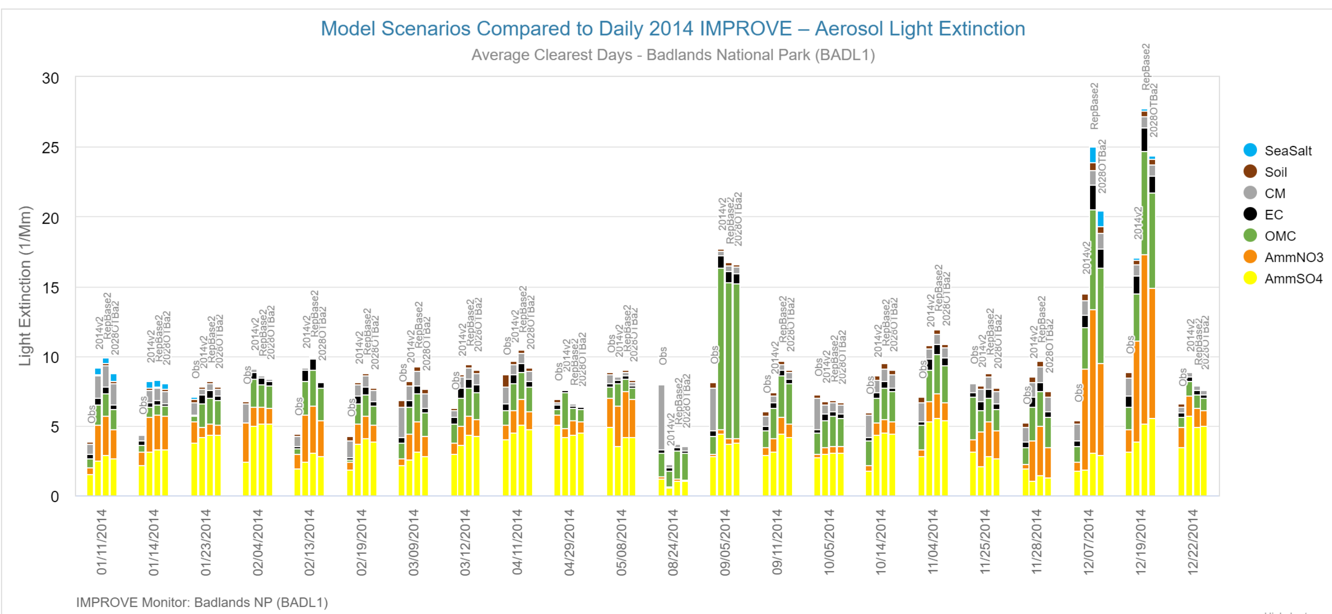
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-2 -- Daily 2014 IMPROVE data and model scenarios comparison for the average of the 20% MIDs at Wind Cave National Park



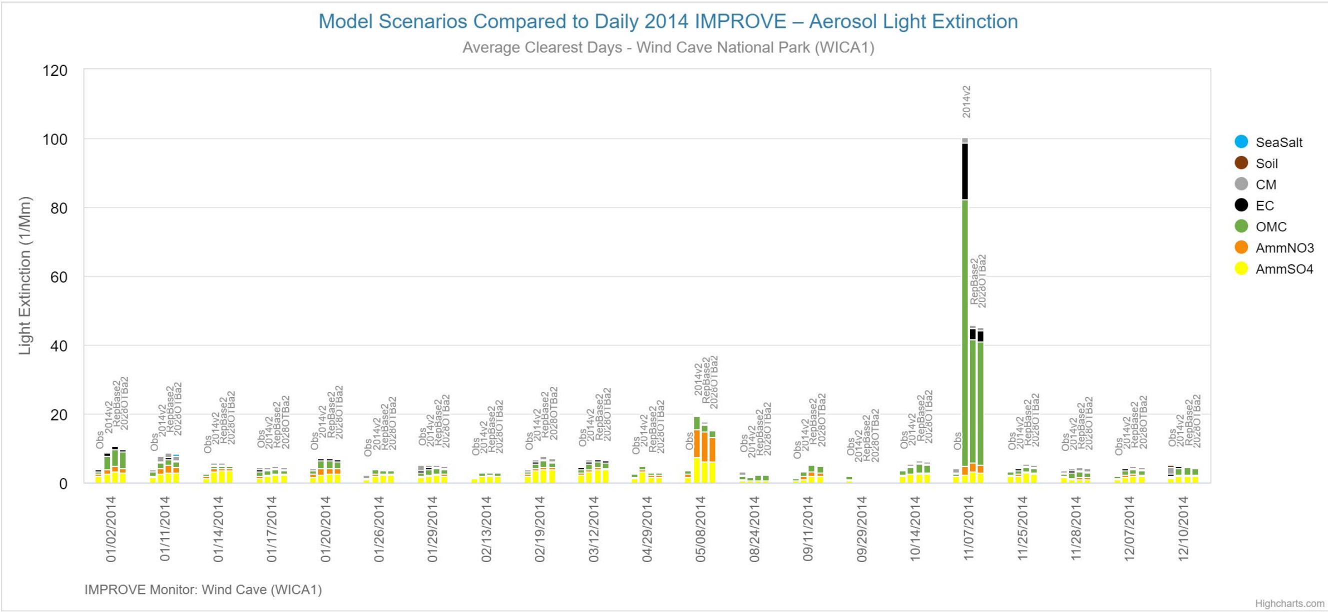
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-3 -- Daily 2014 IMPROVE data and model scenarios comparison for the average of the Clearest Days at Badlands National Park



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-4 -- Daily 2014 IMPROVE data and model scenarios comparison for the average of the Clearest days at Wind Cave National Park



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Regarding the next set of figures, Figures 4-5 through 4-8, these display similar information as the previous set of figures, namely, they compare between model results and the actual 2014 observed IMPROVE data for the average of the monitored Most Impaired Days and Clearest days at both Badlands and Wind Cave National Parks. Also similarly, these charts are able to allow readers to evaluate model performance when comparing between the 2014 IMPROVE data and the 2014v2 model scenario. Similarly, the charts also directly compare modeled light extinction through time, and therefore are able to reveal broad trends.

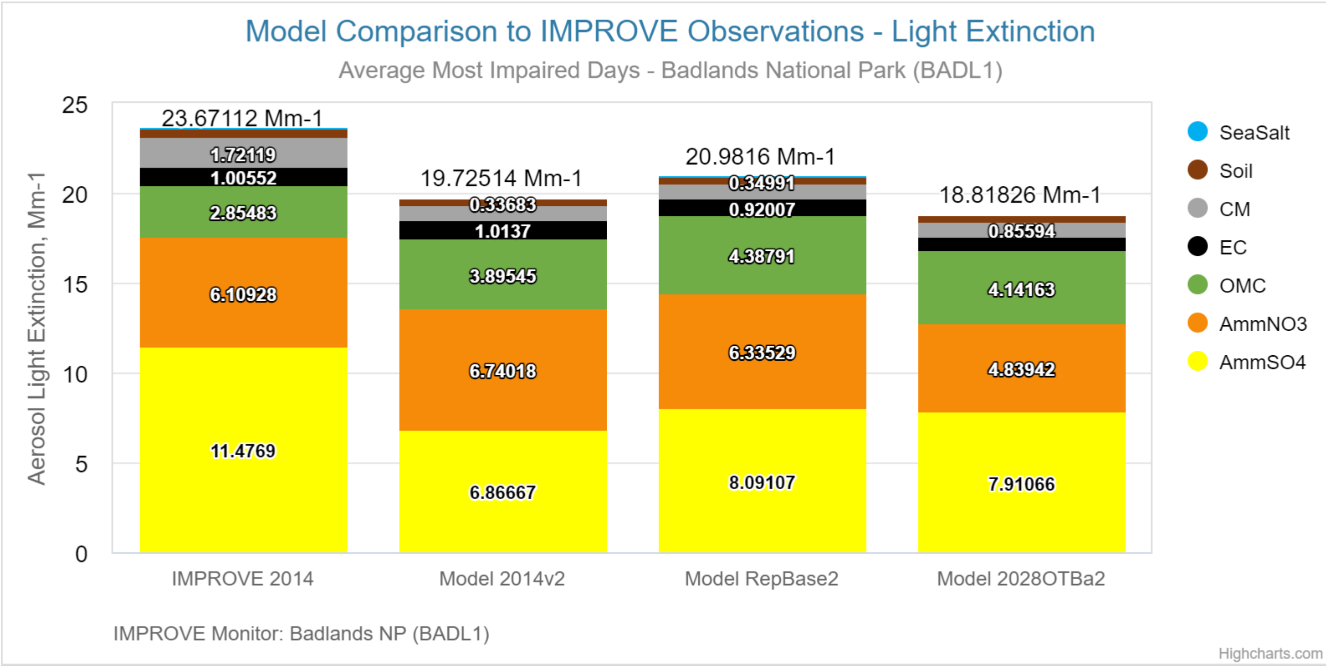
Regarding Figure 4-5 and light extinction for the average of the 20% Most Impaired Days at Badlands National Park, a few trends can easily be identified. First, there is only a slight overall decrease in modeled light extinction through time. Secondly, when comparing between the observed IMPROVE 2014 data to the 2014v2 modeled data, the model underestimates by about four light extinction units, almost all of which are due to underestimates of visibility impacts from the pollution species of ammonium sulfate. This is a relatively insignificant inaccuracy of the model, but not negligible, and thus provides a good reminder that modeled results are not absolute truth, and modeling is not a perfect science. Therefore all model results should be used in conjunction with other evidence, data, and analysis.

Regarding Figure 4-6 and light extinction for the average of the 20% Most Impaired Days at Wind Cave National Park, a few trends can easily be identified. First, there is quite a substantial decrease in modeled light extinction through time, which is indicative of progress towards the 2064 natural visibility conditions goal. Secondly, when comparing between the observed IMPROVE 2014 data to the 2014v2 modeled data, the model underestimates the visibility impacts of the pollutant species ammonium sulfate by about three units. The model also overestimates light extinction by about ten units overall, almost all of which comes from overestimates of the pollutant species organic carbon mass and elemental carbon. This overall overestimate is quite substantial, and thus provides a good reminder that modeled results are not absolute truth, and modeling is not a perfect science. Therefore all model results should be used in conjunction with other evidence, data, and analysis.

Regarding Figure 4-7 and light extinction for the average of the Clearest Days at Badlands National Park, model performance very closely mimics the associated charts for the average of the 20% Most Impaired Days with the exception that the 2014v2 modeled results overestimate and not underestimate the 2014 IMPROVE observed data. Otherwise, the chart is not of huge concern to South Dakota, as South Dakota is well below the Clearest Days threshold established in 40 CFR §51.308(f)(3)(i), stated as follows: "[…] The long-term strategy and the reasonable progress goals must provide for an improvement in visibility for the most impaired days since the baseline period and ensure no degradation in visibility for the clearest days since the baseline period." South Dakota has included these charts anyway because the Clearest Days concept is an important concept in the Regional Haze Rule and shouldn't be completely excluded from public viewing and scrutiny.

Regarding Figure 4-8 and light extinction for the average of the Clearest Days at both Badlands and Wind Cave National Parks, model performance very closely mimics the associated charts for the average of the 20% Most Impaired Days. Therefore, the analysis of such charts is nearly identical as well. Otherwise, the chart is not of much concern to South Dakota, as South Dakota is well below the Clearest Days threshold established in 40 CFR §51.308(f)(3)(i), stated as follows: "[…] The long-term strategy and the reasonable progress goals must provide for an improvement in visibility for the most impaired days since the baseline period and ensure no degradation in visibility for the clearest days since the baseline period." South Dakota has included these charts anyway because the Clearest Days concept is an important cornerstone concept in the Regional Haze Rule and shouldn't be completely excluded from public viewing and scrutiny.

Figure 4-5 -- Daily 2014 IMPROVE data and model scenarios comparison for the average of the 20% MIDs at Badlands National Park

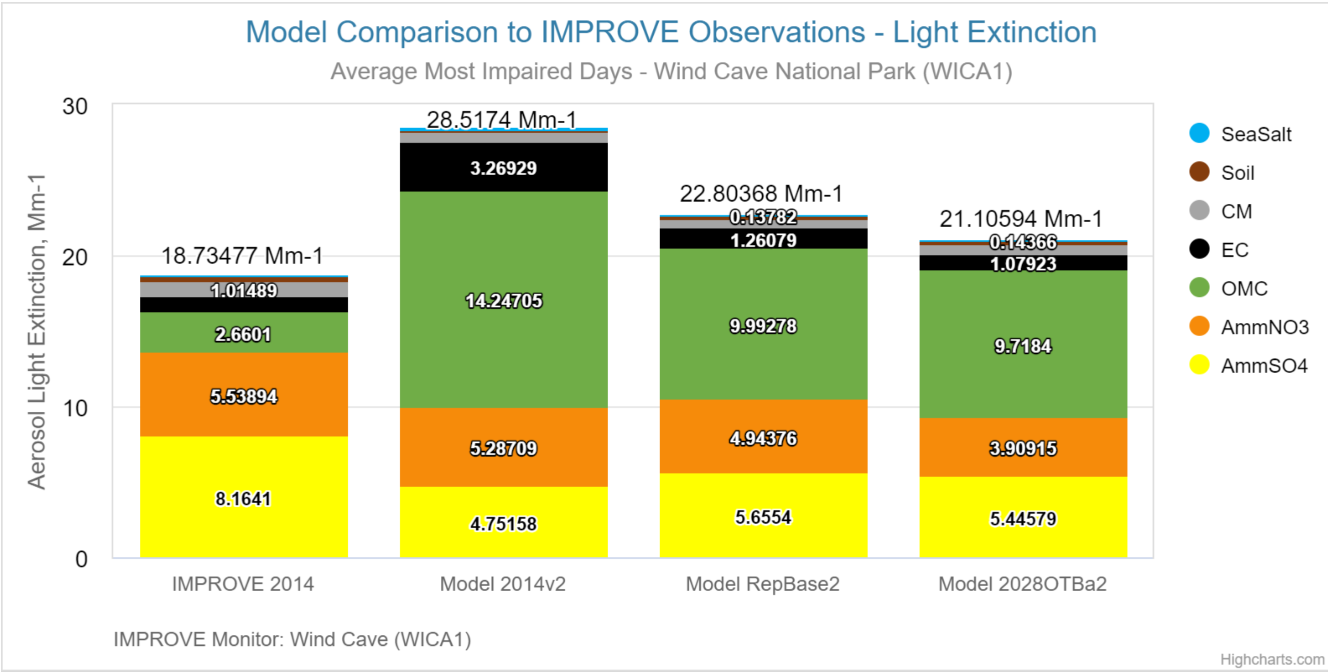


WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Table 4-1 -- Data from Figure 4-5 displayed in tabular form

Dataset Code	Site Code	Year	Group ID	Sea Salt	Soil	CM	EC	OMC	AmmNO3	AmmSO4
Model 2014v2	BADL1	2014	90	0.04003	0.33683	0.83228	1.0137	3.89545	6.74018	6.86667
Model RepBase2	BADL1	2014	90	0.04025	0.34991	0.8571	0.92007	4.38791	6.33529	8.09107
Model 2028OTBa2	BADL1	2014	90	0.04589	0.34772	0.85594	0.677	4.14163	4.83942	7.91066
IMPROVE 2014	BADL1	2014	90	0.04339	0.46001	1.72119	1.00552	2.85483	6.10928	11.4769

Figure 4-6 -- Daily 2014 IMPROVE data and model scenarios comparison for the average of the 20% MIDs at Wind Cave National Park

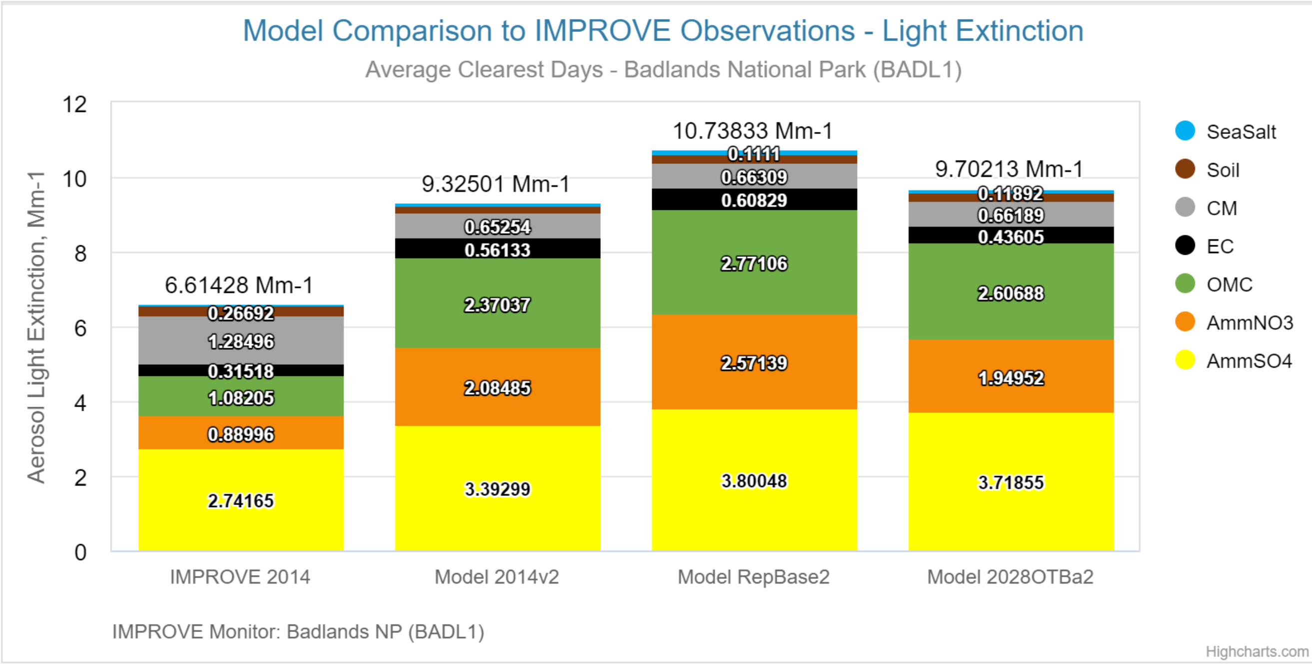


WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Table 4-2 -- Data from Figure 4-6 displayed in tabular form

Dataset Code	Site Code	Year	Group ID	Sea Salt	Soil	CM	EC	OMC	AmmNO3	AmmSO4
Model 2014v2	WICA1	2014	90	0.14831	0.16817	0.64591	3.26929	14.24705	5.28709	4.75158
Model RepBase2	WICA1	2014	90	0.13782	0.20134	0.61179	1.26079	9.99278	4.94376	5.6554
Model 2028OTBa2	WICA1	2014	90	0.14366	0.19904	0.61067	1.07923	9.7184	3.90915	5.44579
IMPROVE 2014	WICA1	2014	90	0.07443	0.32995	1.01489	0.95236	2.6601	5.53894	8.1641

Figure 4-7 -- Daily 2014 IMPROVE data and model scenarios comparison for the average of the Clearest Days at Badlands National Park

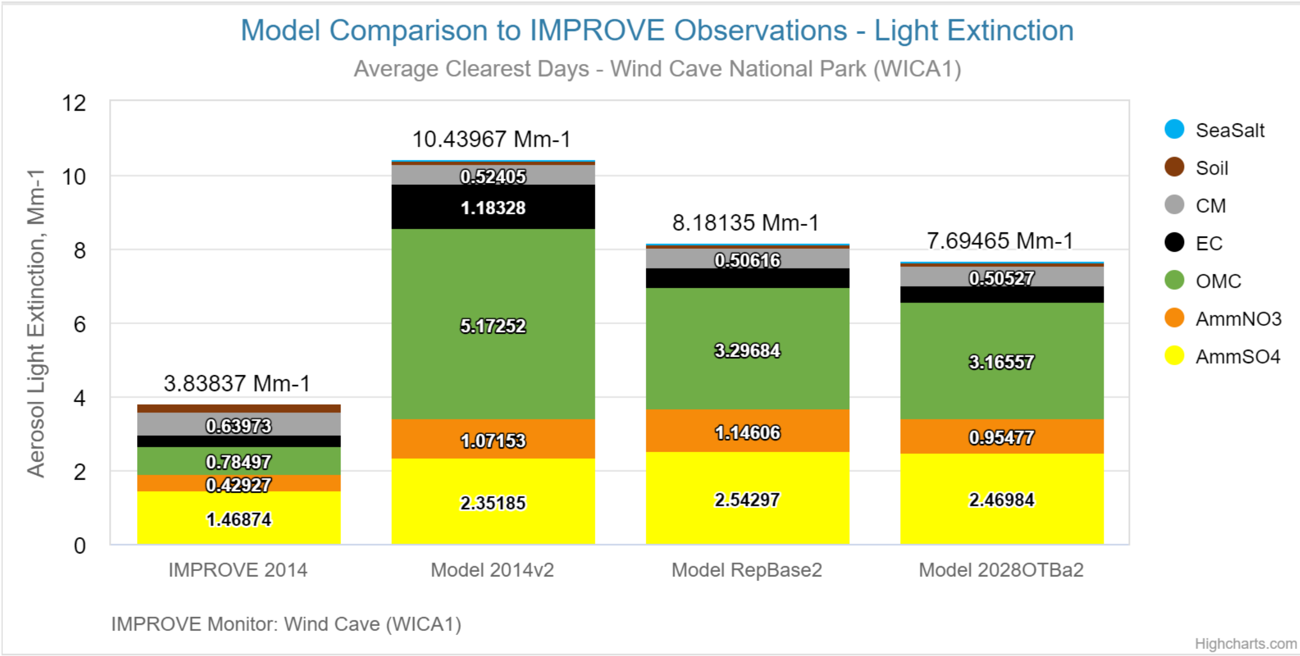


WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Table 4-3 -- Data from Figure 4-7 displayed in tabular form

Dataset Code	Site Code	Year	Group ID	Sea Salt	Soil	CM	EC	OMC	AmmNO3	AmmSO4
Model 2014v2	BADL1	2014	10	0.06883	0.1941	0.65254	0.56133	2.37037	2.08485	3.39299
Model RepBase2	BADL1	2014	10	0.1111	0.21292	0.66309	0.60829	2.77106	2.57139	3.80048
Model 2028OTBa2	BADL1	2014	10	0.11892	0.21032	0.66189	0.43605	2.60688	1.94952	3.71855
IMPROVE 2014	BADL1	2014	10	0.03356	0.26692	1.28496	0.31518	1.08205	0.88996	2.74165

Figure 4-8 -- Daily 2014 IMPROVE data and model scenarios comparison for the average of the Clearest Days at Badlands National Park



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Table 4-4 -- Data from Figure 4-8 displayed in tabular form

Dataset Code	Site Code	Year	Group ID	Sea Salt	Soil	CM	EC	OMC	AmmNO3	AmmSO4
Model 2014v2	WICA1	2014	10	0.05216	0.08428	0.52405	1.18328	5.17252	1.07153	2.35185
Model RepBase2	WICA1	2014	10	0.05071	0.10076	0.50616	0.53785	3.29684	1.14606	2.54297
Model 2028OTBa2	WICA1	2014	10	0.05921	0.09947	0.50527	0.44052	3.16557	0.95477	2.46984
IMPROVE 2014	WICA1	2014	10	0.03113	0.19167	0.63973	0.29286	0.78497	0.42927	1.46874

Regarding the next set of figures, Figures 4-9 through 4-28, a graphical and visual comparison is provided between the adjusted and unadjusted modeled 2028 visibility projections and the 2064 natural conditions glideslope, which gives a clear view of the visibility progress being made at each of South Dakota's Class I Areas. Furthermore, the y-axis scale is important to note, as this is not held constant between graphs. Some pollutant species contribute more to visibility impairment and some contribute less, therefore, it is most important to focus on the glideslope progress of those pollutant species that contribute the most to visibility impairment. It is also important to note that Figures 4-15 through 4-28 only depict the unadjusted 2064 glideslope, not the slopes adjusted for the visibility impairing effects of the source categories of international anthropogenic or U.S. prescribed fires. Furthermore, three 2028 visibility projection options can be seen on the charts, also known as the Reasonable Progress Goals. In most cases these three options are clustered close together, however when they are not, an average of the three can be estimated and pinpointed by the reader, or more weight can be attributed to the EPA Without Fire (EPAwof) point, which is the EPA recommended method. These 2028 estimates are

calculated following WRAP projections guidance found at the following URL:
https://www.wrapair2.org/pdf/2028_Vis_Proj_WhitePaper_2020-12-15v2.pdf

Regarding Figures 4-9 and 4-10: The overall unadjusted visibility trends on the 20% Most Impaired Days and the Clearest Days to 2064 at Badlands National Park is shown in Figure 4-9. Here, the average of the three 2028 visibility projection methods appears to sit right on the Glideslope, thus indicating that even including the effects of pollution from the source categories of international anthropogenic and U.S. prescribed fires, of which South Dakota has no control, Badlands National Park is on track to reaching its goal of natural visibility conditions by 2064. However, because South Dakota chose to adjust its 2064 glideslope to not account for the visibility impairing effects of international anthropogenic or U.S. prescribed fires, the slope if the glideslope line has decreased, as depicted in Figure 4-10. This decrease in glideslope slope causes all three 2028 visibility projections to fall well below the 2064 glideslope, indicating that it may not be warranted for South Dakota to consider adding any additional controls on its facilities during this second State Implementation Planning period in order to stay on track to achieving natural conditions at Badlands National Park by the year 2064.

Regarding Figures 4-11 and 4-14, a data normalization process was conducted, to better show the bigger picture regarding Figures 4-10 and 4-13. Data normalization is the process of organizing or presenting data so it appears similar and can be compared across fields. It was South Dakota's intent to show a breakdown of visibility impairing sources and their impacts when compared against each other, in the context of the 2028 visibility projection in association with the URP adjusted and unadjusted glideslopes. Four steps were taken to conduct this data normalization. The first step consisted of determining the species specific normalization factors. This was conducted by taking the 2028 OTBa2EPA visibility projection for each species, and dividing them by the CAMx 2028OTBa2 model results. The second step consisted of using the step one calculated normalization factors to calculate regional contributions to the 2028 visibility projection-- the annual regional source apportionment data is multiplied by the normalization factors found in step one, which results in normalized regional apportionment data. This data is now comparable to the 2028 visibility projection, which includes Rayleigh scattering. In the third step, South Dakota used the ammonium nitrate and ammonium sulfate normalization factors to calculate state/ sector contributions to the 2028 light extinction. The ammonium nitrate and ammonium sulfate normalization factors are multiplied by each of the state/ sector values. This allows for the state/ sector ammonium nitrate and ammonium sulfate values to correspond to the 2028 visibility projection for the US Anthropogenic section of the light extinction, and also allows South Dakota to differentiate its own sources' ammonium nitrate and ammonium sulfate visibility impairment from the rest of the country's ammonium nitrate and ammonium sulfate sources of visibility impairment. Step four consisted of simply converting the units from visibility impairment in inverse megameters to percent of total visibility impairment, allowing for an easier comparison to figures 4-10 and 4-13 respectively.

Regarding Figures 4-12 and 4-13: The overall unadjusted visibility trends on the 20% Most Impaired Days and the Clearest Days to 2064 at Wind Cave National Park is shown in Figure 4-12. Here, the average of the three 2028 visibility projection methods is below the Glideslope, thus indicating that even including the effects of pollution from the source categories of international anthropogenic and U.S. prescribed fires, of which South Dakota has no control, Wind Cave National Park is on track to reaching its goal of natural visibility conditions by 2064. However, because South Dakota chose to adjust its 2064 glideslope to not account for the visibility impairing effects of international anthropogenic or U.S. prescribed fires, the slope if the glideslope line has decreased, as depicted in Figure 4-13. This decrease in glideslope slope causes all three 2028 visibility projections to fall even further below the 2064 glideslope, indicating that South Dakota does not need to consider adding any additional controls on its facilities during this second State Implementation Planning period in order to stay on track to achieving natural conditions at Wind Cave National Park by the year 2064. Of important note, when using the adjusted glideslope for both international anthropogenic and prescribed fires, the projected 2028 visibility conditions will already be below the estimated 2064 natural conditions goal, therefore suggesting no additional controls will need to be placed on any facilities which negatively affect visibility at this Class I Area from this point forward, assuming the 2028 visibility projections are true.

Regarding Figures 4-15 and 4-16, 2028 Most Impaired Days projections indicate that the pollutant species ammonium nitrate at both Badlands and Wind Cave National Parks will be below the unadjusted 2064 glideslope, indicating that South Dakota may be able to disregard considering placing additional controls on its ammonium nitrate producing sources during this second State Implementation Planning period when considering these two Class I Areas. Furthermore, visibility conditions at 2028 are also projected to stay below the baseline period visibility conditions for the Clearest Days.

Regarding Figures 4-17 and 4-18, 2028 Most Impaired Days projections indicate that the pollutant species ammonium sulfate at both Badlands and Wind Cave National Parks will be below the unadjusted 2064 glideslope, indicating that South Dakota may be able to disregard considering placing additional controls on its ammonium sulfate producing sources during this second State Implementation Planning period when considering these two Class I Areas. Furthermore, visibility conditions at 2028 are also projected to stay below the baseline period visibility conditions for the Clearest Days.

Regarding Figures 4-19 and 4-20, 2028 Most Impaired Days projections indicate that the pollutant species coarse mass at Badlands National Park will be slight above the unadjusted glideslope. An adjusted version of the 2064 coarse mass glideslope is not available, however, any adjustments to decrease the slope of the glidepath would only push the 2028 projections closer to or below the glideslope, therefore South Dakota is not concerned about this pollutant species at this Class I Area. Furthermore, the y-axis of this chart indicates that the pollutant species coarse mass is not a significant contributor to visibility impairment at this Class I Area anyway. Regarding Wind Cave National Park, the 2028 visibility projections are above the 2064 glideslope, however, again, the adjusted 2064 glideslopes will only bring these projections closer to the Glideslope, and also the y-axis indicates that coarse mass is not a significant visibility impairing pollutant at this location. South Dakota is therefore not concerned about the coarse mass pollutant species at Wind Cave National Park during this implementation period. Furthermore, visibility conditions at 2028 are also projected to stay below the baseline period visibility conditions at both Class I Areas during the Clearest Days.

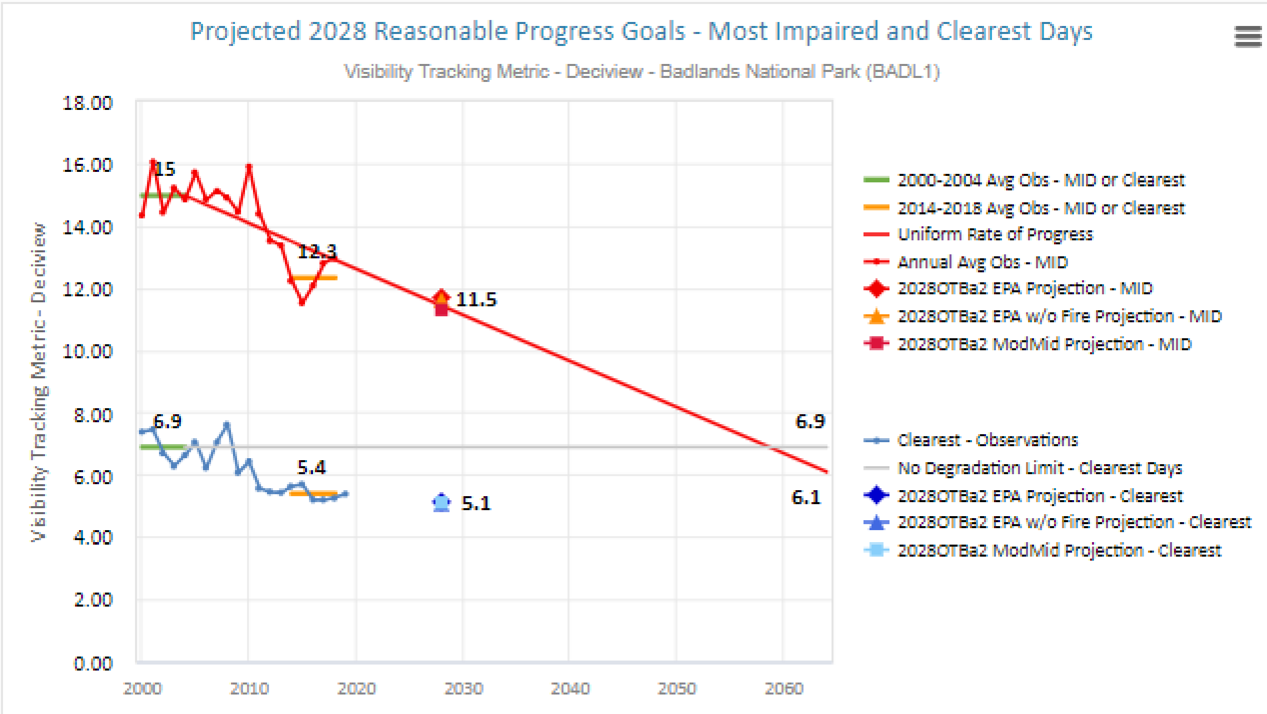
Regarding Figures 4-21 and 4-22, 2028 Most Impaired Days projections indicate that the pollutant species elemental carbon at both Badlands and Wind Cave National Parks will be below the unadjusted 2064 glideslope, indicating that South Dakota should not be concerned about this pollutant species during this second State Implementation Planning period when considering these two Class I Areas. Furthermore, visibility conditions at 2028 are also projected to stay below the baseline period visibility conditions for the Clearest Days.

Regarding Figures 4-23 and 4-24, the average of the 2028 Most Impaired Days projections indicate that the pollutant species organic mass at both Badlands and Wind Cave National Parks will be below or right on the unadjusted 2064 glideslope, indicating that South Dakota should not be concerned about this pollutant species during this second State Implementation Planning period when considering these two Class I Areas. Furthermore, visibility conditions at 2028 are also projected to stay below the baseline period visibility conditions for the Clearest Days.

Regarding Figures 4-25 and 4-26, the 2028 Most Impaired Days projections indicate that the pollutant species sea salt at both Badlands and Wind Cave National Parks will be slightly above the unadjusted 2064 glideslope. However, because sea salt produces an insignificant amount of visibility impairment at both these Class I Areas, South Dakota is not concerned about this pollutant species during this second State Implementation Planning period when considering these two Class I Areas. Furthermore, visibility conditions at 2028 are also projected to also be slightly above the baseline period visibility conditions for the Clearest Days, however these values are larger to such a small extinct, they can practically be considered to be right on the 2064 Glideslope, and therefore of no concern.

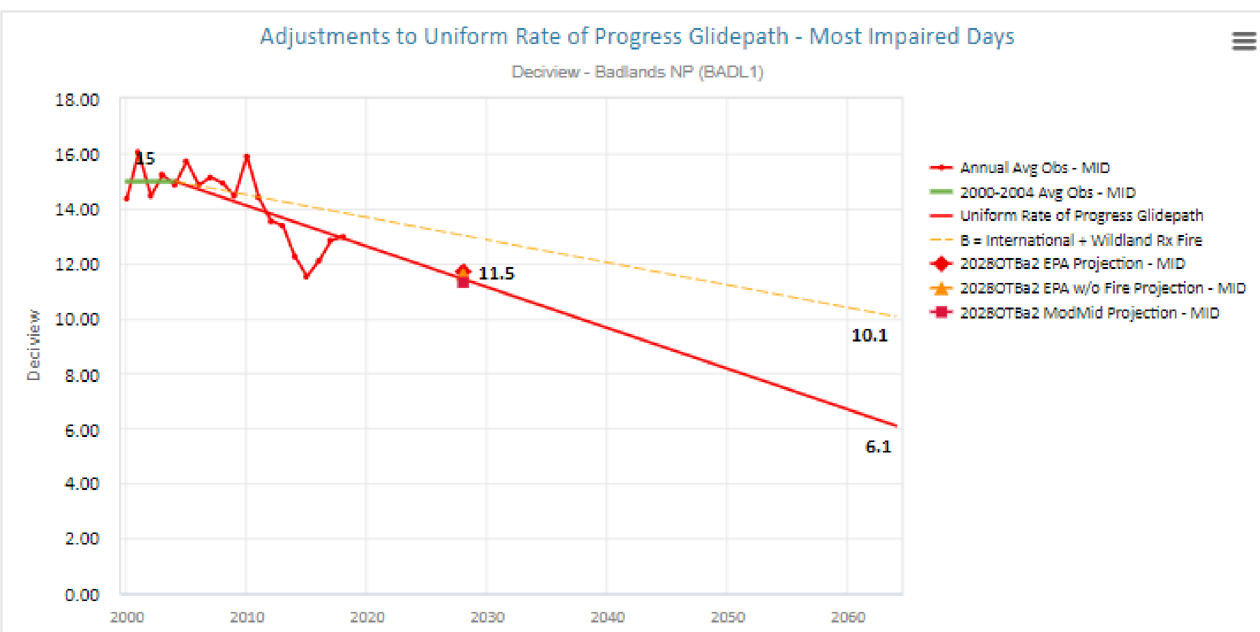
Regarding Figures 4-27 and 4-28, the average of the 2028 Most Impaired Days projections indicate that the pollutant species fine soil at both Badlands and Wind Cave National Parks will be below the unadjusted 2064 glideslope, indicating that South Dakota should not be concerned about this pollutant species during this second State Implementation Planning period when considering these two Class I Areas. Furthermore, visibility conditions at 2028 are also projected to stay below the baseline period visibility conditions for the Clearest Days.

Figure 4-9 -- The unadjusted 2028 visibility projections in Deciviews compared to the Uniform Rate of Progress Glideslope for Badlands National Park, for the Most Impaired and Clearest Days



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-10 -- The adjusted 2028 visibility projections in Deciviews compared to the Uniform Rate of Progress Glideslope for Badlands National Park, for the Most Impaired Days



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-11 -- Badlands Normalized Apportionment Data Plotted for the year 2028

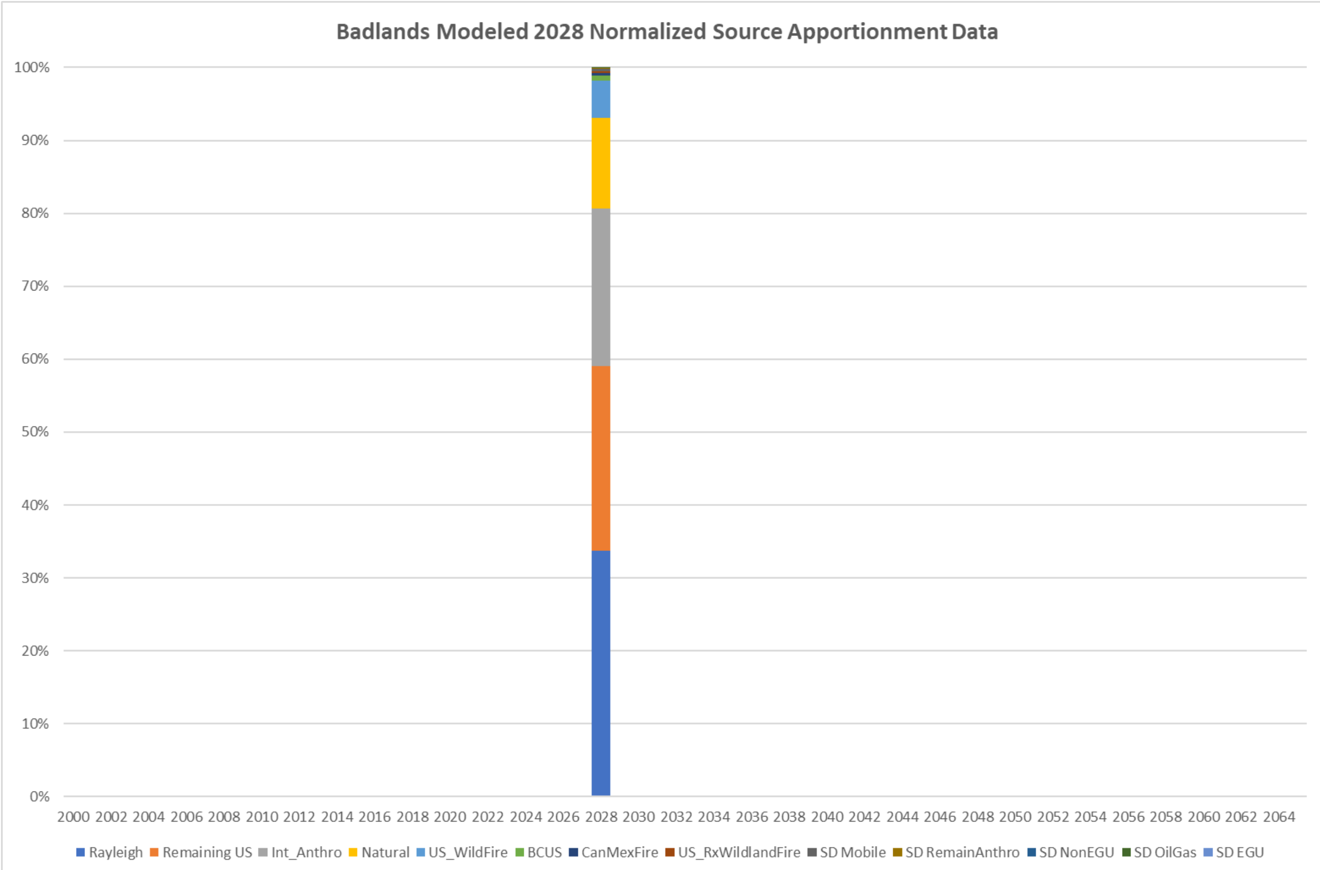
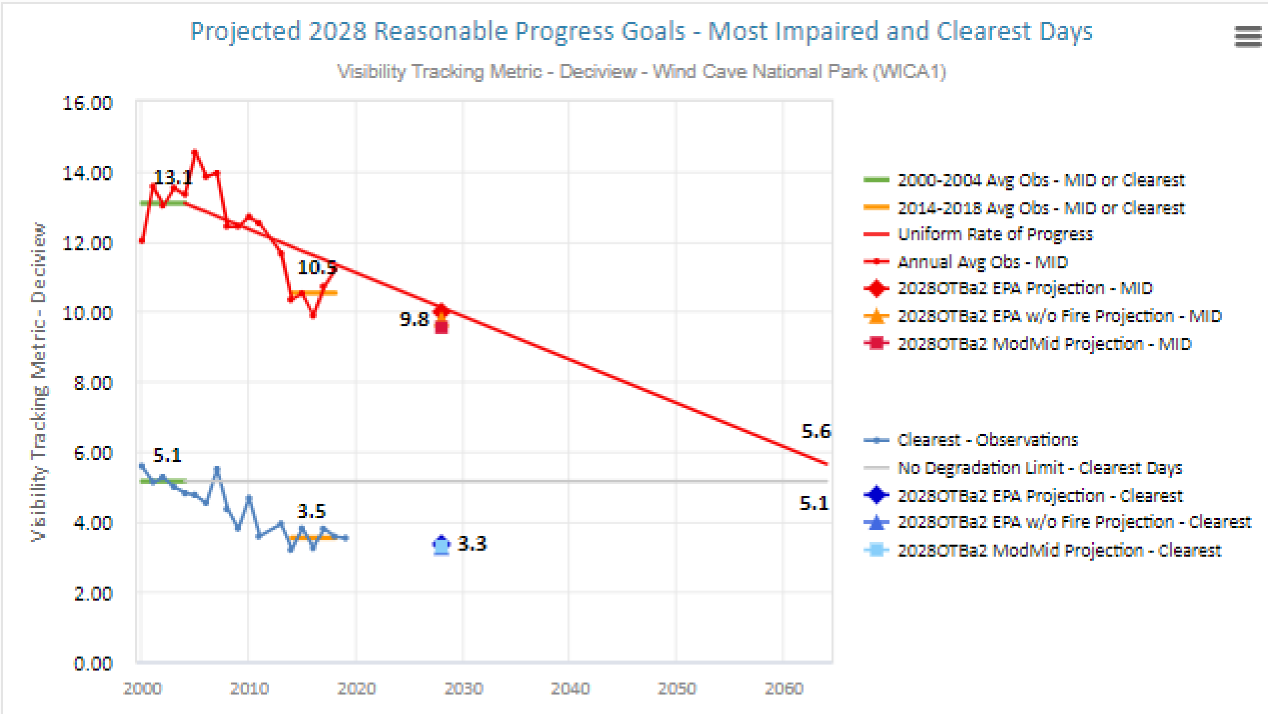
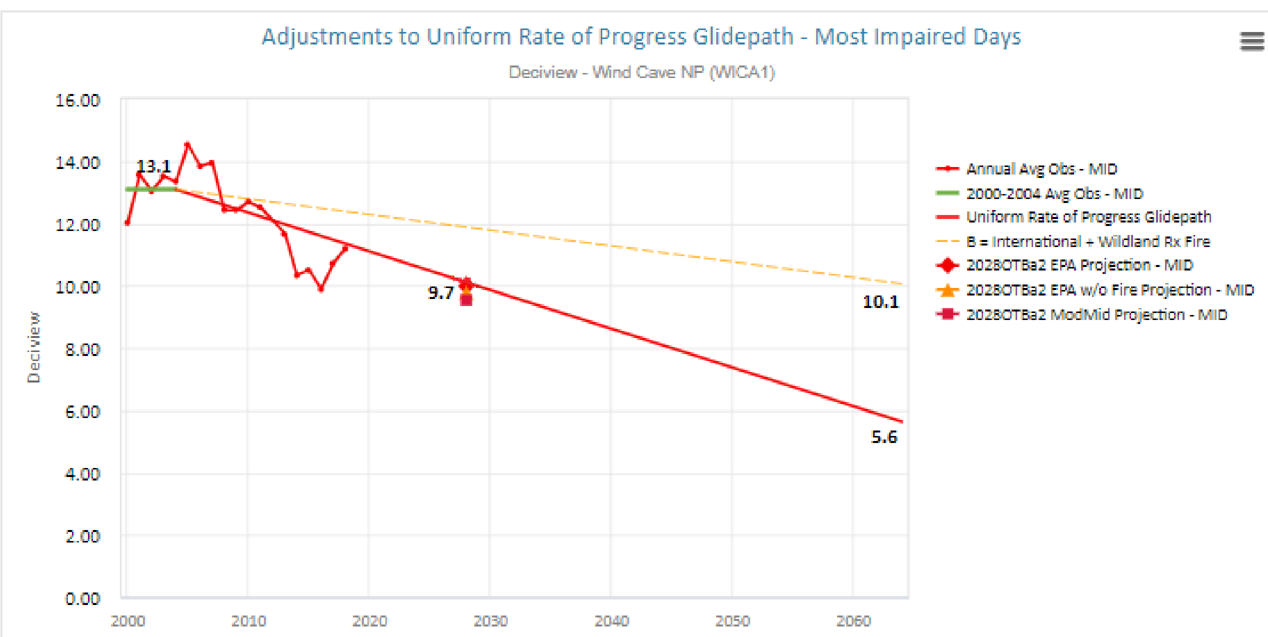


Figure 4-12 -- The unadjusted 2028 visibility projections in Deciviews compared to the Uniform Rate of Progress Glideslope for Wind Cave National Park, for the Most Impaired and Clearest Days



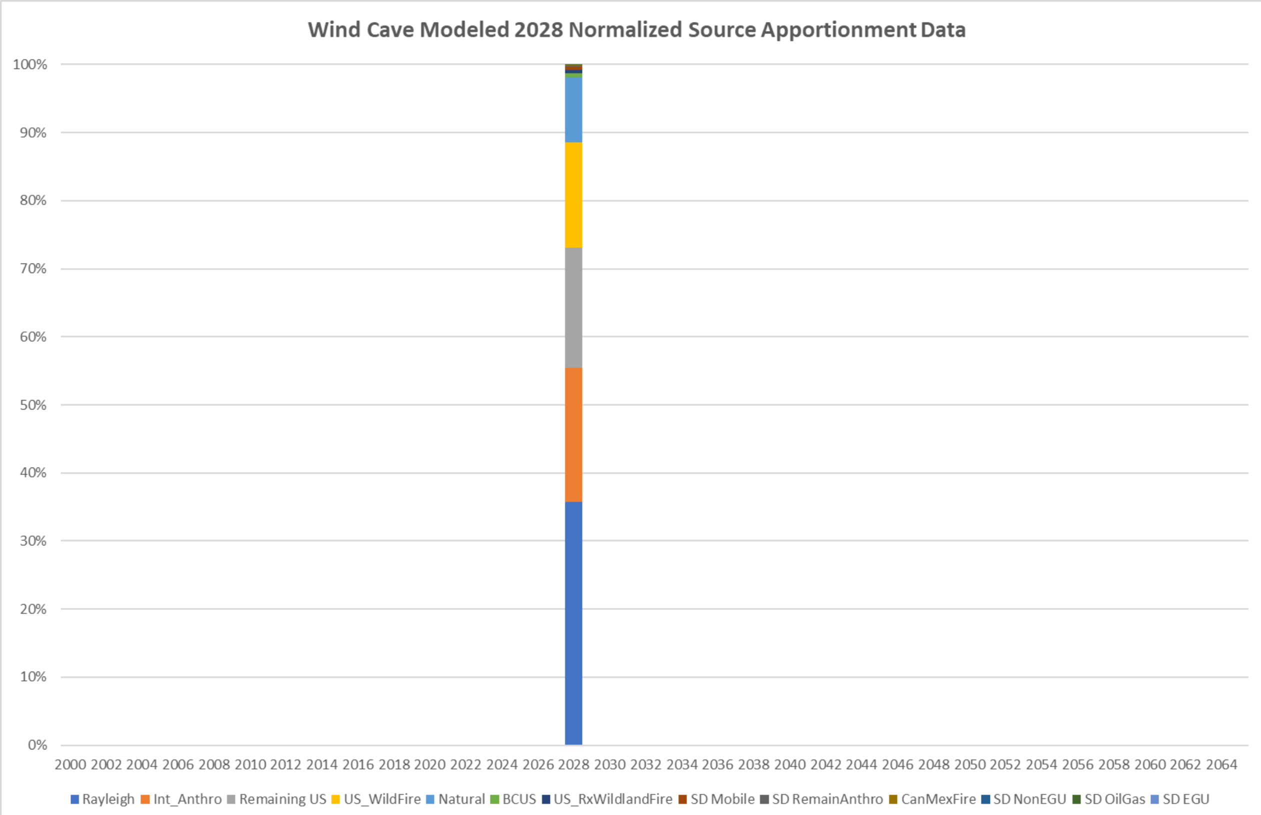
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-13 -- The unadjusted 2028 visibility projections in Deciviews compared to the Uniform Rate of Progress Glideslope for Wind Cave National Park, for the Most Impaired Days



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-14 -- Wind Cave Normalized Apportionment Data Plotted for the year 2028

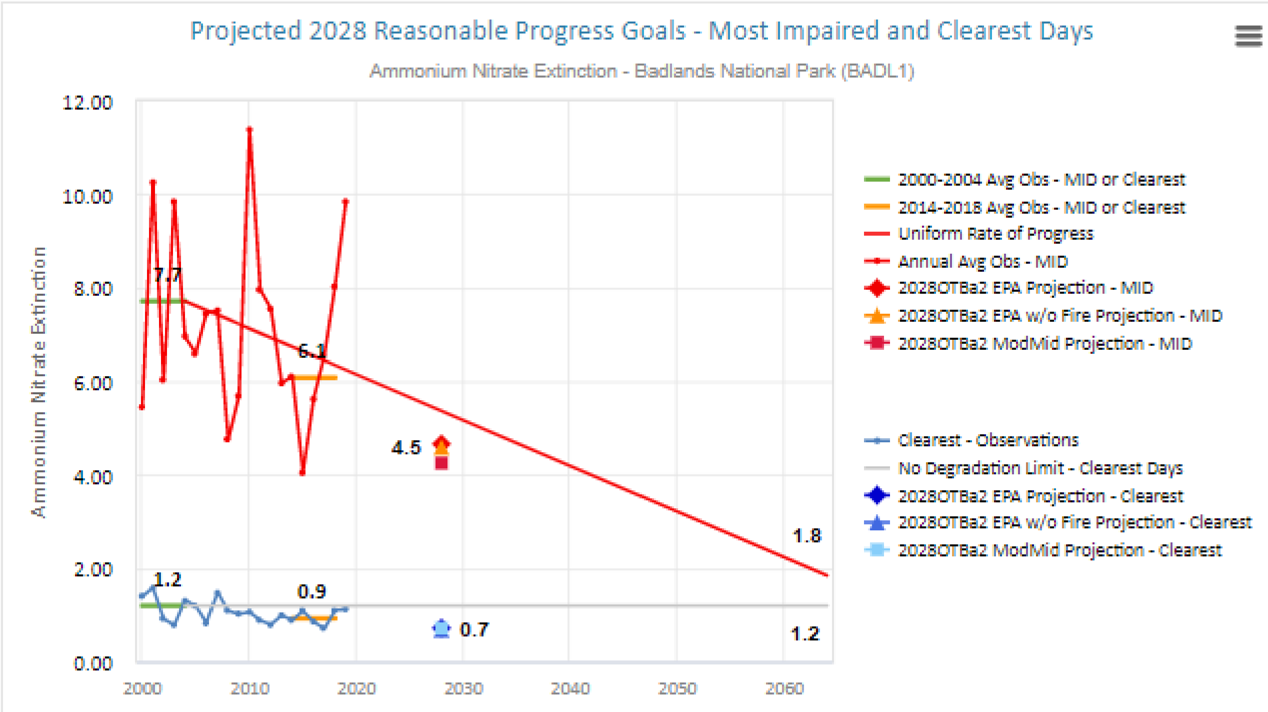


A summary of the reasonable progress results from above can be seen in the table below, Table 4-5.

Table 4-5 -- 2028 reasonable progress summary for South Dakota's two Class I Areas

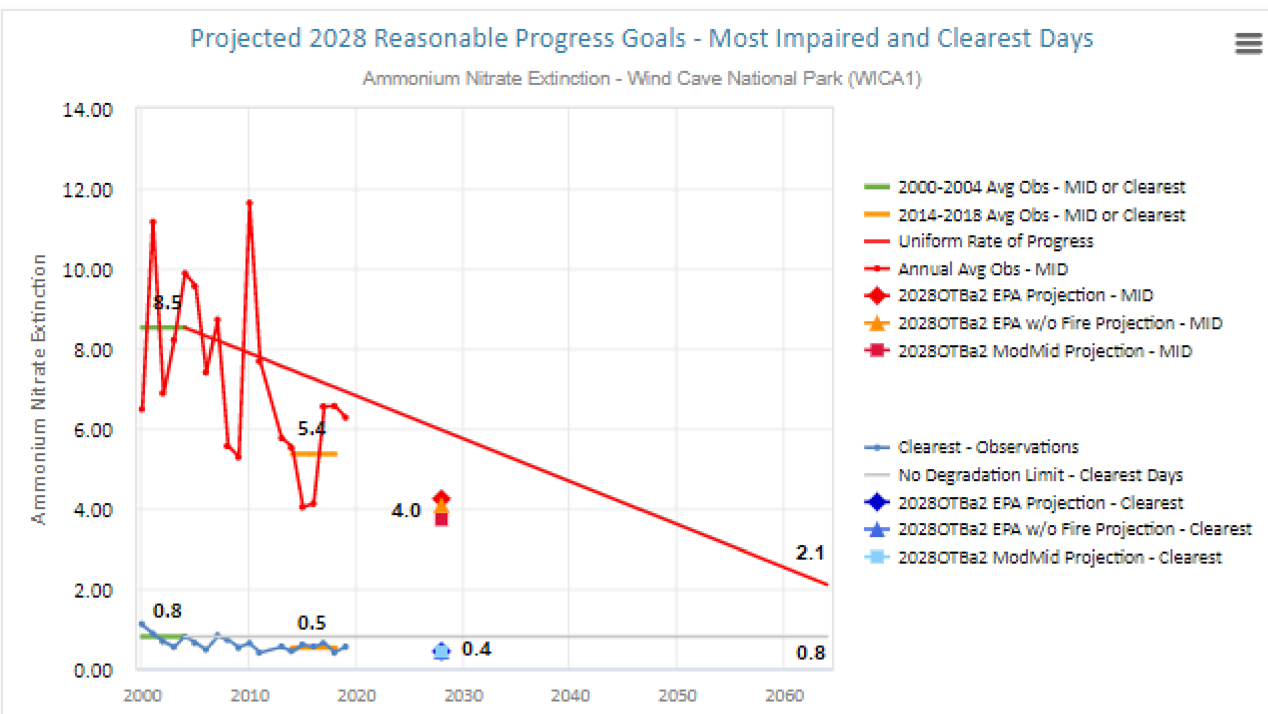
Calendar Year	Badlands National Park		Wind Cave National Park	
	Most Impaired (dv)	Clearest (dv)	Most Impaired (dv)	Clearest (dv)
2000-2004 Average	15	6.9	13.1	5.1
2014-2018 Average	12.3	5.4	10.5	3.5
2028OTBa2 Average	11.53	5.1	9.76	3.4
2028 Adjusted Glideslope (Int Anthro and Rx Fires)	13.0	N/A	11.9	N/A
2064 Adjusted Natural Conditions (Int Anthro and Rx Fires)	10.06	N/A	10.06	N/A

Figure 4-15 -- The 2028 Ammonium Nitrate Extinction projections for Badlands National Park, for the Most Impaired and Clearest Days



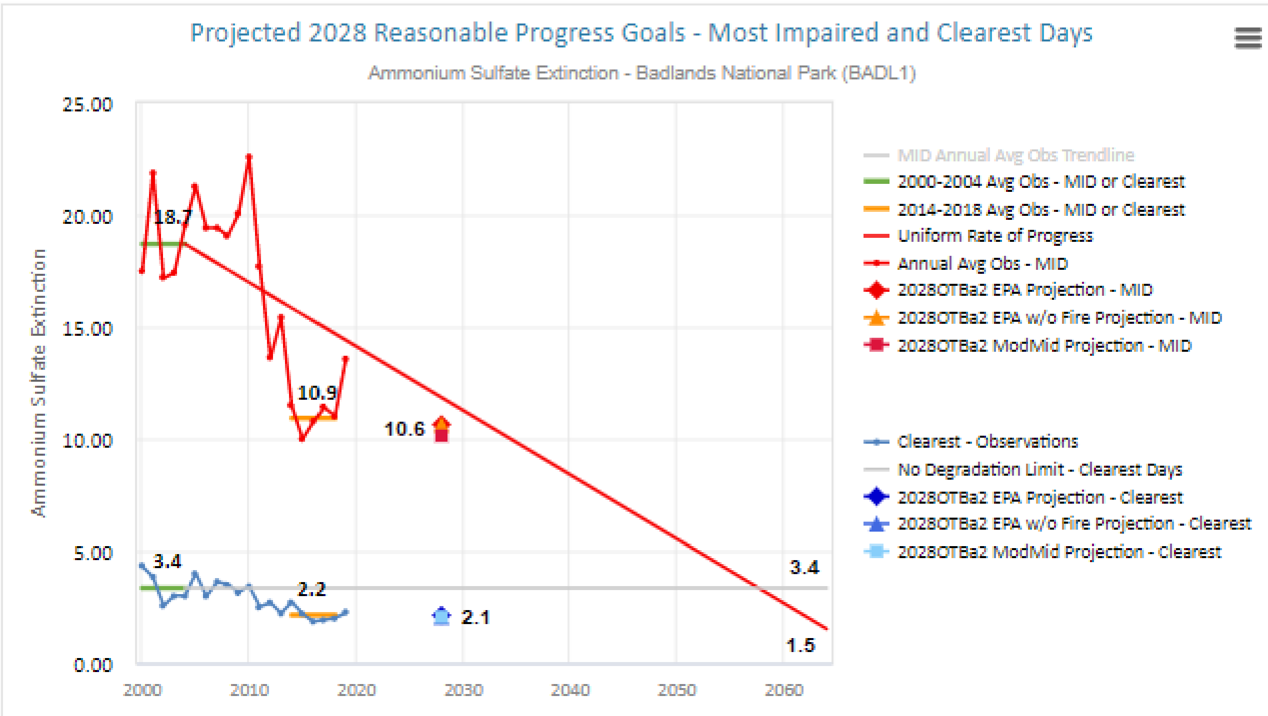
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-16 -- The 2028 Ammonium Nitrate Extinction projections for Wind Cave National Park, for the Most Impaired and Clearest Days



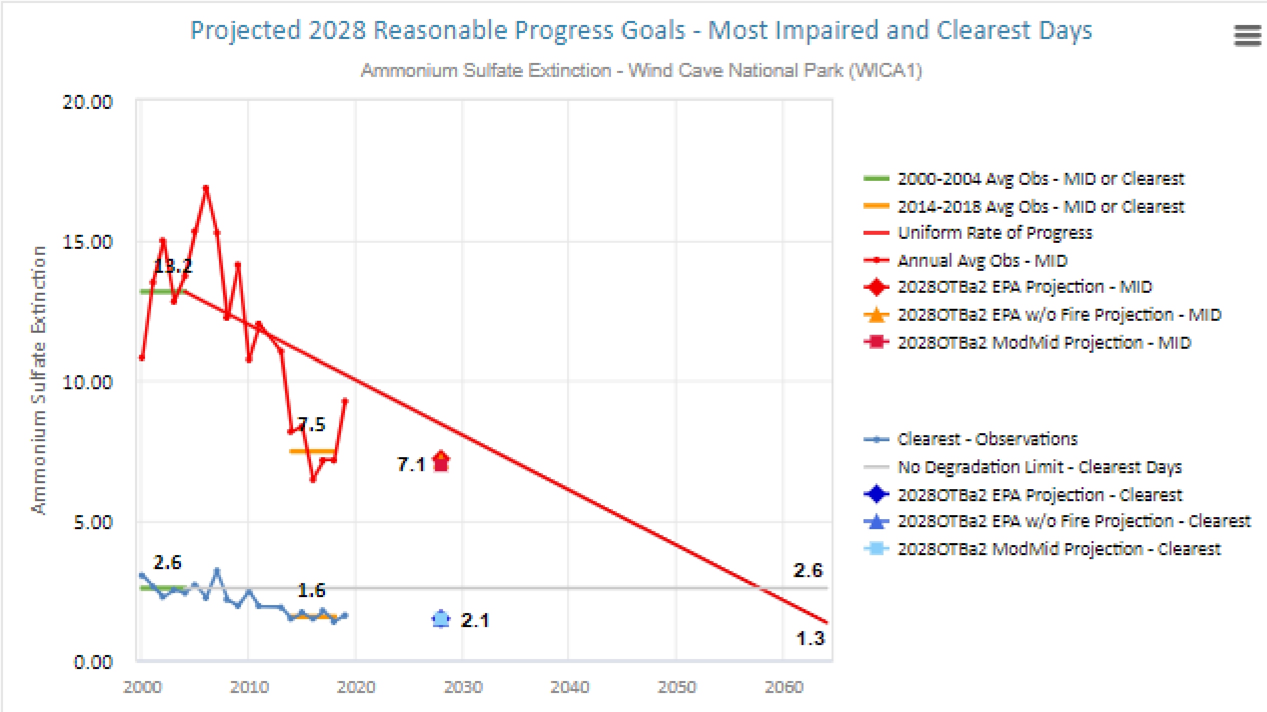
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-17 -- The 2028 Ammonium Sulfate Extinction projections for Badlands National Park, for the Most Impaired and Clearest Days



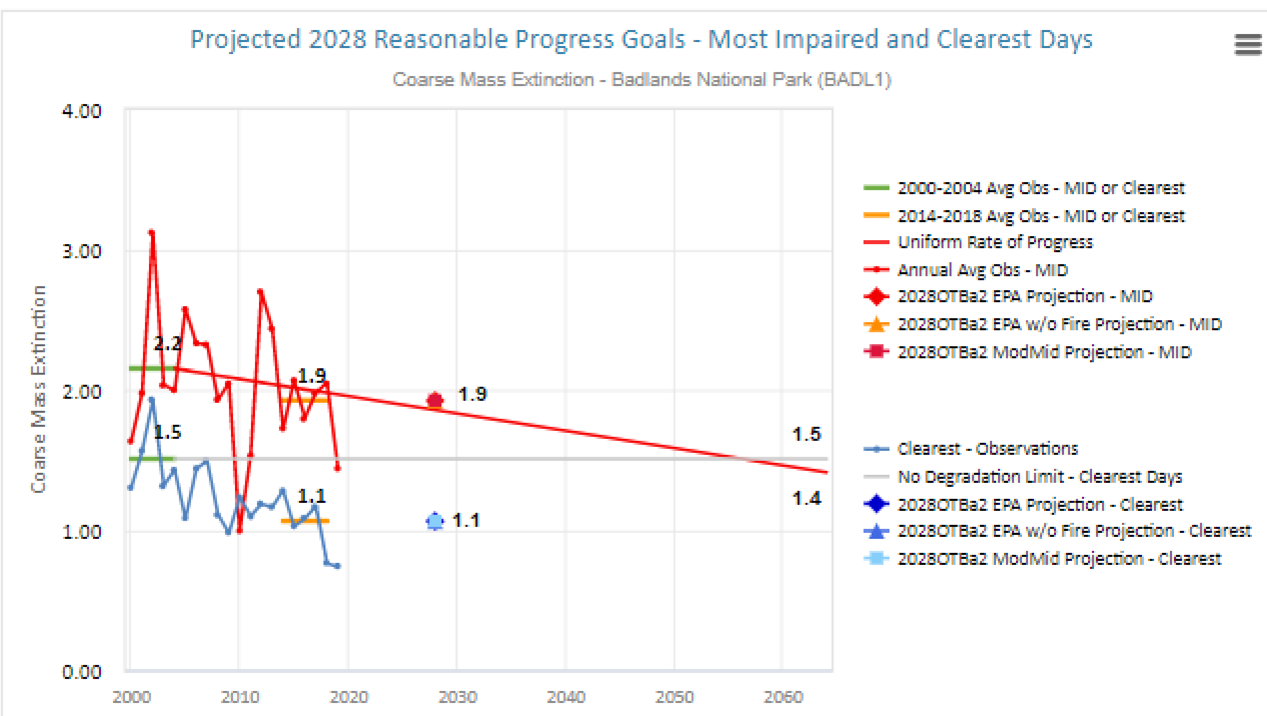
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-18 -- The 2028 Ammonium Sulfate Extinction projections for Wind Cave National Park, for the Most Impaired and Clearest Days



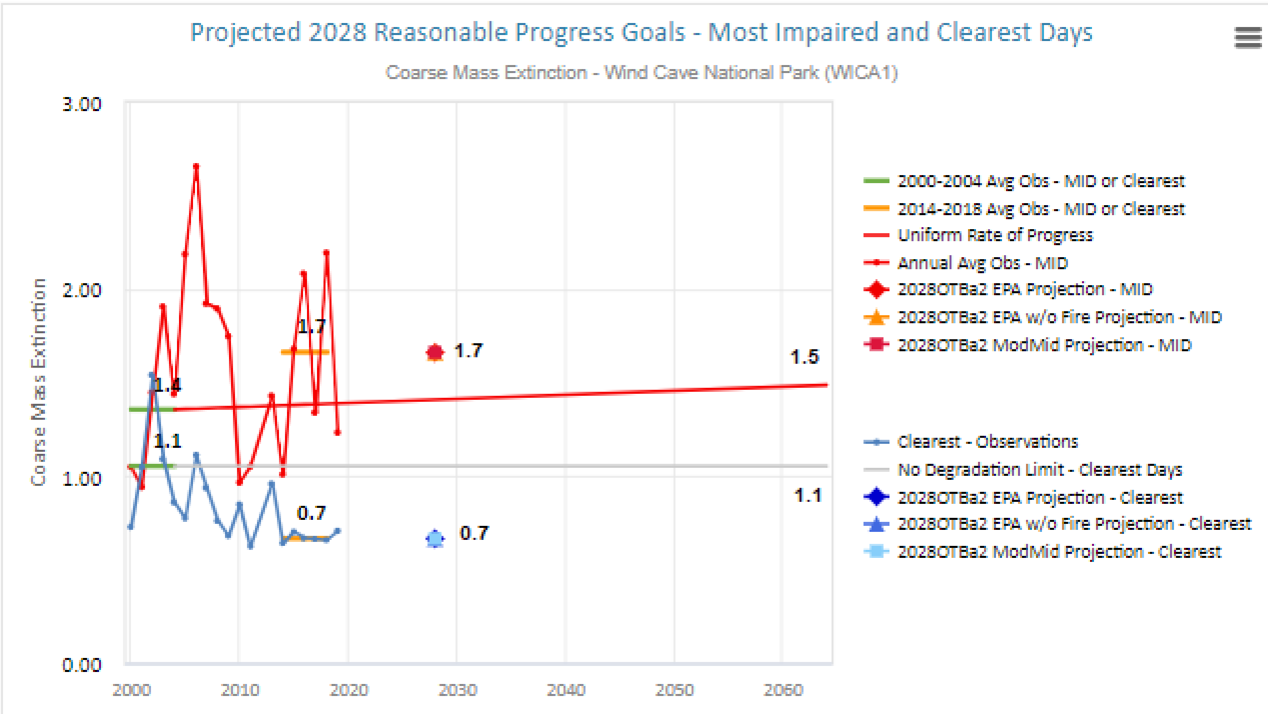
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-19 -- The 2028 Coarse Mass Extinction projections for Badlands National Park, for the Most Impaired and Clearest Days



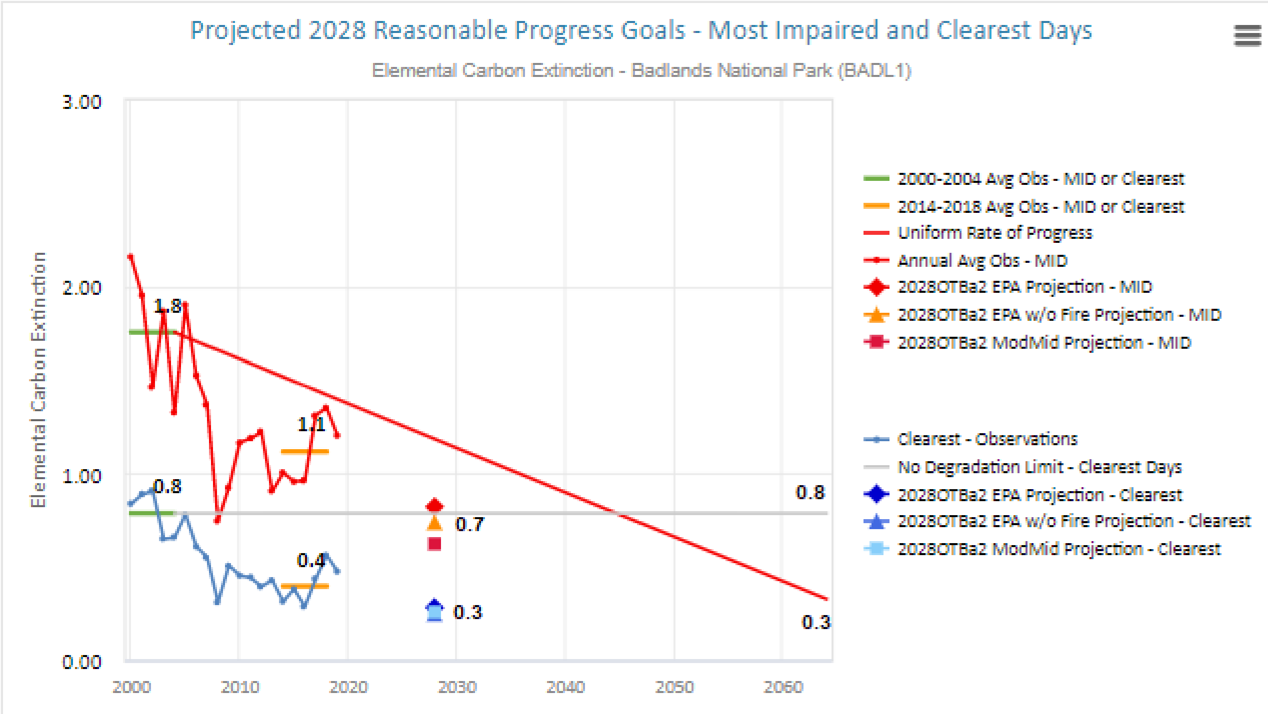
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-20 -- The 2028 Coarse Mass Extinction projections for Wind Cave National Park, for the Most Impaired and Clearest Days



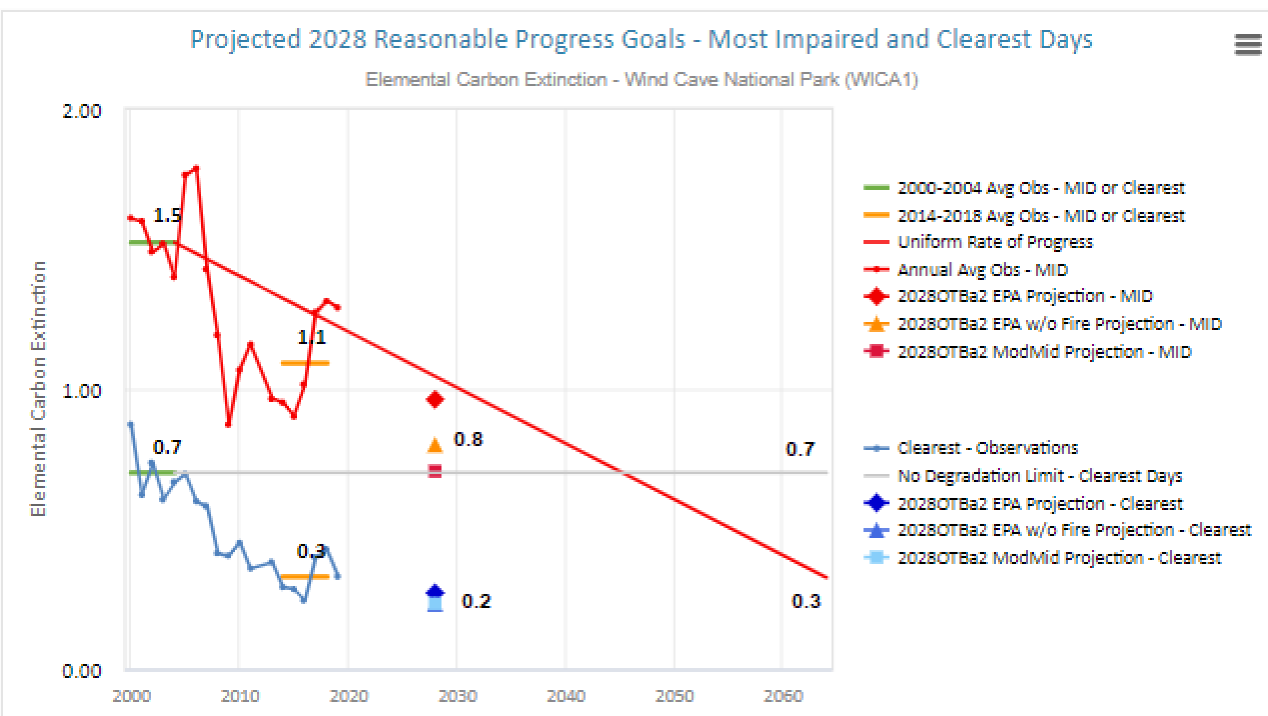
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-21 -- The 2028 Elemental Carbon Extinction projections for Badlands National Park, for the Most Impaired and Clearest Days



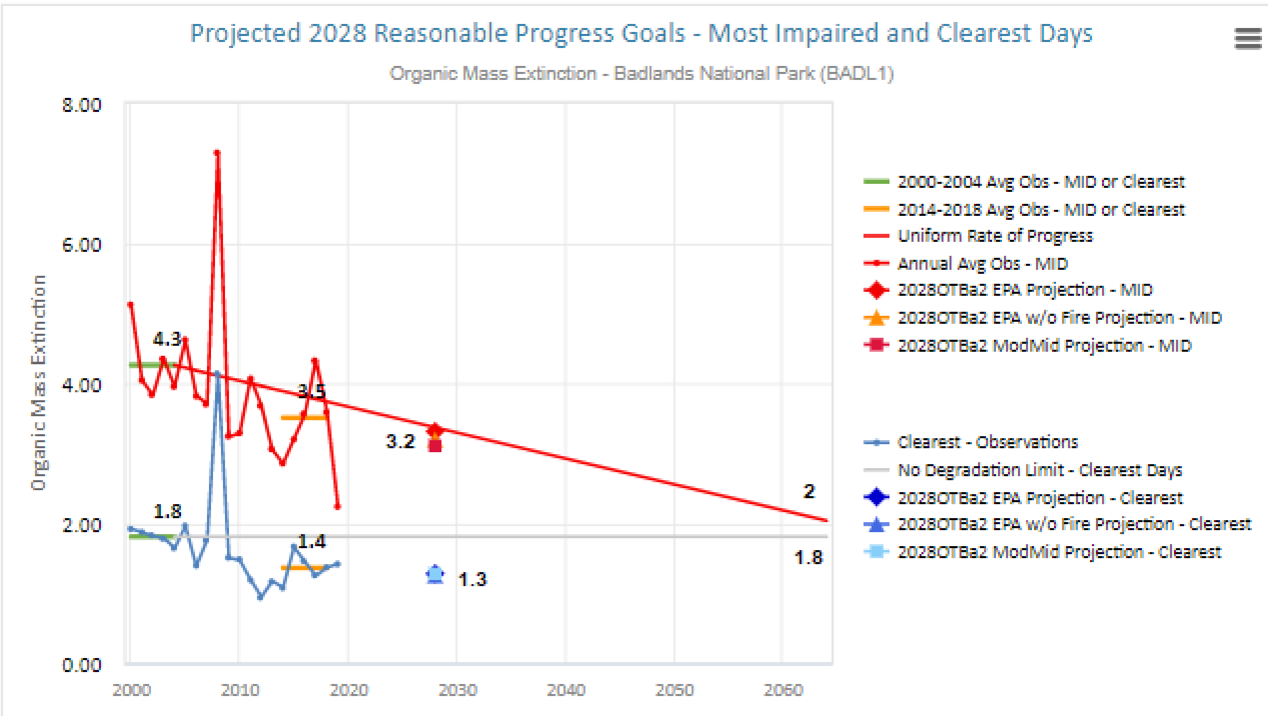
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-22 -- The 2028 Elemental Carbon Extinction projections for Wind Cave National Park, for the Most Impaired and Clearest Days



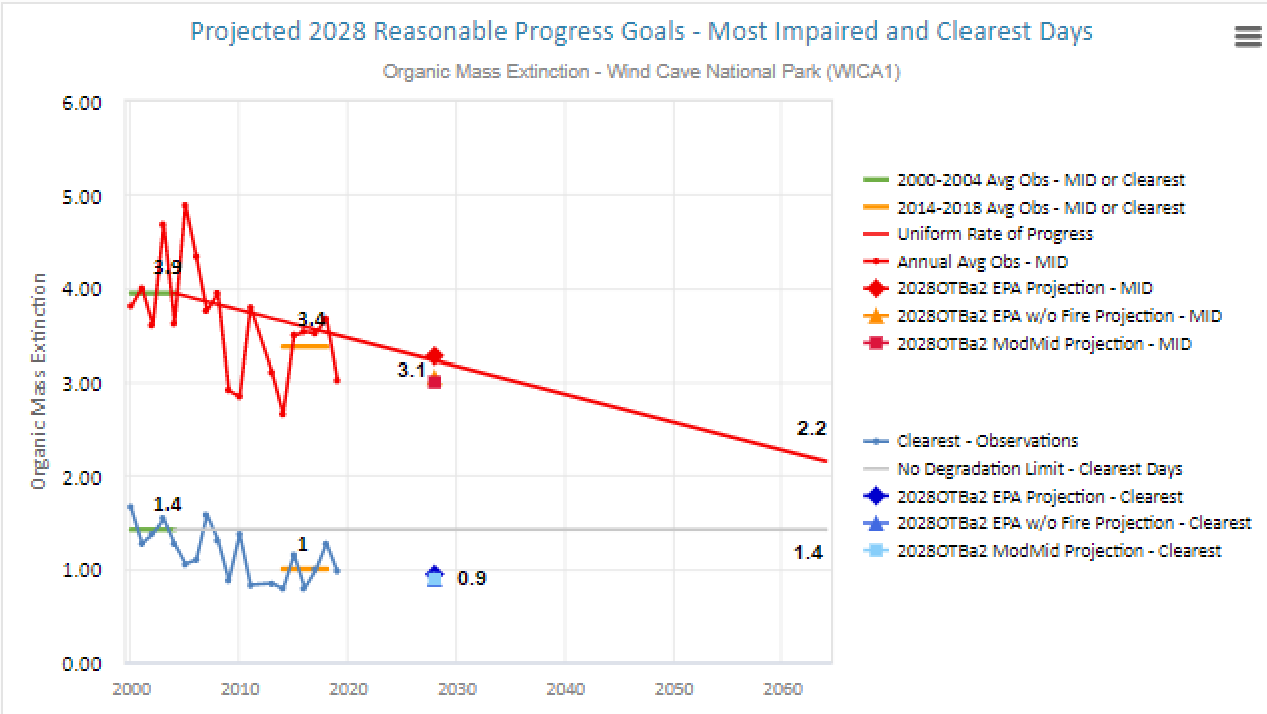
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-23 -- The 2028 Organic Mass Extinction projections for Badlands National Park, for the Most Impaired and Clearest Days



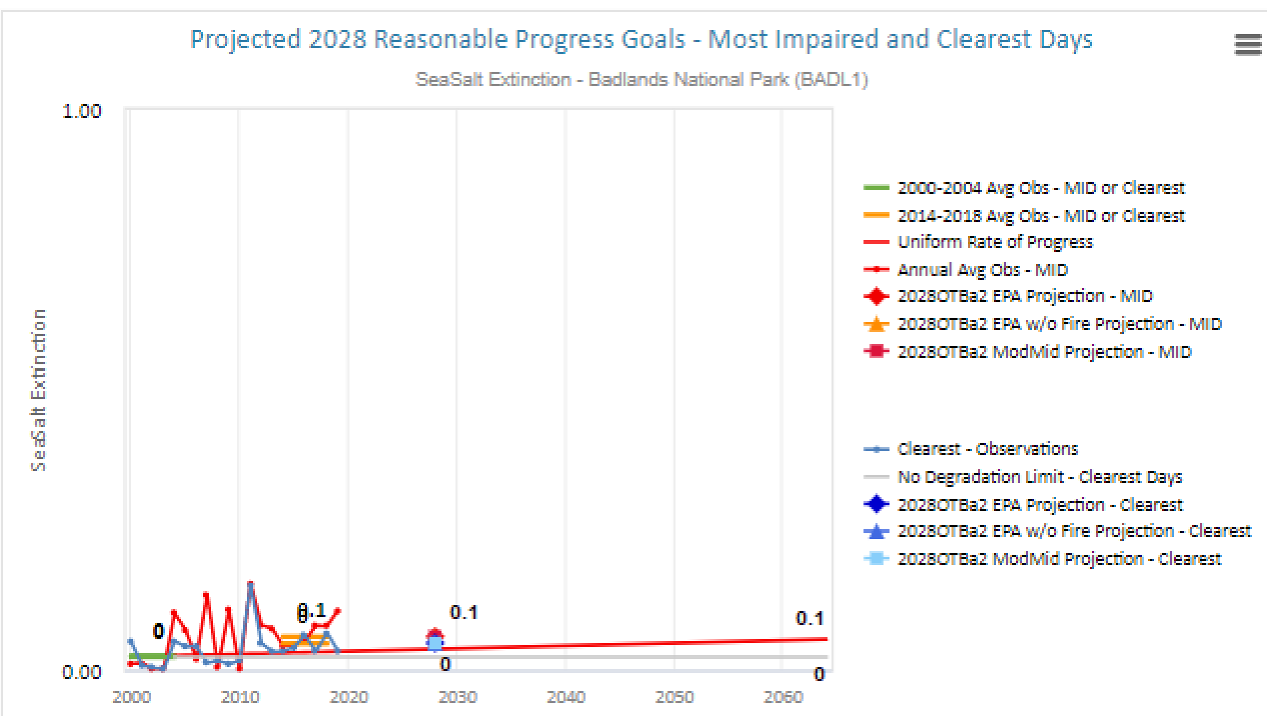
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-24 -- The 2028 Organic Mass Extinction projections for Wind Cave National Park, for the Most Impaired and Clearest Days



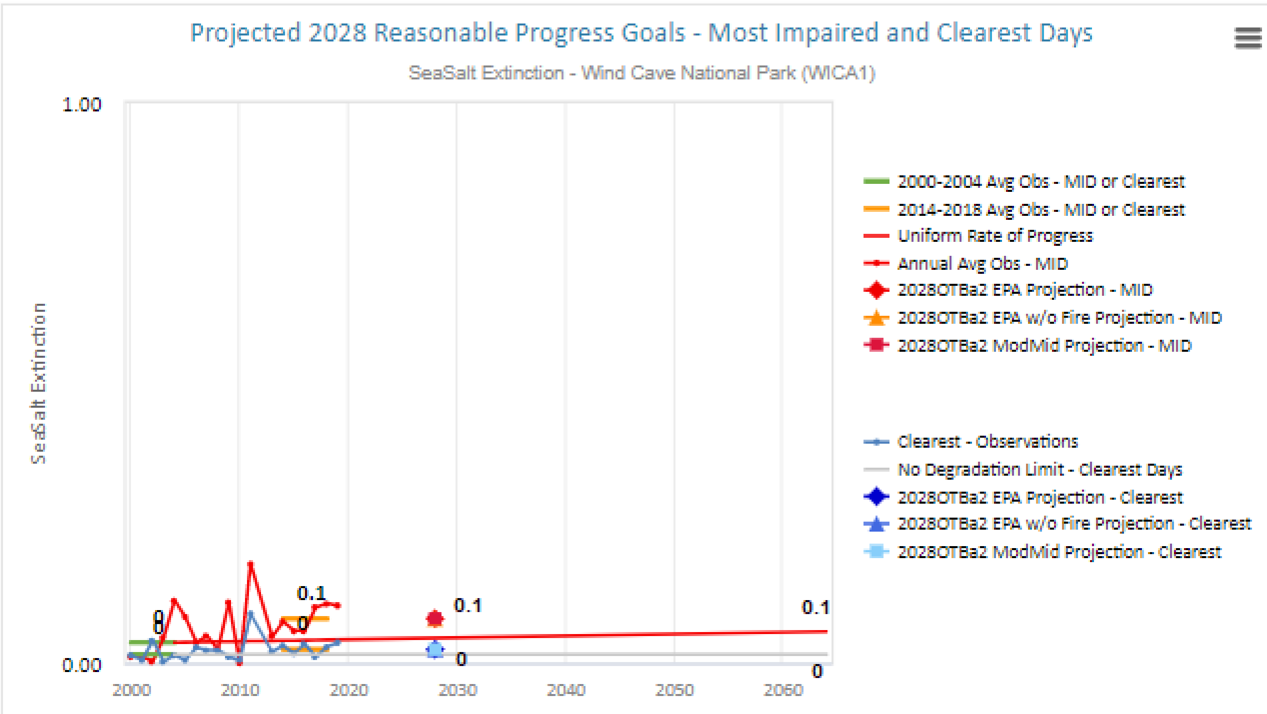
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-25 -- The 2028 Sea Salt Extinction projections for Badlands National Park, for the Most Impaired and Clearest Days



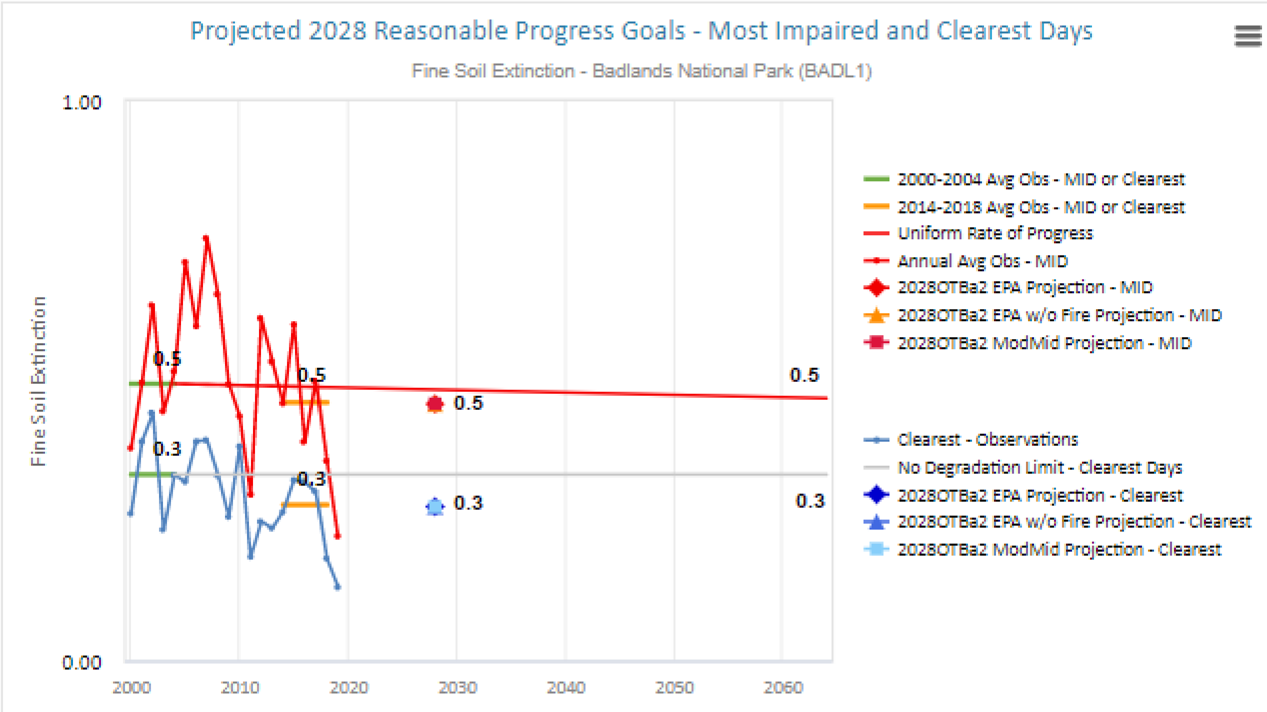
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-26 -- The 2028 Sea Salt Extinction projections for Win dCave National Park, for the Most Impaired and Clearest Days



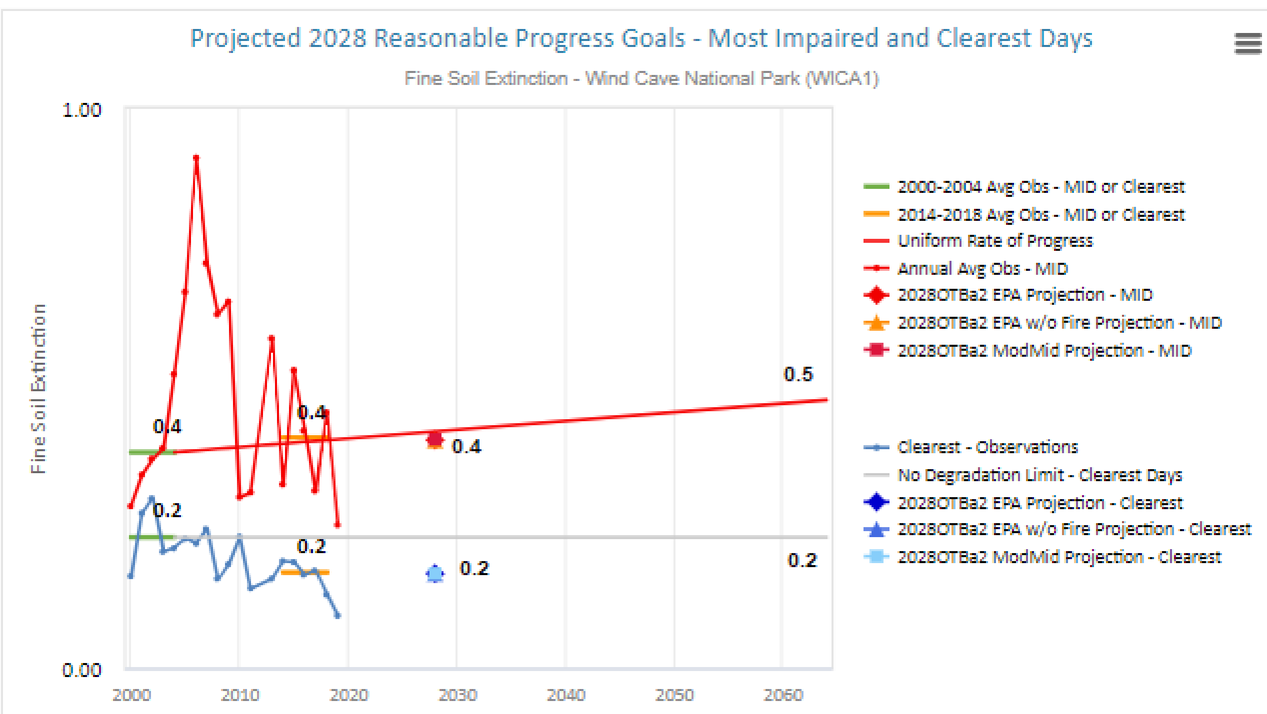
WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-27 -- The 2028 Fine Soil Extinction projections for Badlands National Park, for the Most Impaired and Clearest Days



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

Figure 4-28 -- The 2028 Fine Soil Extinction projections for Wind Cave National Park, for the Most Impaired and Clearest Days



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

According to the requirement of Section 51.308(f)(3)(i) of the Regional Haze Rule, after a state that has a Class I Area projects visibility conditions at each of these Class I Areas to 2028, it must determine whether or not two things have occurred: 1) An improvement in visibility on the 20% Most Impaired Days, and 2) no visibility degradation on the Clearest Days. This metric is determined from IMPROVE monitor data obtained from each of the Class I Areas where IMPROVE monitors are located. Improvement in visibility on the 20% most impaired days must occur since the 2000-2004 baseline period, and no degradation of the 20% clearest days since the same period must also occur. After comparing its modeled long-term strategy and thus its reasonable progress goals to the visibility conditions during the 2000-2004 baseline period, South Dakota determined that improvement in visibility on the 20% Most Impaired Days has occurred, and that no degradation of the Clearest Days has also occurred. Therefore, South Dakota has met this specific Regional Haze Rule requirement.

4.2 Demonstration Of No Possible Additional Emission Reduction Measures For In-State Class I Areas

40 CFR § 51.308(f)(3)(ii)(A) states: ***"If a State in which a mandatory Class I Federal area is located establishes a reasonable progress goal for the most impaired days that provides for a slower rate of improvement in visibility than the uniform rate of progress calculated under paragraph (f)(1)(vi) of this section, the State must demonstrate, based on the analysis required by paragraph (f)(2)(i) of this section, that there are no additional emission reduction measures for anthropogenic sources or groups of sources in the State that may reasonably be anticipated to contribute to visibility impairment in the Class I area that would be reasonable to include in the long-term strategy. The State must provide a robust demonstration, including documenting the criteria used to determine which sources or groups or sources were evaluated and how the four factors required by paragraph (f)(2)(i) were taken into consideration in selecting the measures for inclusion in its long-term strategy. The State must provide to the public for review as part of its implementation plan an assessment of the number of years it would take to attain natural visibility conditions if visibility improvement were to continue at the rate of progress selected by the State as reasonable for the implementation period."***

South Dakota has two Class I Areas. After adjusting the glidepath to not account for visibility impacts from international anthropogenic and prescribed wildland fires, South Dakota compared the reasonable progress goal projections to their Uniform Rate of Progress glide paths at the year 2028, and determined that each Class I Area's 2028 visibility projections were below the Uniform Rate of Progress glideslope, indicating both were on track to reaching natural visibility conditions by the year 2064. Therefore, for this second implementation period, the requirements of 40 CFR § 51.308(f)(3)(ii)(A) do not apply to South Dakota.

4.3 Demonstration Of No Possible Additional Emission Reduction Measures For Out Of State Class I Areas

40 CFR § 51.308(f)(3)(ii)(B) states: ***"If a State contains sources which are reasonably anticipated to contribute to visibility impairment in a mandatory Class I Federal area in***

another State for which a demonstration by the other State is required under (f)(3)(ii)(A) the State must demonstrate that there are no additional emission reduction measures for anthropogenic sources or groups of sources in the State that may reasonably be anticipated to contribute to visibility impairment in the Class I area that would be reasonable to include in its own long-term strategy. The State must provide a robust demonstration, including documenting the criteria used to determine which sources or groups or sources were evaluated and how the four factors required by paragraph (f)(2)(i) were taken into consideration in selecting the measures for inclusion in its long-term strategy."

According to the WEP/ AOI and Q/d analyses detailed in earlier sections, South Dakota does not reasonably negatively affect visibility conditions at any Class I Area outside of South Dakota.

Furthermore, DANR has worked with states contributing to visibility impairment in South Dakota's Class I areas through WRAP and also with those states that are not part of WRAP. DANR believes at this time that the controls and other measures they are adopting under their State Implementation Plans will reduce their impacts on South Dakota's Class I areas.

5 Monitoring Strategy

5.1 Evaluating Reasonably Attributable Visibility Impairment By Other Techniques

40 CFR § 51.308(f)(4) states: ***"If the Administrator, Regional Administrator, or the affected Federal Land Manager has advised a State of a need for additional monitoring to assess reasonably attributable visibility impairment at the mandatory Class I Federal area in addition to the monitoring currently being conducted, the State must include in the plan revision an appropriate strategy for evaluating reasonably attributable visibility impairment in the mandatory Class I Federal area*** by visual observation or other appropriate monitoring techniques."

South Dakota has not been advised by the Administrator, Regional Administrator, or the affected Federal Land Manager of a need for additional monitoring to assess reasonably attributable visibility impairment at either of South Dakota's Class I Federal Areas in addition to the monitoring currently being conducted.

5.2 Strategy For Measuring, Characterizing, And Reporting Of Regional Haze Visibility Impairment

40 CFR § 51.308(f)(6) states: "Monitoring strategy and other implementation plan requirements. ***The State must submit with the implementation plan a monitoring strategy for measuring, characterizing, and reporting of regional haze visibility impairment that is representative of all mandatory Class I Federal areas within the State.*** Compliance with this requirement may be met through participation in the Interagency Monitoring of Protected Visual Environments network. The implementation plan must also provide for the following:"

DANR has been and will continue to participate in the IMPROVE network for both of its Class I areas. The IMPROVE network currently collects and reports aerosol monitoring data which will be used to track long term reasonable progress. Because the long term tracking program has an implementation period nominally set for 60 years, the state expects that the IMPROVE network will provide data based on the following goals:

1. Maintain a stable configuration of the individual monitors and sampling sites and stability in network operations for the purpose of continuity in tracking reasonable progress trends;
2. Assure sufficient data capture of all visibility-impairing species at each site;
3. Comply with EPA quality control and assurance requirements; and
4. Prepare and disseminate periodic reports on IMPROVE network operations.

DANR is relying on the IMPROVE network to meet these monitoring operation and data collection goals, with the fundamental assumption that network data collection operations will not change, or if changed, will remain directly comparable to those operated by the IMPROVE network during the 2000 to 2004 baseline period. Technical analyses and reasonable progress goals in this implementation plan are based on data from these sites. As such, DANR will work with EPA and the Federal Land Managers to ensure these monitors continue to operate and any changes to the IMPROVE network will not jeopardize the use of the data in the monitoring strategy.

The state of South Dakota depends on the following IMPROVE program-operated monitors at the following sites listed in Table 5-1 for tracking reasonable progress:

Table 5-1 -- IMPROVE Monitoring Sites at Class I Areas in South Dakota

IMPROVE Monitoring Sites	Class I Area
BAD1	Badlands National Park
WICA1	Wind Cave National Park

5.3 Establishing Additionally Needed Equipment

40 CFR § 51.308(f)(6) and 40 CFR § 51.308(f)(6)(i) state: "Monitoring strategy and other implementation plan requirements. The State must submit with the implementation plan a monitoring strategy for measuring, characterizing, and reporting of regional haze visibility impairment that is representative of all mandatory Class I Federal areas within the State. Compliance with this requirement may be met through participation in the Interagency Monitoring of Protected Visual Environments network. ***The implementation plan must also provide for the following: The establishment of any additional monitoring sites or equipment needed to assess whether reasonable progress goals to address regional haze for all mandatory Class I Federal areas within the State are being achieved."***

South Dakota has participated in the Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring program since its inception, starting at the beginning of the first implementation period of the Regional Haze program. South Dakota has had its interests represented both by a state air agency representative on the IMPROVE Steering Committee, and also through the allocation of grant funding—specifically CAA air management grant funding to the IMPROVE program.

DANR will also operate additional non-IMPROVE monitors that may be used in assessing if reasonable progress goals in South Dakota's Class I areas are being met. These may include PM2.5 speciation or Federal Reference Methods, and/or more portable monitoring systems than operated at an IMPROVE site. This data is collected throughout the state but the ambient air quality monitoring sites of particular interest are those located next to the IMPROVE sites in the Class I areas in South Dakota. The data collected by these sites, along with data from the other sites throughout the state are reported to EPA's AIRS database. Table 5-2 provides a summary of what DANR is currently monitoring next to the IMPROVE sites in the Class I area in South Dakota.

Table 5-2 -- Ambient Air Monitoring Site Parameters Next to IMPROVE Sites

Monitoring Site	Parameter	Sampling &Analysis Method	Operating Schedule
Badlands National Park	Sulfur Dioxide	Instrumental pulsed florescent	Continuous
	Nitrogen Dioxide	Instrumental chemiluminescence	Continuous
	Ozone	Instrumental ultra violet	Continuous
	PM2.5	Met One BAM – 1020 Very Sharp Cut Cyclone Gravimetric	Continuous
	PM10	Thermal Anderson Series FH62 C14 BETA Gravimetric	Continuous
Wind Cave National Park	Sulfur Dioxide	Instrumental Pulsed Florescent	Continuous
	Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous
	Ozone	Instrumental Ultra Violet	Continuous
	PM2.5	Met One BAM – 1020 Very Sharp Cut Cyclone Gravimetric	Continuous
	PM10	Thermal Anderson Series FH62 C14 BETA Gravimetric	Continuous
	Wind Speed	Electronic signal	Continuous
	Wind Direction	Electronic signal	Continuous
	Ambient Temperature	Electronic signal	Continuous
	Ambient Pressure	Barometric Pressure Transducer	Continuous
	Relative Humidity	Hygroscopic Plastic Film	Continuous

5.4 In-State Emissions Contributions To Regional Haze Visibility Impairment

40 CFR § 51.308(f)(6) and 40 CFR § 51.308(f)(6)(ii) state: "Monitoring strategy and other implementation plan requirements. The State must submit with the implementation plan a monitoring strategy for measuring, characterizing, and reporting of regional haze visibility impairment that is representative of all mandatory Class I Federal areas within the State.

Compliance with this requirement may be met through participation in the Interagency Monitoring of Protected Visual Environments network. ***The implementation plan must also provide for the following: Procedures by which monitoring data and other information are used in determining the contribution of emissions from within the State to regional haze visibility impairment at mandatory Class I Federal areas both within and outside the State.”***

South Dakota has participated in the Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring program since its inception, starting at the beginning of the first implementation period of the Regional Haze program. South Dakota has had its interests represented both by a state air agency representative on the IMPROVE Steering Committee, and also through the allocation of grant funding—specifically CAA air management grant funding to the IMPROVE program.

DANR will use data reported by the IMPROVE program as part of the regional technical support analysis tools found at the Visibility Information Exchange Web System (VIEWS), as well as other analysis tools that are available. DANR will participate in the ongoing regional analysis activities to collectively assess and verify the progress toward reasonable progress goals, also supporting interstate consultation as the regional haze rules are implemented and collaborate with EPA, states, tribes, and federal land managers to ensure the continued operation of these technical support analysis tools and systems.

5.5 Annual Reporting Of Visibility Monitoring Data

40 CFR § 51.308(f)(6) and 40 CFR § 51.308(f)(6)(iv) state: “Monitoring strategy and other implementation plan requirements. The State must submit with the implementation plan a monitoring strategy for measuring, characterizing, and reporting of regional haze visibility impairment that is representative of all mandatory Class I Federal areas within the State. Compliance with this requirement may be met through participation in the Interagency Monitoring of Protected Visual Environments network. ***The implementation plan must also provide for the following: The implementation plan must provide for the reporting of all visibility monitoring data to the Administrator at least annually for each mandatory Class I Federal area in the State.*** To the extent possible, the State should report visibility monitoring data electronically.”

South Dakota has participated in the Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring program since its inception, starting at the beginning of the first implementation period of the Regional Haze program. South Dakota has had its interests represented both by a state air agency representative on the IMPROVE Steering Committee, and also through the allocation of grant funding—specifically CAA air management grant funding to the IMPROVE program.

Furthermore, because the IMPROVE program provides data to the EPA directly, this requirement of the Regional Haze Rule is fulfilled. The direct exchange from IMPROVE to EPA is the equivalent of states reporting visibility monitoring data to the Administrator annually.

DANR will depend on the routine timely reporting of haze monitoring data by the IMPROVE program for the reasonable progress tracking sites to the EPA air quality data system and VIEWS. DANR will collaborate with EPA, states, tribes, and federal land managers to ensure the continued operation of these technical support analysis tools and systems.

5.6 Statewide Inventory Of Emissions Of Pollutants

40 CFR § 51.308(f)(6) and 40 CFR § 51.308(f)(6)(v) state: "Monitoring strategy and other implementation plan requirements. The State must submit with the implementation plan a monitoring strategy for measuring, characterizing, and reporting of regional haze visibility impairment that is representative of all mandatory Class I Federal areas within the State. Compliance with this requirement may be met through participation in the Interagency Monitoring of Protected Visual Environments network. ***The implementation plan must also provide for the following: A statewide inventory of emissions of pollutants that are reasonably anticipated to cause or contribute to visibility impairment in any mandatory Class I Federal area. The inventory must include emissions for the most recent year for which data are available, and estimates of future projected emissions. The State must also include a commitment to update the inventory periodically."***

This is DANR's commitment to update the statewide inventory of emissions periodically.

DANR and WRAP based the emission inventory on EPA's "*Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations*." The guidance establishes the baseline year as 2002. The guidance specified what pollutants should be inventoried, which are reasonably anticipated to cause or contribute to visibility impairment in a mandatory Class I area.

The air pollutants of concern are primary particulate matter (PM), sulfur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and ammonia (NH_3). Particulate matter is further separated into primary particulate matter coarse and fine. Primary particulate matter coarse is particulate matter 10 microns in diameter or less (PM10) minus primary particulate matter fine, which is particulate matter 2.5 microns in diameter or less (PM2.5). Where available, DANR will include primary organic aerosol (organic carbon) and elemental carbon (EC). The definition of VOC is defined in the Administrative Rules of South Dakota, Section 74:36:01:01(77), which is derived from 40 CFR § 51.100.

The pollutants that are reasonably anticipated to cause or contribute to visibility impairment are emitted by natural and anthropogenic sources. The goal of the regional haze program is to minimize the impacts from anthropogenic sources and bring our Class I areas into their natural visibility condition. Determining natural visibility condition is difficult since anthropogenic activity has influenced our Class I areas for many years. This influence includes mobile sources, electric generation, prescribed burning, manufacturing activities, farming, preventing and fighting fires, and many other activities that result in the air emissions of the above pollutants.

5.6.1 Current Emission Inventory

The most current air emission inventory for South Dakota is 2019, but only contains air emissions from Title V air quality permitted sources. DANR calculates an annual air emission inventory for point sources that are required to pay fees under the Title V air quality permit program. The point source data for 2019 is displayed in Table 5-3.

DANR conducts an annual air emission inventory for stationary sources that are required to pay air fees under the Title V air quality permit program. The air emission inventory consists of criteria air pollutants. The stationary sources required to report consist of major sources (actual air emissions that exceed 100 tons per year) and area sources. DANR will expand the air emission inventory to include all air emissions that impact visibility from these stationary sources.

Table 5-3 -- 2017 South Dakota Point Source Emissions[1]

PM10 [1]	SO_2	NOx	VOCs	CO
790.8	1,335.8	4,233.6	3,519.6	2,738

[1] – "PM10" means particulate matter less than or equal to 10 microns in diameter or less, "SO2" means sulfur dioxide, "NOx" means nitrogen oxide, "VOCs" means volatile organic compounds, and "CO" means carbon monoxide; and

[1] - The PM10 emissions are based on coarse and fine particulate matter.

DANR will continue to work with other organizations and states to ensure all inventory data used in future modeling will be accurate. The future emission inventories and the data provided by states in EPA's National Emission Inventory database will be used to track the progress of South Dakota and neighboring states on controlling and reducing air pollution that cause or contribute to visibility impairment in our Class I areas and neighboring Class I areas.

5.6.2 WRAP's 2028 Emissions Projections

WRAP projected emission inventories for 2028. In support of WRAP's regional haze air quality modeling efforts, Ramboll developed emissions inventories, including projected emissions. Each of these inventories has undergone a number of revisions throughout the development process to arrive at the final versions used in CAMx air quality modeling. WRAP emission inventories developed by Ramboll include:

1. A Representative Baseline 2 (RepBase2) emission inventory.
2. An actual base case (2014v2) emission inventory.
3. A 2028 On-the-Books projected scenario (2028OTBa2) with RepBase fires.
4. A 2028 Potential Additional Controls (PAC2) projected scenario.

WRAP projected an air emissions inventory for 2028 (2028OTBa2) for the same source types and pollutants as the base year. The projection methodology included the following steps:

1. Adjustments: Emission increases for new facilities that have come on-line since 2014, deletion of emissions for facilities that retired in 2014 and will not return to operation in the future; and other adjustments;
2. Control Factors: Emission reductions due to known (e.g., on-the-books) controls, consent decrees reductions, State Implementation Plan control measures, and other relevant

regulations that have gone into effect since 2014, or will go into effect before the end of 2028. These controls do not include impacts from any future control scenarios that have yet to be determined;

3. Growth Factors: Standard Classification Code specific growth factors developed from the Economic Growth and Analysis System projection factor model; special analysis of electric generating unit growth relative to unit capacity threshold;
4. Retirement & Replacement Rates: Effects of retirement estimates using annual retirement rates based on expected equipment lifetimes. Retired equipment replaced by lower-emitting new equipment. Unit lifetime examined for natural gas-fired electric generating units. No retirements assumed for coal-fired electric generating units;
5. Permit Limits: Used in the cases where the projected emissions may have inadvertently exceeded an enforceable emission limit (e.g., emissions were adjusted downward to the permit limit, as applicable); and
6. Section 309 Flags: Point sources in the Grand Canyon Visibility Transport States (e.g., AZ, CA, CO, ID, NV, NM, OR, UT, and WY) whose 2002 facility-level sulfur dioxide emissions are at least 100 tons per year.)

The following tables, Tables 5-4 through 5-10 can be found from the WRAP TSS website: http://views.cira.colostate.edu/tssv2/Express/EmissionsTools.aspx. These project and compare South Dakota emissions information by source category and emissions scenario. The emissions scenarios compared are the 2014v2 actual emissions, the Representative Baseline 2 emissions (emissions averaged between the five year period from 2014-2018), and the modeled 2028 On The Books a2 emissions. Modeled Potential Additional Controls (PAC2) emissions were also used by other states, however South Dakota did not choose to alter its 2028 On The Books numbers for the 2028 PAC2 model run. A significant jump in Nitrogen Oxides (NOx) tons/ year and Carbon Monoxide (CO) tons/year in the On-Road Mobile and Non-road Mobile source categories exists between the Representative Baseline 2 emissions and the modeled 2028 OTB a2 emissions due to the model projecting an increase in fuel efficient vehicles and technology between now and 2028. Furthermore, significant jumps in the Wildfire source category can be seen in multiple tables as well, which again follow a set of complex predictions in the applied model.

Table 5-4 -- South Dakota's NOx emissions projections and scenarios comparison

South Dakota Nitrogen Oxides (NOx) tons/year				
State Emissions	Source Category	2014v2 Actual	Representative Baseline 2	2028 OTB a2[1]
Anthropogenic	Electric Generating Units (EGU)	87	168	246
Anthropogenic	Oil and Gas - Point	435	435	435
Anthropogenic	Industrial and Non-EGU Point	2,824	2,828	2,828
Anthropogenic	Oil and Gas - Non-point	398	468	317
Anthropogenic	Residential Wood Combustion	154	154	154
Anthropogenic	Fugitive dust[3]	0	0	0

Anthropogenic	Agriculture[2]	0	0	0
Anthropogenic	Remaining Non-point	1,275	1,275	1,275
Anthropogenic	On-Road Mobile	27,996	27,996	7,592
Anthropogenic	Non-road Mobile	19,294	15,506	6,881
Anthropogenic	Rail	3,794	3,794	2,237
Anthropogenic	Commercial Marine[4]	0	0	0
Anthropogenic	Agricultural Fire	348	348	348
Anthropogenic	Wildland Prescribed Fire	1,119	1,445	1,445
Natural	Wildfire	178	8,049	8,049
Natural	Biogenic[5]	57,259	57,259	57,259

1. 2028OTBa2 refers to the On the Books assumptions for US anthropogenic emissions in 2028. 2028OTBa2 fire emissions are the same as Representative Baseline and cover the period 2014-2018.
2. The Agricultural emissions sector includes only NH3 emissions from nonpoint livestock and fertilizer application.
3. The Fugitive Dust sector contains only PM10 and PM2.5 emissions from area-source anthropogenic dust sources.
4. Commercial Marine Shipping C1, C2, and C3 emissions within and offshore of the state.
5. Biogenic emissions are reported for CO, NOx, and VOC.

Table 5-5 -- South Dakota's SO2 emissions projections and scenarios comparison

South Dakota Sulfur Dioxide tons/year				
State Emissions	Source Category	2014v2 Actual	Representative Baseline 2	2028 OTB a2[1]
Anthropogenic	Electric Generating Units (EGU)	5	7	7
Anthropogenic	Oil and Gas - Point	1	1	1
Anthropogenic	Industrial and Non-EGU Point	653	654	654
Anthropogenic	Oil and Gas - Non-point	45	59	29
Anthropogenic	Residential Wood Combustion	37	37	37
Anthropogenic	Fugitive dust[3]	0	0	0
Anthropogenic	Agriculture[2]	0	0	0
Anthropogenic	Remaining Non-point	127	127	127
Anthropogenic	On-Road Mobile	84	84	48
Anthropogenic	Non-road Mobile	33	23	17
Anthropogenic	Rail	2	2	2
Anthropogenic	Commercial Marine[4]	0	0	0
Anthropogenic	Agricultural Fire	142	142	142
Anthropogenic	Wildland Prescribed Fire	710	1,056	1,056
Natural	Wildfire	118	2,910	2,910
Natural	Biogenic[5]	0	0	0

1. 2028OTBa2 refers to the On the Books assumptions for US anthropogenic emissions in 2028. 2028OTBa2 fire emissions are the same as Representative Baseline and cover the period 2014-2018.

2. The Agricultural emissions sector includes only NH3 emissions from nonpoint livestock and fertilizer application.
3. The Fugitive Dust sector contains only PM10 and PM2.5 emissions from area-source anthropogenic dust sources.
4. Commercial Marine Shipping C1, C2, and C3 emissions within and offshore of the state.
5. Biogenic emissions are reported for CO, NOx, and VOC.

Table 5-6 -- South Dakota's PM2.5 Mass emissions projections and scenarios comparison

South Dakota PM2.5 Mass tons/year				
State Emissions	Source Category	2014v2 Actual	Representative Baseline 2	2028 OTB a21
Anthropogenic	Electric Generating Units (EGU)	13	23	22
Anthropogenic	Oil and Gas - Point	69	69	69
Anthropogenic	Industrial and Non-EGU Point	688	666	666
Anthropogenic	Oil and Gas - Non-point	7	7	7
Anthropogenic	Residential Wood Combustion	1,598	1,598	1,598
Anthropogenic	Fugitive dust3	27,902	27,902	27,902
Anthropogenic	Agriculture2	0	0	0
Anthropogenic	Remaining Non-point	1,070	1,070	1,070
Anthropogenic	On-Road Mobile	971	971	283
Anthropogenic	Non-road Mobile	1,600	1,294	476
Anthropogenic	Rail	107	107	58
Anthropogenic	Commercial Marine4	0	0	0
Anthropogenic	Agricultural Fire	1,048	1,048	1,048
Anthropogenic	Wildland Prescribed Fire	9,194	14,152	14,152
Natural	Wildfire	1,570	30,800	30,800
Natural	Biogenic5	0	0	0

1. 2028OTBa2 refers to the On the Books assumptions for US anthropogenic emissions in 2028. 2028OTBa2 fire emissions are the same as Representative Baseline and cover the period 2014-2018.
2. The Agricultural emissions sector includes only NH3 emissions from nonpoint livestock and fertilizer application.
3. The Fugitive Dust sector contains only PM10 and PM2.5 emissions from area-source anthropogenic dust sources.
4. Commercial Marine Shipping C1, C2, and C3 emissions within and offshore of the state.
5. Biogenic emissions are reported for CO, NOx, and VOC.

Table 5-7 -- South Dakota's PM10 Mass emissions projections and scenarios comparison

South Dakota PM10 Mass tons/year				
State Emissions	Source Category	2014v2 Actual	Representative Baseline 2	2028 OTB a21
Anthropogenic	Electric Generating Units (EGU)	13	23	22
Anthropogenic	Oil and Gas - Point	69	69	69
Anthropogenic	Industrial and Non-EGU	786	783	783

	Point			
Anthropogenic	Oil and Gas - Non-point	7	7	7
Anthropogenic	Residential Wood Combustion	1,600	1,600	1,600
Anthropogenic	Fugitive dust3	149,273	149,273	149,273
Anthropogenic	Agriculture2	0	0	0
Anthropogenic	Remaining Non-point	1,242	1,242	1,242
Anthropogenic	On-Road Mobile	1,417	1,417	732
Anthropogenic	Non-road Mobile	1,660	1,342	497
Anthropogenic	Rail	116	116	59
Anthropogenic	Commercial Marine4	0	0	0
Anthropogenic	Agricultural Fire	1,692	1,692	1,692
Anthropogenic	Wildland Prescribed Fire	10,849	15,778	15,778
Natural	Wildfire	1,853	33,282	33,282
Natural	Biogenic5	0	0	0

1. 2028OTBa2 refers to the On the Books assumptions for US anthropogenic emissions in 2028. 2028OTBa2 fire emissions are the same as Representative Baseline and cover the period 2014-2018.
2. The Agricultural emissions sector includes only NH_3 emissions from nonpoint livestock and fertilizer application.
3. The Fugitive Dust sector contains only PM_{10} and $PM_{2.5}$ emissions from area-source anthropogenic dust sources.
4. Commercial Marine Shipping C1, C2, and C3 emissions within and offshore of the state.
5. Biogenic emissions are reported for CO, NO_x, and VOC.

Table 5-8 -- South Dakota's Ammonia Gas emissions projections and scenarios comparison

South Dakota Ammonia Gas tons/year				
State Emissions	Source Category	2014v2 Actual	Representative Baseline 2	2028 OTB a21
Anthropogenic	Electric Generating Units (EGU)	0	0	0
Anthropogenic	Oil and Gas - Point	0	0	0
Anthropogenic	Industrial and Non-EGU Point	35	35	35
Anthropogenic	Oil and Gas - Non-point	0	0	0
Anthropogenic	Residential Wood Combustion	70	70	70
Anthropogenic	Fugitive dust3	0	0	0
Anthropogenic	Agriculture2	61,847	61,847	61,847
Anthropogenic	Remaining Non-point	173	173	173
Anthropogenic	On-Road Mobile	366	366	286
Anthropogenic	Non-road Mobile	24	20	21
Anthropogenic	Rail	2	2	2
Anthropogenic	Commercial Marine4	0	0	0
Anthropogenic	Agricultural Fire	1,635	1,635	1,635

Anthropogenic	Wildland Prescribed Fire	1,801	2,086	2,086
Natural	Wildfire	309	4,002	4,002
Natural	Biogenic5	0	0	0

1. 2028OTBa2 refers to the On the Books assumptions for US anthropogenic emissions in 2028. 2028OTBa2 fire emissions are the same as Representative Baseline and cover the period 2014-2018.
2. The Agricultural emissions sector includes only NH3 emissions from nonpoint livestock and fertilizer application.
3. The Fugitive Dust sector contains only PM10 and PM2.5 emissions from area-source anthropogenic dust sources.
4. Commercial Marine Shipping C1, C2, and C3 emissions within and offshore of the state.
5. Biogenic emissions are reported for CO, NOx, and VOC.

Table 5-9 -- South Dakota's Volatile Organic Compounds emissions projections and scenarios comparison

South Dakota Volatile Organic Compounds tons/year				
State Emissions	Source Category	2014v2 Actual	Representative Baseline 2	2028 OTB a21
Anthropogenic	Electric Generating Units (EGU)	4	0	0
Anthropogenic	Oil and Gas - Point	17	17	17
Anthropogenic	Industrial and Non-EGU Point	3,223	3,225	3,225
Anthropogenic	Oil and Gas - Non-point	8,241	10,279	5,200
Anthropogenic	Residential Wood Combustion	1,719	1,719	1,719
Anthropogenic	Fugitive dust3	0	0	0
Anthropogenic	Agriculture2	6,976	6,976	6,976
Anthropogenic	Remaining Non-point	25,475	25,475	25,475
Anthropogenic	On-Road Mobile	12,864	12,864	5,110
Anthropogenic	Non-road Mobile	8,247	6,342	3,949
Anthropogenic	Rail	186	186	96
Anthropogenic	Commercial Marine4	0	0	0
Anthropogenic	Agricultural Fire	469	469	469
Anthropogenic	Wildland Prescribed Fire	21,961	43,629	43,629
Natural	Wildfire	3,733	84,371	84,371
Natural	Biogenic5	280,338	280,338	280,338

1. 2028OTBa2 refers to the On the Books assumptions for US anthropogenic emissions in 2028. 2028OTBa2 fire emissions are the same as Representative Baseline and cover the period 2014-2018.
2. The Agricultural emissions sector includes only NH3 emissions from nonpoint livestock and fertilizer application.
3. The Fugitive Dust sector contains only PM10 and PM2.5 emissions from area-source anthropogenic dust sources.
4. Commercial Marine Shipping C1, C2, and C3 emissions within and offshore of the state.
5. Biogenic emissions are reported for CO, NOx, and VOC.

Table 5-10 -- South Dakota's Carbon Monoxide emissions projections and scenarios comparison

South Dakota Carbon Monoxide tons/year				
State Emissions	Source Category	2014v2 Actual	Representative Baseline 2	2028 OTB a21
Anthropogenic	Electric Generating Units (EGU)	19	45	45
Anthropogenic	Oil and Gas - Point	145	145	145
Anthropogenic	Industrial and Non-EGU Point	4,461	4,494	4,494
Anthropogenic	Oil and Gas - Non-point	1,191	1,342	639
Anthropogenic	Residential Wood Combustion	10,693	10,693	10,693
Anthropogenic	Fugitive dust3	0	0	0
Anthropogenic	Agriculture2	0	0	0
Anthropogenic	Remaining Non-point	5,250	5,250	5,250
Anthropogenic	On-Road Mobile	122,683	122,683	49,363
Anthropogenic	Non-road Mobile	52,311	46,855	43,212
Anthropogenic	Rail	606	606	509
Anthropogenic	Commercial Marine4	0	0	0
Anthropogenic	Agricultural Fire	9,657	9,657	9,657
Anthropogenic	Wildland Prescribed Fire	110,042	112,234	112,234
Natural	Wildfire	18,925	258,719	258,719
Natural	Biogenic5	87,934	87,934	87,934

1. 2028OTBa2 refers to the On the Books assumptions for US anthropogenic emissions in 2028. 2028OTBa2 fire emissions are the same as Representative Baseline and cover the period 2014-2018.
2. The Agricultural emissions sector includes only NH3 emissions from nonpoint livestock and fertilizer application.
3. The Fugitive Dust sector contains only PM10 and PM2.5 emissions from area-source anthropogenic dust sources.
4. Commercial Marine Shipping C1, C2, and C3 emissions within and offshore of the state.
5. Biogenic emissions are reported for CO, NOx, and VOC.

5.7 Other Elements Necessary To Assess And Report On Visibility

40 CFR § 51.308(f)(6) and 40 CFR § 51.308(f)(6)(vi) state: "Monitoring strategy and other implementation plan requirements. The State must submit with the implementation plan a monitoring strategy for measuring, characterizing, and reporting of regional haze visibility impairment that is representative of all mandatory Class I Federal areas within the State. Compliance with this requirement may be met through participation in the Interagency Monitoring of Protected Visual Environments network. ***The implementation plan must also provide for the following: Other elements, including reporting, recordkeeping, and other measures, necessary to assess and report on visibility."***

Since the IMPROVE program provides data to the EPA directly, this requirement of the Regional Haze Rule is fulfilled. The direct exchange from IMPROVE to EPA is the equivalent of states reporting visibility monitoring data to the Administrator annually.

DANR will track data related to the regional haze implementation plan for sources for which the state has regulatory authority. DANR will also depend on the IMPROVE program and working with states and other organizations to collect and analyze efforts and data support systems for monitoring and emissions inventory data, respectively. To ensure the availability of data and analyses required to report on visibility conditions and progress toward Class I area visibility goals, the state of South Dakota will collaborate with EPA, states, tribes, and FLMs to ensure the continued operation of the IMPROVE program.

6. Coordination And Consultation

6.1 Federal Land Manager Consultation

40 CFR § 51.308(i)(1) and 40 CFR § 51.308(i)(1)(i)-(ii) state: ***"By November 29, 1999, the State must identify in writing to the Federal Land Managers the title of the official to which the Federal Land Manager of any mandatory Class I Federal area can submit any recommendations on the implementation of this subpart including, but not limited to: Identification of impairment of visibility in any mandatory Class I Federal area(s); and Identification of elements for inclusion in the visibility monitoring strategy required by §51.305 and this section."***

DANR provided the state's contact to the federal land managers through its involvement with WRAP. WRAP represents a conglomeration of stakeholders representing federal land managers, industry, states, tribes, environmental groups and the general public. Through participation in this process, a significant portion of the consultation process with federal land managers and other states has been met. In the WRAP process these stakeholders participated in various forums to help develop a coordinated emissions inventory and analysis of the impacts sources have on regional haze in the west. Coordination and evaluation of monitoring data and modeling processes were also overseen by WRAP participants. Through these coordinated technical evaluations, a regional haze oriented evaluation of South Dakota's Class I areas was constructed.

South Dakota has been a participating member of the WRAP since its inception. WRAP identifies major products and milestones; serves as an instrument of coordination; provides the direction and transparency needed to foster stakeholder participation and consensus-based decision making, and provides guidance to the individual plans of WRAP forums and committees.

The initial deadline for State Implementation Plan submittal for this second implementation period was July 31st, 2021, and therefore Federal Land Manager consultation initially was required to be conducted no later than 60 days before this deadline. Consultation was delayed however, due to multiple WRAP and WRAP contractor-provided modeling products having been delayed. The reason for the delays are explained in detail in Appendix E.

40 CFR § 51.308(i)(2) and 40 CFR § 51.308(i)(2)(i)-(ii) state: ***"The State must provide the Federal Land Manager with an opportunity for consultation, in person at a point early enough in the State's policy analyses of its long-term strategy emission reduction obligation so***

that information and recommendations provided by the Federal Land Manager can meaningfully inform the State's decisions on the long-term strategy. The opportunity for consultation will be deemed to have been early enough if the consultation has taken place at least 120 days prior to holding any public hearing or other public comment opportunity on an implementation plan (or plan revision) for regional haze required by this subpart. The opportunity for consultation on an implementation plan (or plan revision) or on a progress report must be provided no less than 60 days prior to said public hearing or public comment opportunity. ***This consultation must include the opportunity for the affected Federal Land Managers to discuss their: Assessment of impairment of visibility in any mandatory Class I Federal area; and Recommendations on the development and implementation of strategies to address visibility impairment."***

DANR is committed to providing the federal land managers opportunities to provide input as South Dakota's State Implementation Plan for the regional haze program is developed and implemented. This includes providing the federal land managers with at least 60 days prior notice to any public hearing.

On September 15th, 2021, DANR fulfilled this obligation and submitted South Dakota's draft Regional Haze Program to the following Federal Land Managers:

1. Tim Allen, U.S. Fish & Wildlife Service, Lakewood, Colorado;
2. Jeff Sorkin, USDA Forest Service, Great Lakes National Forests – Eastern Region;
3. Melanie Peters, National Park Service, Air Resources Division, Lakewood, Colorado;
4. Don Shepherd, National Park Service, Air Resources Division, Lakewood, Colorado;
5. Andrea Stacy, National Park Service, Air Resources Division, Lakewood, Colorado;
6. Debra Miller, National Park Service, Air Resources Division, Lakewood, Colorado;
7. Lisa Devore, National Park Service, Air Resources Division, Lakewood, Colorado;
8. David Pohlman, National Park Service, Air Resources Division, Lakewood, Colorado;
9. Kirsten King, National Park Service, Air Resources Division, Lakewood, Colorado;
10. Milton Haar, National Park Service, Badlands National Park;
11. Marc Ohms, National Park Service, Wind Cave National Park, and
12. Leigh Welling, National Park Service, Wind Cave National Park.

6.1.1 Addressing Federal Land Managers' Comments

40 CFR § 51.308(i)(3) states: "In developing any implementation plan (or plan revision) or progress report, ***the State must include a description of how it addressed any comments provided by the Federal Land Managers."***

DANR has informally been in contact and with the Federal Land Managers through WRAP meetings and correspondence through this second round. DANR also emailed the Federal Land Managers with a copy of South Dakota's SIP Draft on September 15th 2021, and received comments thereafter. The Federal Land Manager comments were analyzed and modifications to the draft were made. South Dakota then summarized and responded to each comment, included the information in an appendix, and made both it and the draft SIP available for public comment and review.

6.1.2 Procedures For Continuing Consultation

40 CFR § 51.308(i)(4) states: ***"The plan (or plan revision) must provide procedures for continuing consultation between the State and Federal Land Manager on the implementation of the visibility protection program required by this subpart, including development and review of implementation plan revisions and progress reports, and on the implementation of other programs having the potential to contribute to impairment of visibility in mandatory Class I Federal areas."***

DANR is committed to working with the federal land managers to protect the Class I Areas in South Dakota and in neighboring states. This will be accomplished with our continued involvement in regional organizations and through our contacts with the federal land managers.

DANR has already involved the federal land managers in other programs that may impact visibility in a Class I area through our Prevention of Significant Deterioration air quality permit program. DANR also has an open door policy in which the federal land managers can submit recommendations on an ongoing basis.

6.2 Consultation With Other States

40 CFR § 51.308(f)(2)(ii) states: ***"The State must consult with those States that have emissions that are reasonably anticipated to contribute to visibility impairment in the mandatory Class I Federal area to develop coordinated emission management strategies containing the emission reductions necessary to make reasonable progress."***

South Dakota believes it has met this requirement in large part through a formal participation in WRAP and by contacting and working with other states that are not members of WRAP. Through the WRAP process, all 13 western US states have been in direct contact through group conference calls, and have discussed amongst themselves and others many aspects of the requirements and technical details of the Regional Haze Rule for this second implementation period. During these conference calls, states shared and considered each other's strategies with the goal of receiving feedback and additional guidance regarding best practices in State Implementation Plan planning and development, execution, and writing processes.

WRAP gathered information regarding what states were doing to reduce air emissions that contribute to visibility impairment and provided that information to other states. The same information was used by WRAP in the 2028 projection models to determine the impacts those reductions will have on each Class I area. As noted previously, DANR has been a participant in

WRAP since its inception and considers its involvement as fulfilling part of the requirements for consultation. WRAP conducted numerous face-to-face meetings and monthly calls. All western states, EPA, Tribes and Federal Land Managers participated in the WRAP activities and were involved throughout the process.

According to section 3.2 of this report, South Dakota sources are not reasonably anticipated to contribute to visibility impairment at any other states' Class I Areas. Furthermore, according to the same section, the states that have emissions that are reasonably anticipated to contribute to visibility impairment in South Dakota's mandatory Class I Federal Areas are: North Dakota, Montana, Wyoming, Colorado, and Nebraska. Notably, DANR has consulted directly with the State of Nebraska over the past few years through email and phone calls, mostly in regards to impacts the Gerald Gentleman Power Plant has on visibility impairment in Class I areas in South Dakota, and their plans to control emissions from the Gerald Gentlemen Power Plant.

DANR sent South Dakota's draft Regional Haze State Implementation Plan to the following states on September 15th, 2021:

1. Tracy Wharton, State of Nebraska;
2. Weston Carloss, State of Colorado;
3. Rhonda Payne, State of Montana;
4. Amber Potts, State of Wyoming;
5. Hassan Bouchareb, State of Minnesota; and
6. David Stroh, State of North Dakota

40 CFR § 51.308(f)(2)(ii)(B) states: ***"The State must consider the emission reduction measures identified by other States for their sources as being necessary to make reasonable progress in the mandatory Class I Federal area."***

South Dakota considered implementing into its long-term strategy the control measures determined as necessary by other states for similar in-state sources selected in the source selection step for an analysis of control measures through its active and ongoing participation and inclusion in WRAP and the WRAP process.

40 CFR § 51.308(f)(2)(ii)(C) states: ***"In any situation in which a State cannot agree with another State on the emission reduction measures necessary to make reasonable progress in a mandatory Class I Federal area, the State must describe the actions taken to resolve the disagreement.*** In reviewing the State's implementation plan, the Administrator will take this information into account in determining whether the plan provides for reasonable progress at each mandatory Class I Federal area that is located in the State or that may be affected by emissions from the State. ***All substantive interstate consultations must be documented."***

DANR did not experience any situation in which we disagreed with another state on a reasonable progress goal. DANR will continue to work with states to ensure South Dakota's Class I areas achieve natural conditions by 2064 and air emissions from within South Dakota do not impair other state's progress in achieving natural condition in their Class I areas by 2064.

40 CFR § 51.308(f)(2)(ii)(A) states: ***"The State must demonstrate that it has included in its implementation plan all measures agreed to during state-to-state consultations or a regional planning process, or measures that will provide equivalent visibility improvement."***

Throughout the second implementation planning period, South Dakota has been involved in a regional planning process known as WRAP. Much of the WRAP's effort is focused on regional technical analysis that serves as the basis for developing strategies to meet the Regional Haze Rule requirements to demonstrate reasonable progress towards natural visibility conditions in Class I areas. This includes the compilation of emission inventories, air quality modeling, and ambient monitoring and data analysis. The WRAP is committed to using the most recent and scientifically acceptable data and methods. The WRAP does not sponsor basic research, but WRAP committees and forums interact with the research community to refine and incorporate the best available tools and information pertaining to western haze. WRAP was organized into various work groups, including the Regional Technical Operations Work Group, the Fire and Smoke Work Group, the Oil and Gas Work Group, the Regional Haze Planning Work Group, and the Tribal Data Work Group. Some work groups also had their own subcommittees, as was the case with the Regional Haze Planning Work Group; The RHPWG subcommittees were the Coordination and Glide Path Subcommittee, the Emissions Inventory and Modeling Protocol Subcommittee, and the Control Measures Subcommittee. Each work group had its own system for developing and distributing its work products, both via online on the WRAP website, and via many conference calls with states, federal land managers, the EPA, and others. Individual states had the freedom to attend the conference calls and access the work products of any of the work groups they so chose, depending on their needs. South Dakota attended many WRAP Work Group conference calls, and accessed many WRAP Work Group work products while developing its State Implementation Plan. South Dakota agreed with all measures agreed to during this regional planning process, and was overall agreed with the way everyone worked together to ensure a timely delivery of State Implementation Plans by the states.

6.3 Other Coordination And Consultation

40 CFR § 51.308(f)(3)(ii)(A) states: ***"If a State in which a mandatory Class I Federal area is located establishes a reasonable progress goal for the most impaired days that provides for a slower rate of improvement in visibility than the uniform rate of progress calculated under paragraph (f)(1)(vi) of this section, the State must demonstrate, based on the analysis required by paragraph (f)(2)(i) of this section, that there are no additional emission reduction measures for anthropogenic sources or groups of sources in the State that may reasonably be anticipated to contribute to visibility impairment in the Class I area that would be reasonable to include in the long-term strategy. The State must provide a robust demonstration, including documenting the criteria used to determine which sources or groups or sources were evaluated and how the four factors required by paragraph (f)(2)(i) were taken into consideration in selecting the measures for inclusion in its long-term strategy. The State must provide to the public for review as part of its implementation plan an assessment of the number of years it***

would take to attain natural visibility conditions if visibility improvement were to continue at the rate of progress selected by the State as reasonable for the implementation period."

Based on the modeling analysis WRAP conducted on projected visibility in 2028, the reasonable progress goal is below the Glideslope for each of South Dakota's two Class I Areas. Therefore, 40 CFR § 51.308(f)(3)(ii)(A) does not apply to South Dakota during this second implementation period.

40 CFR § 51.308(g) states: "Requirements for periodic reports describing progress towards the reasonable progress goals. […] Each State identified in §51.300(b) must periodically submit a report to the Administrator evaluating progress towards the reasonable progress goal for each mandatory Class I Federal area located within the State and in each mandatory Class I Federal area located outside the State that may be affected by emissions from within the State. The first progress report is due 5 years from submittal of the initial implementation plan addressing paragraphs (d) and (e) of this section. The first progress reports must be in the form of implementation plan revisions that comply with the procedural requirements of §51.102 and §51.103. Subsequent progress reports are due by January 31, 2025, July 31, 2033, and every 10 years thereafter. ***Subsequent progress reports must be made available for public inspection and comment for at least 30 days prior to submission to EPA and all comments received from the public must be submitted to EPA along with the subsequent progress report, along with an explanation of any changes to the progress report made in response to these comments.*** Periodic progress reports must contain at a minimum the following elements:"

DANR provided the public an opportunity to comment on the proposed regional haze program and provide testimony at a public hearing that was held in front of the Board of Minerals and Environment in April, 2022. DANR also solicited public comments on the DANR webpage prior to the State Implementation Plan submission to the EPA.

In addition, DANR took this opportunity to solicit comments from the following:

1. Jaslyn Dobrahner, EPA Region VIII;
2. Aaron Worstell, EPA Region VIII;
3. Jim Anderson, GCC Dacotah, Rapid City, SD;
4. Danielle Wiebers, Pete Lien and Sons, Rapid City, SD; and
5. Mark Thoma, Otter Tail Power Company, Big Stone Power Plant.

The comments from the public and others and DANR's response to those comments may be reviewed in Appendix B.

7 Periodic Review

DANR will coordinate with EPA to conduct these reviews jointly to satisfy the requirements of 40 CFR § 51.306(c).

7.1 Evaluation And Reassessment Every 10 Years

40 CFR § 51.308(f) states: "Requirements for periodic comprehensive revisions of implementation plans for regional haze. ***Each State identified in §51.300(b) must revise and submit its regional haze implementation plan revision to EPA by July 31, 2021, July 31, 2028, and every 10 years thereafter. The plan revision due on or before July 31, 2021, must include a commitment by the State to meet the requirements of paragraph (g) of this section. In each plan revision, the State must address regional haze in each mandatory Class I Federal area located within the State and in each mandatory Class I Federal area located outside the State that may be affected by emissions from within the State.*** To meet the core requirements for regional haze for these areas, the State must submit an implementation plan containing the following plan elements and supporting documentation for all required analyses:"

In accordance with 40 CFR § 51.308(f), DANR will review, revise, and submit revisions to South Dakota's State Implementation Plan by July 31, 2018, July 31, 2021, July 31, 2028, and every ten years thereafter, and is thus committing to meet the requirements of 40 CFR § 51.308(g). In the plan revision, South Dakota will also address regional haze in each mandatory Class I Federal area located within the State and in each mandatory Class I Federal area located outside the State that may be affected by emissions from within the State.

7.2 Progress Report

40 CFR § 51.308(f)(5) states: "So that the plan revision will serve also as a progress report, ***the State must address in the plan revision the requirements of paragraphs (g)(1) through (5) of this section.*** However, the period to be addressed for these elements shall be the period since the most recent progress report."

40 CFR § 51.308(g) states: "Requirements for periodic reports describing progress towards the reasonable progress goals. ***Each State identified in §51.300(b) must periodically submit a report to the Administrator evaluating progress towards the reasonable progress goal for each mandatory Class I Federal area located within the State and in each mandatory Class I Federal area located outside the State that may be affected by emissions from within the State. The first progress report is due 5 years from submittal of the initial implementation plan addressing paragraphs (d) and (e) of this section.*** The first progress reports must be in the form of implementation plan revisions that comply with the procedural requirements of §51.102 and §51.103. ***Subsequent progress reports are due by January 31, 2025, July 31, 2033, and every 10 years thereafter.*** Subsequent progress reports must be made available for public inspection and comment for at least 30 days prior to submission to EPA and all comments received from the public must be submitted to EPA along with the subsequent progress report, along with an explanation of any changes to the progress report made in response to these comments. Periodic progress reports must contain at a minimum the following elements:"

DANR will evaluate and report its progress towards the reasonable progress goal for each mandatory Class I federal area located within South Dakota and in each mandatory Class I federal area located outside the state which may be affected by emissions from within the state.

The progress reports will be in the form of an implementation plan revision that complies with the procedural requirements of 40 CFR §§ 51.102 and 51.103.

7.2.1 Status Of Implementation Of Measures For Achieving Reasonable Progress Goals

40 CFR § 51.308(g) and 40 CFR § 51.308(g)(1) state: "Requirements for periodic reports describing progress towards the reasonable progress goals. Each State identified in §51.300(b) must periodically submit a report to the Administrator evaluating progress towards the reasonable progress goal for each mandatory Class I Federal area located within the State and in each mandatory Class I Federal area located outside the State that may be affected by emissions from within the State. The first progress report is due 5 years from submittal of the initial implementation plan addressing paragraphs (d) and (e) of this section. The first progress reports must be in the form of implementation plan revisions that comply with the procedural requirements of §51.102 and §51.103. Subsequent progress reports are due by January 31, 2025, July 31, 2033, and every 10 years thereafter. Subsequent progress reports must be made available for public inspection and comment for at least 30 days prior to submission to EPA and all comments received from the public must be submitted to EPA along with the subsequent progress report, along with an explanation of any changes to the progress report made in response to these comments. ***Periodic progress reports must contain at a minimum the following elements: A description of the status of implementation of all measures included in the implementation plan for achieving reasonable progress goals for mandatory Class I Federal areas both within and outside the State."***

7.2.1.1 Best Available Retrofit Technology (BART) Requirements

South Dakota has one Best Available Retrofit Technology (BART) eligible source. This BART eligible source is the Big Stone Power Plant coal-fired power plant owned by Montana-Dakota Utilities Company, NorthWestern Energy, and Otter Tail Power Company. The Big Stone Power Plant is located near Milbank in the northeastern corner of South Dakota.

In December 2010, South Dakota finalized its BART determination for the Big Stone Power Plant. South Dakota's BART determination required the Big Stone Power Plant's main boiler (Unit #1) to install a selective catalytic reduction (SCR) system and separated over-fire-air (SOFA) for nitrogen oxide (NO_x) control, a dry flue gas desulfurization (FGD) system for sulfur dioxide (SO_2) control and a fabric filter system for particulate matter (PM) control.

The air pollution controls and limits established under the BART determination are required to be installed and implemented within five years of EPA's approval of South Dakota's Regional Haze State Implementation Plan. EPA approved South Dakota's Regional Haze State Implementation Plan on April 26, 2012. Therefore, the Big Stone Power Plant is required to meet the emission limits established in the BART determination by April 26, 2017.

South Dakota issued a construction permit to the Big Stone Power Plant for the air quality control system project on September 30, 2013. The permit incorporated the BART emission limits established in Administrative Rules of South Dakota § 74:36:21:06. Installation of the air quality control system project has been completed, and it is currently operating with the control system in place.

7.2.1.2 Other State Rules

South Dakota's current air quality rules under Administrative Rules of South Dakota article 74:36 – Air Pollution Control Program, currently protects and improves visibility in Class I areas. Examples of existing rules that protect and improve visibility in Class I areas are listed below:

1. ARSD § 74:36:01:05 – Applicable requirements of Clean Air Act defined: Subsection (12) states "*Any national ambient air quality standard or increment or visibility requirement under Part C of Title I of the Clean Air Act, but only as it would apply to temporary sources permitted pursuant to § 504(e) of the Clean Air Act*";
2. ARSD § 74:36:01:10 – Modification defined: Subsection (3) states "*The change requires or changes a case-by-case determination of an emission limit or other standard, a source-specific determination for temporary sources of ambient impacts, or a visibility or increment analysis*";
3. ARSD § 74:36:02:01 – Air quality goals: Subsection (3) states one of the goals is "*Optimization of visibility*";
4. ARSD § 74:36:04 – Operating permits for minor sources and § 74:36:05 – Operating permits for Part 70 sources: The permits issued under these chapters require sources to meet all applicable emission limits, demonstrate compliance, monitoring, recordkeeping and reporting requirements to ensure compliance with all applicable requirements of the Clean Air Act;
5. ARSD §§ 74:36:06 – Regulated Air Pollutant Emissions; 74:36:07 – New Source Performance Standards; 74:36:08 – National Emission Standards for Hazardous Air Pollutants, and ARSD § 74:36:12 – Control of Visible Emissions: These chapters restrict air emissions from regulated entities that contribute to visibility impairment and prohibits certain open burning practices such as open burning waste oil, rubber, waste tires, asphalt shingles, railroad ties, etc.;
6. ARSD § 74:36:09 – Prevention of Significant Deterioration: This chapter requires a visibility analysis to prevent sources subject to these requirements from contributing to visibility impairment in Class I areas;
7. ARSD § 74:36:10 – New Source Review: This chapter requires a visibility analysis to prevent sources subject to these requirements from contributing to visibility impairment in Class I areas;
8. ARSD § 74:36:18 – Regulations for State Facilities in the Rapid City Area: This chapter restricts visible emissions from fugitive sources; and
9. ARSD § 84:36:20 – Construction permits for new sources or modifications: The permits issued under this chapter requires newly constructed sources and modifications to existing sources to meet all applicable emission limits, demonstrate compliance, monitoring, recordkeeping, and reporting requirements to ensure compliance will all applicable requirements under the Clean Air Act.

7.2.1.3 Federal Programs

The following EPA rules are also helping to protect and improve visibility in Class I areas throughout the nation:

1. Heavy-Duty Highway Diesel Rule – 40 CFR Part 86: Within this rule, EPA set a particulate matter (PM) emissions standard for new heavy-duty engines of 0.01 gram per brake horsepower-hour (g/bhp-hr), which took full effect for diesel engines in the 2007 model year. The rule also included standards for oxides of nitrogen and non-methane hydrocarbons of 0.20 g/bhp-hr and 0.14 g/bhp-hr, respectively. The two standards were successfully phased in together between 2007 and 2010. The rule also required the sulfur in highway diesel fuel be reduced to 15 parts per million (ultra-low sulfur diesel fuel). This amounted to a 97% reduction in the sulfur content. The requirements of the rule were implemented within the time frames established by the rule.
2. Tier 2 Vehicle and Gasoline Sulfur Program – 40 CFR Part 80 Subpart H; Part 85; Part 86: EPA's Tier 2 Program set federal emission standards for on-road vehicles, including sport utility vehicles, minivans, vans, and pick-up trucks, as well as passenger cars. The program created fleet-averaging standards for nitrogen oxide, allowing manufacturers to produce vehicles with varying emissions, as long as the fleet of vehicles produced by a manufacturer had average nitrogen oxide emissions below a specified value. The standards became effective in the 2005 model year. Mobile emissions continue to benefit from this program as consumers replace older, more polluting vehicles with cleaner vehicles.
3. Non-road Diesel Rule – 40 CFR Part 89: This rule sets standards for emissions of nitrogen oxide, hydrocarbons, and carbon monoxide from non-road engines, including industrial spark-ignition engines, recreational non-road vehicles and a variety of farm and construction equipment. These rules were initially effective in 2004 and were fully phased in by 2012. The non-road diesel rule also set limits on the sulfur content of non-road diesel fuel. Starting in 2007, the rule reduced sulfur levels by 99 percent from previous levels. The reduction in fuel sulfur levels applied to most non-road diesel fuel in 2010 and applied to fuel used in locomotives and marine vessels in 2012

7.2.2 Emissions Reductions Achieved Throughout The State From Regional Haze State Implementation Plan Strategies

40 CFR § 51.308(g) and 40 CFR § 51.308(g)(2) state: "Requirements for periodic reports describing progress towards the reasonable progress goals. Each State identified in §51.300(b) must periodically submit a report to the Administrator evaluating progress towards the reasonable progress goal for each mandatory Class I Federal area located within the State and in each mandatory Class I Federal area located outside the State that may be affected by emissions from within the State. The first progress report is due 5 years from submittal of the initial implementation plan addressing paragraphs (d) and (e) of this section. The first progress reports must be in the form of implementation plan revisions that comply with the procedural requirements of §51.102 and §51.103. Subsequent progress reports are due by January 31, 2025, July 31, 2033, and every 10 years thereafter. Subsequent progress reports must be made available for public inspection and comment for at least 30 days prior to submission to EPA and all comments received from the public must be submitted to EPA along with the subsequent progress report, along with an explanation of any changes to the progress report made in

response to these comments. ***Periodic progress reports must contain at a minimum the following elements: A summary of the emissions reductions achieved throughout the State through implementation of the measures described in paragraph (g)(1) of this section."***

As identified earlier, the Best Available Retrofit Technology emission controls for the Big Stone Power Plant were installed in 2015. Table 7-1 shows the Big Stone Power Plant's actual average emission rates for the last ten years to illustrate the emission reductions Best Available Retrofit Technology controls had after being installed and operational. Emissions information is from the following URL: https://ampd.epa.gov/ampd/

Table 7-2 shows South Dakota emissions from the National Emissions Inventory, compared between 2014 and 2017, for the parameters of SO2, NOx, NH3, VOC, and CO.

Table 7-1 -- Big Stone Power Plant Actual Emission Rates

Calendar Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Actual SO2 Emissions (tons/year)	12,589	10,663	12,290	15,340	13,845	4,805	827	846	1,003	1,095	664
Actual NOx Emissions (tons/year)	12,308	9,823	10,579	11,213	10,507	3,148	962	985	1,051	1,085	784

Table 7-2 -- National Emissions Inventory South Dakota Emissions

			Change (2014-2017)	
Pollutant	2014	2017	Tons	Percentage
SO2	16,123	4,842	-11,281	-69.97%
NOx	105,636	91,550	-14,086	-13.33%
NH3	63,245	87,576	24,331	38.47%
VOC	395,781	291,023	-104,758	-26.47%
CO	463,315	467,193	3,878	0.837%

7.2.3 Assessment Of Visibility Conditions And Changes

7.2.3.1 Current Visibility Conditions

40 CFR § 51.308(g) and 40 CFR § 51.308(g)(3) and 40 CFR § 51.308(g)(3)(i)(A) state: "Requirements for periodic reports describing progress towards the reasonable progress goals. Each State identified in §51.300(b) must periodically submit a report to the Administrator evaluating progress towards the reasonable progress goal for each mandatory Class I Federal area located within the State and in each mandatory Class I Federal area located outside the State that may be affected by emissions from within the State. The first progress report is due 5 years from submittal of the initial implementation plan addressing paragraphs (d) and (e) of this section. The first progress reports must be in the form of implementation plan revisions that

comply with the procedural requirements of §51.102 and §51.103. Subsequent progress reports are due by January 31, 2025, July 31, 2033, and every 10 years thereafter. Subsequent progress reports must be made available for public inspection and comment for at least 30 days prior to submission to EPA and all comments received from the public must be submitted to EPA along with the subsequent progress report, along with an explanation of any changes to the progress report made in response to these comments. ***Periodic progress reports must contain at a minimum the following elements: For each mandatory Class I Federal area within the State, the State must assess the following visibility conditions and changes,*** with values for most impaired, least impaired and/or clearest days as applicable expressed in terms of 5-year averages of these annual values. The period for calculating current visibility conditions is the most recent 5-year period preceding the required date of the progress report for which data are available as of a date 6 months preceding the required date of the progress report. Progress reports due before January 31, 2025. ***The current visibility conditions for the most impaired and least impaired days."***

Regional haze progress in federal Class I areas is tracked using calculations based on speciated aerosol mass collected by the Interagency Monitoring of Protected Visual Environments (IMPROVE) monitors at each Class I area. Haze is tracked in units of Deciview (dv), as the Deciview metric was designed to be linearly associated with human perception of visibility. In a pristine atmosphere, the Deciview metric is near zero, and a one Deciview change is approximately equivalent to a 10% change in cumulative species extinction. To better understand visibility conditions, summaries here include both the Deciview and light extinction due to the various aerosol species which are measured in inverse mega meters (Mm^{-1}).

In accordance with 40 CFR§ 51.308 (g)(3)(i), the report shall address the current visibility conditions for the most impaired and least impaired days for each Class I area. In EPA's 2003 Guidance for Tracking Progress under the Regional Haze Rule, it specifies that progress is tracked against the 2000-2004 baseline period using corresponding averages of successive 5-year periods; i.e., 2005-2009, 2006-2010, etc. For this 5-year progress report South Dakota used the most current visibility data available which is the 5-year period of 2014-2018.

Tables 7-3 and 7-4 represent the 20% most impaired and 20% least impaired days, respectively, for both Badlands and Wind Cave National Parks. The tables provide the average haze index, measured in Deciviews, and the average percent contribution to light extinction, measured in inverse mega meters, for each aerosol species for the 2014-2018 progress period.

Table 7-3 -- Percent Contribution to Extinction - 20% Most Impaired Days (2014-2018)

National Park	Deciview (dv)	Percent Light Extinction						
		Ammonium Sulfate (Mm-1)	Ammonium Nitrate (Mm-1)	Organic Mass (Mm-1)	Elemental Carbon (Mm-1)	Fine Soil (Mm-1)	Coarse Mass (Mm-1)	Sea Salt (Mm-1)
Badlands	12.33	45.4%	25.2%	14.6%	4.6%	1.9%	7.9%	0.25%
Wind Cave	10.526	38.4%	27.5%	17.3%	5.6%	2.1%	8.5%	0.41%

For the 20% most impaired days, nearly half of the light extinction at the Badlands National Park comes from ammonium sulfate. The second largest contributor is ammonium nitrate at 25% followed by organic mass at 14.6% and then coarse mass at 7.9%. Elemental carbon, soil and sea salt contribute minor amounts to the light extinction.

For the 20% most impaired days at the Wind Cave National Park, over one-third of the light extinction comes from ammonium sulfate and just under a third from ammonium nitrate. Organic mass is the third largest contributor to the light extinction at 17.3%. Elemental carbon, soil, coarse mass, and sea salt contribute minor amounts to the light extinction.

Table 7-4 -- Percent Contribution to Extinction - 20% Clearest Days (2014-2018)

National Park	Deciview (dv)	Percent Light Extinction						
		Ammonium Sulfate (Mm-1)	Ammonium Nitrate (Mm-1)	Organic Mass (Mm-1)	Elemental Carbon (Mm-1)	Fine Soil (Mm-1)	Coarse Mass (Mm-1)	Sea Salt (Mm-1)
Badlands	5.39	34.5%	14.9%	21.8%	6.4%	4.5%	17.1%	0.76%
Wind Cave	3.52	36.4%	12.3%	23.4%	7.7%	4%	15.6%	0.58%

For the 20% Clearest Days at the Badlands and Wind Cave National Parks the makeup of extinction between the two national parks is very similar, which is expected as the least impaired days are usually impacted by local sources rather than large regional sources or events that can travel great distances. Ammonium sulfate is the largest contributor to the light extinction at both parks at around 35%. The next largest contributor is organic mass, followed by coarse mass and ammonium nitrate. Elemental carbon, fine soil and sea salt have very little impact at either park on the least impaired days.

The haze index and light extinction were next broken out by year to determine if one or more years influenced the five year average. Tables 7-5 and 7-6 represent the annual visibility conditions for the 20% most impaired days at the Badlands and Wind Cave National Parks, respectively, for the haze index and light extinction by aerosol species.

Table 7-5 -- Badlands Aerosol Concentrations from 2014-2018

Year	Deciview (dv)	Badlands 20% Most Impaired Days (Mm^{-1})						
		Ammonium Sulfate (Mm-1)	Ammonium Nitrate (Mm-1)	Organic Mass (Mm-1)	Elemental Carbon (Mm-1)	Fine Soil (Mm-1)	Coarse Mass (Mm-1)	Sea Salt (Mm-1)
2014	12.2	11.5	6.1	2.85	1	0.46	1.7	0.04
2015	11.5	9.9	4.06	3.2	0.96	0.6	2.1	0.04
2016	12.1	10.7	5.6	3.5	0.96	0.39	1.8	0.05
2017	12.8	11.4	6.5	4.3	1.3	0.5	1.9	0.08

2018	12.9	11	8.03	3.6	1.35	0.36	2.05	0.08

Data for the 20% Most Impaired Days at Badlands National Park looks relatively consistent among all parameters, with no obvious outliers. While reviewing the annual values for the aerosol species at the Badlands National Park, the Department of Agriculture and Natural Resources (DANR) also noticed higher values for ammonium nitrate in 2018. One possibility for this slight increase could be a regional issue such as transport from an outside source causing the high ammonium nitrate value in 2018. The DANR was unable to identify a reason for the high ammonium nitrate concentration in 2018 for its two Class I Areas.

Table 7-6 -- Wind Cave Annual Aerosol Concentrations 2014-2018

Year	Deciview (dv)	Wind Cave 20% Most Impaired Days (Mm^{-1})						
		Ammonium Sulfate (Mm-1)	Ammonium Nitrate (Mm-1)	Organic Mass (Mm-1)	Elemental Carbon (Mm-1)	Fine Soil (Mm-1)	Coarse Mass (Mm-1)	Sea Salt (Mm-1)
2014	10.3	8.2	5.5	2.6	0.9	0.3	1	0.07
2015	10.5	8.4	4	3.5	0.9	0.5	1.6	0.05
2016	11.1	6.5	4.1	3.5	1	0.4	2.1	0.06
2017	10.9	7.2	6.5	3.5	1.2	0.3	1.3	0.09
2018	11.2	7.2	6.5	3.6	1.3	0.4	2.2	0.1

The 20% Most Impaired Days data for Wind Cave National Park shows relatively consistent values across time, with no significant trends or outliers. Ammonium sulfate is consistently the top contributor to visibility extinction, followed by ammonium nitrate, and then organic mass.

Tables 7-7 and 7-8 represent the annual visibility conditions for the 20% least impaired days at Badlands and Wind Cave National Parks for the current planning period represented by the 5-year period 2014-2018. A review of the data for the least impaired data does not indicate any outliers for either park. The values for each park for each haze index and light extinction by species seem to be consistent over the years, which would indicate no degradation to the least impaired days.

Table 7-7 -- Badlands Annual Aerosol Concentrations 2014-2018

Year	Deciview (dv)	Badlands 20% Clearest Days (Mm^{-1})						
		Ammonium Sulfate (Mm-1)	Ammonium Nitrate (Mm-1)	Organic Mass (Mm-1)	Elemental Carbon (Mm-1)	Fine Soil (Mm-1)	Coarse Mass (Mm-1)	Sea Salt (Mm-1)
2014	5.6	2.7	0.9	1.1	0.3	0.26	1.3	0.03
2015	5.5	2.2	1.1	1.6	0.4	0.3	1	0.04
2016	5.2	1.8	0.8	1.4	0.3	0.3	1.1	0.06
2017	5.2	1.9	0.7	1.2	0.4	0.3	1.2	0.3
2018	5.3	2	1.1	1.4	0.5	0.2	0.7	0.06

Table 7-8 -- Wind Cave Annual Aerosol Concentrations 2014-2018

Year	Deciview (dv)	Wind Cave 20% Clearest Days (Mm^{-1})						
		Ammonium Sulfate (Mm-1)	Ammonium Nitrate (Mm-1)	Organic Mass (Mm-1)	Elemental Carbon (Mm-1)	Fine Soil (Mm-1)	Coarse Mass (Mm-1)	Sea Salt (Mm-1)
2014	3.2	1.5	0.4	0.8	0.3	0.2	0.6	0.03
2015	3.8	1.7	0.6	1.15	0.3	0.2	0.7	0.02
2016	3.3	1.5	0.5	0.8	0.2	0.17	0.67	0.03
2017	3.8	1.7	0.6	0.9	0.4	0.17	0.6	0.01
2018	3.5	1.4	0.4	1.3	0.4	0.1	0.6	0.03

7.2.3.2 Difference Between Current And Baseline Visibility Conditions

40 CFR § 51.308(g) and 40 CFR § 51.308(g)(3) and 40 CFR § 51.308(g)(3)(ii)(A) state: "Requirements for periodic reports describing progress towards the reasonable progress goals. Each State identified in §51.300(b) must periodically submit a report to the Administrator evaluating progress towards the reasonable progress goal for each mandatory Class I Federal area located within the State and in each mandatory Class I Federal area located outside the State that may be affected by emissions from within the State. The first progress report is due 5 years from submittal of the initial implementation plan addressing paragraphs (d) and (e) of this section. The first progress reports must be in the form of implementation plan revisions that comply with the procedural requirements of §51.102 and §51.103. Subsequent progress reports are due by January 31, 2025, July 31, 2033, and every 10 years thereafter. Subsequent progress reports must be made available for public inspection and comment for at least 30 days prior to submission to EPA and all comments received from the public must be submitted to EPA along with the subsequent progress report, along with an explanation of any changes to the progress report made in response to these comments. ***Periodic progress reports must contain at a minimum the following elements: For each mandatory Class I Federal area within the State, the State must assess the following visibility conditions and changes,*** with values for most impaired, least impaired and/or clearest days as applicable expressed in terms of 5-year averages of these annual values. The period for calculating current visibility conditions is the most recent 5-year period preceding the required date of the progress report for which data are available as of a date 6 months preceding the required date of the progress report. Progress reports due before January 31, 2025. ***The difference between current visibility conditions for the most impaired and least impaired days and baseline visibility conditions."***

In accordance with 40 CFR§ 51.308 (g)(3)(ii), the 5-year progress report shall address the difference between current visibility conditions and baseline visibility conditions for the 20% most impaired days and 20% least impaired days. The baseline values consist of data from 2000 – 2004 and the current conditions are represented by the 2014-2018 time period.

Table 7-9 represents the difference between the baseline period and the current progress period for the 20% Most Impaired Days at Badlands National Park, to show the gradual trends being observed at each park. Each aerosol species remained relatively constant in light extinction other than a slight increase for ammonium nitrate. No large improvements or degradations in light extinction were seen.

Table 7-9 -- Comparing Extinction - Badlands - 20% Most Impaired Days (Mm^{-1})

Year	Deciview (dv)	Ammonium Sulfate (Mm-1)	Ammonium Nitrate (Mm-1)	Organic Mass (Mm-1)	Elemental Carbon (Mm-1)	Fine Soil (Mm-1)	Coarse Mass (Mm-1)	Sea Salt (Mm-1)
Baseline 2000-2004	17.1	18.85	5.85	11.78	2.59	0.98	5.94	0.19
2014	12.2	11.5	6.1	2.85	1	0.46	1.7	0.04
2015	11.5	9.9	4.06	3.2	0.96	0.6	2.1	0.04
2016	12.1	10.7	5.6	3.5	0.96	0.39	1.8	0.05
2017	12.8	11.4	6.5	4.3	1.3	0.5	1.9	0.08
2018	12.9	11	8.03	3.6	1.35	0.36	2.05	0.08

Table 7-10 represents the difference between the baseline period and the current progress period for the 20% Most Impaired Days at Wind Cave National Park. Separate years were added to show the gradual trends observed at the park. At Wind Cave National Park all pollutants besides sea salt showed light extinction improvements from the baseline to the current progress period. The haze index value measured in Deciviews also improved by 4.6 Deciviews.

Table 7-10 -- Comparing Extinction - Wind Cave - 20% Most Impaired Days (Mm^{-1})

Year	Deciview (dv)	Ammonium Sulfate (Mm-1)	Ammonium Nitrate (Mm-1)	Organic Mass (Mm-1)	Elemental Carbon (Mm-1)	Fine Soil (Mm-1)	Coarse Mass (Mm-1)	Sea Salt (Mm-1)
Baseline 2000-2004	15.8	13.2	6.98	13.22	2.92	0.85	3.52	0.03
2014	10.3	8.2	5.5	2.6	0.9	0.3	1	0.07
2015	10.5	8.4	4	3.5	0.9	0.5	1.6	0.05
2016	11.1	6.5	4.1	3.5	1	0.4	2.1	0.06
2017	10.9	7.2	6.5	3.5	1.2	0.3	1.3	0.09
2018	11.2	7.2	6.5	3.6	1.3	0.4	2.2	0.1

Table 7-11 represents the difference between the baseline period and the current progress period split up by year to show the gradual trends for the 20% Clearest Days at Badlands National Park. All aerosol species showed improvement in light extinction other than sea salt, with various species including ammonium sulfate and particulate organic mass showing large improvements. The Regional Haze Rule at 40 CFR § 51.308(f)(3)(i) requires no degradation on the Clearest Days since the baseline period; the haze index value at Badlands National Park improved by 1.3 Deciviews since the baseline period.

Table 7-11 -- Comparing Extinction - Badlands - 20% Clearest Days (Mm^{-1})

Year	Deciview (dv)	Ammonium Sulfate (Mm-1)	Ammonium Nitrate (Mm-1)	Organic Mass (Mm-1)	Elemental Carbon (Mm-1)	Fine Soil (Mm-1)	Coarse Mass (Mm-1)	Sea Salt (Mm-1)
Baseline 2000-2004	6.9	3.36	1.20	1.81	0.79	0.33	1.51	0.02
2014	5.6	2.7	0.9	1.1	0.3	0.26	1.3	0.03
2015	5.5	2.2	1.1	1.6	0.4	0.3	1	0.04
2016	5.2	1.8	0.8	1.4	0.3	0.3	1.1	0.06
2017	5.2	1.9	0.7	1.2	0.4	0.3	1.2	0.3
2018	5.3	2	1.1	1.4	0.5	0.2	0.7	0.06

Table 7-12 represents the difference between the baseline period and the current progress period for the 20% Clearest Days at Wind Cave National Park. The chart is broken up into separate years to show the gradual trends. Ammonium sulfate showed the largest improvement, however all species besides sea salt improved. Due to the reduction of the extinction species at the Wind Cave National Park, overall the Deciview level improved by 1.6 Deciviews.

Table 7-12 -- Comparing Extinction Wind Cave - 20% Clearest Days (Mm^{-1})

Year	Deciview (dv)	Ammonium Sulfate (Mm-1)	Ammonium Nitrate (Mm-1)	Organic Mass (Mm-1)	Elemental Carbon (Mm-1)	Fine Soil (Mm-1)	Coarse Mass (Mm-1)	Sea Salt (Mm-1)
Baseline 2000-2004	5.1	2.58	0.80	1.42	0.71	0.23	1.05	0.01
2014	3.2	1.5	0.4	0.8	0.3	0.2	0.6	0.03
2015	3.8	1.7	0.6	1.15	0.3	0.2	0.7	0.02
2016	3.3	1.5	0.5	0.8	0.2	0.17	0.67	0.03
2017	3.8	1.7	0.6	0.9	0.4	0.17	0.6	0.01
2018	3.5	1.4	0.4	1.3	0.4	0.1	0.6	0.03

7.2.3.3 Change In Visibility Impairment

40 CFR § 51.308(g) and 40 CFR § 51.308(g)(3) and 40 CFR § 51.308(g)(3)(iii)(A) state: “Requirements for periodic reports describing progress towards the reasonable progress goals. Each State identified in §51.300(b) must periodically submit a report to the Administrator evaluating progress towards the reasonable progress goal for each mandatory Class I Federal area located within the State and in each mandatory Class I Federal area located outside the State that may be affected by emissions from within the State. The first progress report is due 5 years from submittal of the initial implementation plan addressing paragraphs (d) and (e) of this section. The first progress reports must be in the form of implementation plan revisions that comply with the procedural requirements of §51.102 and §51.103. Subsequent progress reports

are due by January 31, 2025, July 31, 2033, and every 10 years thereafter. Subsequent progress reports must be made available for public inspection and comment for at least 30 days prior to submission to EPA and all comments received from the public must be submitted to EPA along with the subsequent progress report, along with an explanation of any changes to the progress report made in response to these comments. ***Periodic progress reports must contain at a minimum the following elements: For each mandatory Class I Federal area within the State, the State must assess the following visibility conditions and changes,*** with values for most impaired, least impaired and/or clearest days as applicable expressed in terms of 5-year averages of these annual values. The period for calculating current visibility conditions is the most recent 5-year period preceding the required date of the progress report for which data are available as of a date 6 months preceding the required date of the progress report. Progress reports due before January 31, 2025. ***The change in visibility impairment for the most impaired and least impaired days over the period since the period addressed in the most recent plan required under paragraph (f) of this section."***

Tables 7-13 and 7-14 show the haze index (Deciview) and the light extinction for each aerosol species for the 20% Most Impaired Days on a yearly basis for 2014 – 2018, and the total change between the specific years from 2014 to 2018. Despite both minor increases and decreases in some of the aerosol species, the Deciview value overall indicates a small degradation in visibility at both Badlands National Park and Wind Cave National Park. The greatest improvements at Badlands National Park were from ammonium sulfate. Wind Cave National Park also showed its largest improvement coming from ammonium sulfate.

Table 7-13 -- Change in Light Extinction - Badlands - 20% Most Impaired Days (Mm^{-1})

Year	Deciview (dv)	Ammonium Sulfate (Mm-1)	Ammonium Nitrate (Mm-1)	Organic Mass (Mm-1)	Elemental Carbon (Mm-1)	Fine Soil (Mm-1)	Coarse Mass (Mm-1)	Sea Salt (Mm-1)
2014	12.2	11.5	6.1	2.9	1	0.46	1.7	0.04
2015	11.5	9.9	4.06	3.2	0.96	0.6	2.1	0.04
2016	12.1	10.7	5.6	3.5	0.96	0.39	1.8	0.05
2017	12.8	11.4	6.5	4.3	1.3	0.5	1.9	0.08
2018	12.9	11	8	3.6	1.4	0.36	2	0.08
	0.7	-0.5	1.9	0.7	0.4	-0.1	0.3	0.04

Table 7-14 -- Change in Light Extinction - Wind Cave - 20% Most Impaired Days (Mm^{-1})

Year	Deciview (dv)	Ammonium Sulfate (Mm-1)	Ammonium Nitrate (Mm-1)	Organic Mass (Mm-1)	Elemental Carbon (Mm-1)	Fine Soil (Mm-1)	Coarse Mass (Mm-1)	Sea Salt (Mm-1)
2014	10.3	8.2	5.5	2.6	0.9	0.3	1	0.07
2015	10.5	8.4	4	3.5	0.9	0.5	1.6	0.05
2016	11.1	6.5	4.1	3.5	1	0.4	2.1	0.06
2017	10.9	7.2	6.5	3.5	1.2	0.3	1.3	0.09
2018	11.2	7.2	6.5	3.6	1.3	0.4	2.2	0.1

Year	Deciview (dv)	Ammonium Sulfate (Mm-1)	Ammonium Nitrate (Mm-1)	Organic Mass (Mm-1)	Elemental Carbon (Mm-1)	Fine Soil (Mm-1)	Coarse Mass (Mm-1)	Sea Salt (Mm-1)
	0.9	-1	1	1	0.4	0.1	1.2	0.3

Tables 7-15 and 7-16 show the haze index (Deciview) and the extinction for each species for the 20% Clearest Days for each year from 2014-2018. All of the aerosol species except for coarse mass and sea salt show a reduction at both Badlands and Wind Cave National Park. The Deciview value improved slightly over the 5 years at the Badlands National Park and showed a slight degradation in visibility at the Wind Cave National Park.

Table 7-15 -- Change in Light Extinction - Badlands - 20% Clearest Days (Mm^{-1})

Year	Deciview (dv)	Ammonium Sulfate (Mm-1)	Ammonium Nitrate (Mm-1)	Organic Mass (Mm-1)	Elemental Carbon (Mm-1)	Fine Soil (Mm-1)	Coarse Mass (Mm-1)	Sea Salt (Mm-1)
2014	5.6	2.7	0.9	1.1	0.3	0.3	1.3	0.03
2015	5.5	2.2	1.1	1.6	0.4	0.3	1	0.04
2016	5.2	1.8	0.8	1.4	0.3	0.3	1.1	0.06
2017	5.2	1.9	0.7	1.2	0.4	0.3	1.2	0.3
2018	5.3	2	1.1	1.4	0.5	0.2	0.7	0.06
	-0.3	-0.7	0.2	0.3	0.2	-0.1	-0.6	0.03

Table 7-16 -- Change in Light Extinction - Wind Cave - 20% Clearest Days (Mm^{-1})

Year	Deciview (dv)	Ammonium Sulfate (Mm-1)	Ammonium Nitrate (Mm-1)	Organic Mass (Mm-1)	Elemental Carbon (Mm-1)	Fine Soil (Mm-1)	Coarse Mass (Mm-1)	Sea Salt (Mm-1)
2014	3.2	1.5	0.4	0.8	0.3	0.2	0.6	0.03
2015	3.8	1.7	0.6	1.15	0.3	0.2	0.7	0.02
2016	3.3	1.5	0.5	0.8	0.2	0.17	0.67	0.03
2017	3.8	1.7	0.6	0.9	0.4	0.17	0.6	0.01
2018	3.5	1.4	0.4	1.3	0.4	0.1	0.6	0.03
	0.3	-0.1	0	0.5	0.1	-0.1	0	0

7.2.4 Change In Emissions Of Pollutants Contributing To Visibility Impairment

40 CFR § 51.308(g) and 40 CFR § 51.308(g)(4) state: "Requirements for periodic reports describing progress towards the reasonable progress goals. Each State identified in §51.300(b) must periodically submit a report to the Administrator evaluating progress towards the reasonable progress goal for each mandatory Class I Federal area located within the State and in each mandatory Class I Federal area located outside the State that may be affected by emissions from within the State. The first progress report is due 5 years from submittal of the initial implementation plan addressing paragraphs (d) and (e) of this section. The first progress reports

must be in the form of implementation plan revisions that comply with the procedural requirements of §51.102 and §51.103. Subsequent progress reports are due by January 31, 2025, July 31, 2033, and every 10 years thereafter. Subsequent progress reports must be made available for public inspection and comment for at least 30 days prior to submission to EPA and all comments received from the public must be submitted to EPA along with the subsequent progress report, along with an explanation of any changes to the progress report made in response to these comments. ***Periodic progress reports must contain at a minimum the following elements: An analysis tracking the change over the period since the period addressed in the most recent plan required under paragraph (f) of this section in emissions of pollutants contributing to visibility impairment from all sources and activities within the State.*** Emissions changes should be identified by type of source or activity. With respect to all sources and activities, ***the analysis must extend at least through the most recent year for which the state has submitted emission inventory information to the Administrator in compliance with the triennial reporting requirements of subpart A of this part as of a date 6 months preceding the required date of the progress report.*** With respect to sources that report directly to a centralized emissions data system operated by the Administrator, ***the analysis must extend through the most recent year for which the Administrator has provided a State-level summary of such reported data or an internet-based tool by which the State may obtain such a summary as of a date 6 months preceding the required date of the progress report.*** The State is not required to back cast previously reported emissions to be consistent with more recent emissions estimation procedures, and may draw attention to actual or possible inconsistencies created by changes in estimation procedures."

The emissions for the baseline years are represented using a 2014 inventory, which was developed with support from the WRAP. The most current emissions inventory is the WRAP's Representative Baseline 2 inventory, which averages the years 2014-2018 an emissions inventory of the average of the years 2014-2018. Note that the comparison of differences between inventories does not necessarily reflect a change in emissions, as a number of methodology changes and enhancements have occurred between developments of the individual inventories. Inventories for all major visibility impairing pollutants are presented for major source categories and categorized as either anthropogenic or natural emissions.

Looking at Table 7-17 and sulfur dioxide emissions, anthropogenic sources can include coal burning power plants, other industrial sources such as refineries and cement plants, and both on and off-road diesel engines. During the time frame from 2014 to the average of 2014-2018, sulfur dioxide emissions in South Dakota increased by 3,145 tons per year. The largest increase was seen in the natural wildfire category. The increase is likely due to a combination of actual changes in source contributions and methodology differences.

Table 7-17 -- Changes in Sulfur Dioxide Emissions (tons per year)

South Dakota Sulfur Dioxide tons/year				
State Emissions	Source Category	2014v2 Actual	Representative Baseline 2	Difference
Anthropogenic	Electric Generating Units (EGU)	5	7	2

Anthropogenic	Oil and Gas - Point	1	1	0
Anthropogenic	Industrial and Non-EGU Point	653	654	1
Anthropogenic	Oil and Gas - Non-point	45	59	14
Anthropogenic	Residential Wood Combustion	37	37	0
Anthropogenic	Fugitive dust[2]	0	0	0
Anthropogenic	Agriculture[1]	0	0	0
Anthropogenic	Remaining Non-point	127	127	0
Anthropogenic	On-Road Mobile	84	84	0
Anthropogenic	Non-road Mobile	33	23	-10
Anthropogenic	Rail	2	2	0
Anthropogenic	Commercial Marine[3]	0	0	0
Anthropogenic	Agricultural Fire	142	142	0
Anthropogenic	Wildland Prescribed Fire	710	1,056	346
	Total Anthropogenic	**1,839**	**2,192**	**353**
Natural	Wildfire	118	2,910	2,792
Natural	Biogenic[4]	0	0	0
	Total Natural	**118**	**2,910**	**2,792**
	Total Emissions	**1,957**	**5,102**	**3,145**

1. The Agricultural emissions sector includes only NH3 emissions from nonpoint livestock and fertilizer application.
2. The Fugitive Dust sector contains only PM10 and PM2.5 emissions from area-source anthropogenic dust sources.
3. Commercial Marine Shipping C1, C2, and C3 emissions within and offshore of the state.
4. Biogenic emissions are reported for CO, NOx, and VOC.

Regarding Table 7-18 and nitrogen oxide emissions, nitrogen oxide emissions can react with ammonia from area and mobile sources and produce ammonium nitrate. Both anthropogenic and natural activities produce nitrogen oxide emissions. Some of the more common anthropogenic sources include combustion activities, especially those involving automobiles. Table 7-18 shows the changes in nitrogen oxide emissions from 2014 through the average from 2014-2018. During that time frame, nitrogen oxide emissions in South Dakota increased by 4,564 tons per year. The largest decrease was seen in the non-road mobile source category which may be related to changes in the methodology and not actual reductions. The only real increase in nitrogen oxide emissions was from natural wildfires with an increase of 7,871 tons per year, again possibly the result of changes in methodology.

Table 7-18 -- Changes in Nitrogen Oxide Emissions (tons per year)

South Dakota Nitrogen Oxides (NOx) tons/year				
State Emissions	Source Category	2014v2 Actual	Representative Baseline 2	Difference
Anthropogenic	Electric Generating Units (EGU)	87	168	81
Anthropogenic	Oil and Gas - Point	435	435	0
Anthropogenic	Industrial and Non-EGU	2,824	2,828	4

	Point			
Anthropogenic	Oil and Gas - Non-point	398	468	70
Anthropogenic	Residential Wood Combustion	154	154	0
Anthropogenic	Fugitive dust[2]	0	0	0
Anthropogenic	Agriculture[1]	0	0	0
Anthropogenic	Remaining Non-point	1,275	1,275	0
Anthropogenic	On-Road Mobile	27,996	27,996	0
Anthropogenic	Non-road Mobile	19,294	15,506	-3,788
Anthropogenic	Rail	3,794	3,794	0
Anthropogenic	Commercial Marine[3]	0	0	0
Anthropogenic	Agricultural Fire	348	348	0
Anthropogenic	Wildland Prescribed Fire	1,119	1,445	326
	Total Anthropogenic	**57,724**	**54,417**	**-3307**
Natural	Wildfire	178	8,049	7,871
Natural	Biogenic[4]	57,259	57,259	0
	Total Natural	**57,437**	**65,308**	**7,871**
	Total Emissions	**115,161**	**119,725**	**4,564**

1. The Agricultural emissions sector includes only NH3 emissions from nonpoint livestock and fertilizer application.
2. The Fugitive Dust sector contains only PM10 and PM2.5 emissions from area-source anthropogenic dust sources.
3. Commercial Marine Shipping C1, C2, and C3 emissions within and offshore of the state.
4. Biogenic emissions are reported for CO, NOx, and VOC.

Regarding table 7-19 and PM2.5 Mass emissions, overall a total increase of 33,870 tons per year can be seen from 2014 to the average from 2014-2018, due primarily to increases in natural wildfires. These increases may have to do with methodology changes between the two time periods. Another large increase in emissions can be seen in the anthropogenic wildland prescribed fire category, and the only notable decrease can be seen in the anthropogenic non-road mobile source category.

Table 7-19 -- South Dakota's PM2.5 Mass emissions projections and scenarios comparison

South Dakota PM2.5 Mass tons/year				
State Emissions	Source Category	2014v2 Actual	Representative Baseline 2	Difference
Anthropogenic	Electric Generating Units (EGU)	13	23	10
Anthropogenic	Oil and Gas - Point	69	69	0
Anthropogenic	Industrial and Non-EGU Point	688	666	-22
Anthropogenic	Oil and Gas - Non-point	7	7	0
Anthropogenic	Residential Wood Combustion	1,598	1,598	0
Anthropogenic	Fugitive dust[2]	27,902	27,902	0

Anthropogenic	Agriculture[1]	0	0	0
Anthropogenic	Remaining Non-point	1,070	1,070	0
Anthropogenic	On-Road Mobile	971	971	0
Anthropogenic	Non-road Mobile	1,600	1,294	-306
Anthropogenic	Rail	107	107	0
Anthropogenic	Commercial Marine[3]	0	0	0
Anthropogenic	Agricultural Fire	1,048	1,048	0
Anthropogenic	Wildland Prescribed Fire	9,194	14,152	4,958
	Total Anthropogenic	**44,267**	**48,907**	**4,640**
Natural	Wildfire	1,570	30,800	29,230
Natural	Biogenic[4]	0	0	0
	Total Natural	**1,570**	**30,800**	**29,230**
	Total Emissions	**45,837**	**79,707**	**33,870**

1. The Agricultural emissions sector includes only NH3 emissions from nonpoint livestock and fertilizer application.
2. The Fugitive Dust sector contains only PM10 and PM2.5 emissions from area-source anthropogenic dust sources.
3. Commercial Marine Shipping C1, C2, and C3 emissions within and offshore of the state.
4. Biogenic emissions are reported for CO, NOx, and VOC.

Regarding table 7-20 and PM10 Mass emissions, similar to the PM2.5 Mass metric, an overall total increase of 36,047 tons per year can be seen from 2014 to the average from 2014-2018, due primarily to increases in natural wildfires. These increases may have to do with methodology changes between the two time periods. Another large increase in emissions can be seen in the anthropogenic wildland prescribed fire category, and the only notable decrease can be seen in the anthropogenic non-road mobile source category.

Table 7-20 -- South Dakota's PM10 Mass emissions projections and scenarios comparison

South Dakota PM10 Mass tons/year				
State Emissions	Source Category	2014v2 Actual	Representative Baseline 2	Difference
Anthropogenic	Electric Generating Units (EGU)	13	23	10
Anthropogenic	Oil and Gas - Point	69	69	0
Anthropogenic	Industrial and Non-EGU Point	786	783	-3
Anthropogenic	Oil and Gas - Non-point	7	7	0
Anthropogenic	Residential Wood Combustion	1,600	1,600	0
Anthropogenic	Fugitive dust[2]	149,273	149,273	0
Anthropogenic	Agriculture[1]	0	0	0
Anthropogenic	Remaining Non-point	1,242	1,242	0
Anthropogenic	On-Road Mobile	1,417	1,417	0
Anthropogenic	Non-road Mobile	1,660	1,342	-318
Anthropogenic	Rail	116	116	0

Anthropogenic	Commercial Marine[3]	0	0	0
Anthropogenic	Agricultural Fire	1,692	1,692	0
Anthropogenic	Wildland Prescribed Fire	10,849	15,778	4,929
	Total Anthropogenic	**168,724**	**173,342**	**4,618**
Natural	Wildfire	1,853	33,282	31,429
Natural	Biogenic[4]	0	0	0
	Total Natural	**1,853**	**33,282**	**31,429**
	Total Emissions	**170,577**	**206,624**	**36,047**

1. The Agricultural emissions sector includes only NH3 emissions from nonpoint livestock and fertilizer application.
2. The Fugitive Dust sector contains only PM10 and PM2.5 emissions from area-source anthropogenic dust sources.
3. Commercial Marine Shipping C1, C2, and C3 emissions within and offshore of the state.
4. Biogenic emissions are reported for CO, NOx, and VOC.

Regarding Table 7-21 and ammonia, ammonia emissions are primarily a product of anthropogenic area sources such as feedlots, but can also be produced by vehicles and natural sources such as fire. Changes in ammonia emissions can be seen between 2014 and the average of the years 2014-2018. During this time period South Dakota saw an overall increase of 3,974 tons. The largest increase was seen in the natural wildfire source category. The increase in emissions may be due to a combination of population changes and differences in methodologies used to estimate these emissions.

Table 7-21 -- Changes in Ammonia Emissions (tons per year)

South Dakota Ammonia Gas tons/year				
State Emissions	Source Category	2014v2 Actual	Representative Baseline 2	Difference
Anthropogenic	Electric Generating Units (EGU)	0	0	0
Anthropogenic	Oil and Gas - Point	0	0	0
Anthropogenic	Industrial and Non-EGU Point	35	35	0
Anthropogenic	Oil and Gas - Non-point	0	0	0
Anthropogenic	Residential Wood Combustion	70	70	0
Anthropogenic	Fugitive dust[2]	0	0	0
Anthropogenic	Agriculture[1]	61,847	61,847	0
Anthropogenic	Remaining Non-point	173	173	0
Anthropogenic	On-Road Mobile	366	366	0
Anthropogenic	Non-road Mobile	24	20	-4
Anthropogenic	Rail	2	2	0
Anthropogenic	Commercial Marine[3]	0	0	0
Anthropogenic	Agricultural Fire	1,635	1,635	0
Anthropogenic	Wildland Prescribed Fire	1,801	2,086	285
	Total Anthropogenic	**65,953**	**66,234**	**281**

Natural	Wildfire	309	4,002	3,693
Natural	Biogenic[4]	0	0	0
	Total Natural	**309**	**4,002**	**3,693**
	Total Emissions	**66,262**	**70,236**	**3,974**

1. The Agricultural emissions sector includes only NH3 emissions from nonpoint livestock and fertilizer application.
2. The Fugitive Dust sector contains only PM10 and PM2.5 emissions from area-source anthropogenic dust sources.
3. Commercial Marine Shipping C1, C2, and C3 emissions within and offshore of the state.
4. Biogenic emissions are reported for CO, NOx, and VOC.

Regarding Table 7-22 and Volatile Organic Compounds, South Dakota saw an overall increase in emissions of 102,437 tons. A substantial increase of a little over 80,000 tons was seen in the natural wildfire source category, while smaller yet still notable increases were seen in area oil and gas and prescribed fire source categories. The largest decrease was seen in the anthropogenic non-road mobile source category. Changes reported may be more reflective of methodology changes than actual changes in emissions.

Table 7-22 -- Changes in Volatile Organic Compounds Emissions (tons per year)

South Dakota Volatile Organic Compounds tons/year				
State Emissions	Source Category	2014v2 Actual	Representative Baseline 2	Difference
Anthropogenic	Electric Generating Units (EGU)	4	0	-4
Anthropogenic	Oil and Gas - Point	17	17	0
Anthropogenic	Industrial and Non-EGU Point	3,223	3,225	2
Anthropogenic	Oil and Gas - Non-point	8,241	10,279	2,038
Anthropogenic	Residential Wood Combustion	1,719	1,719	0
Anthropogenic	Fugitive dust[2]	0	0	0
Anthropogenic	Agriculture[1]	6,976	6,976	0
Anthropogenic	Remaining Non-point	25,475	25,475	0
Anthropogenic	On-Road Mobile	12,864	12,864	0
Anthropogenic	Non-road Mobile	8,247	6,342	-1,905
Anthropogenic	Rail	186	186	0
Anthropogenic	Commercial Marine[3]	0	0	0
Anthropogenic	Agricultural Fire	469	469	0
Anthropogenic	Wildland Prescribed Fire	21,961	43,629	21,668
	Total Anthropogenic	**89,382**	**111,181**	**21,799**
Natural	Wildfire	3,733	84,371	80,638
Natural	Biogenic[4]	280,338	280,338	0
	Total Natural	**284,071**	**364,709**	**80,638**
	Total Emissions	**373,453**	**475,890**	**102,437**

1. The Agricultural emissions sector includes only NH3 emissions from nonpoint livestock and fertilizer application.
2. The Fugitive Dust sector contains only PM10 and PM2.5 emissions from area-source anthropogenic dust sources.

3. Commercial Marine Shipping C1, C2, and C3 emissions within and offshore of the state.
4. Biogenic emissions are reported for CO, NOx, and VOC.

Regarding Table 7-23 and carbon monoxide, carbon monoxide is produced from both anthropogenic and natural sources and is also naturally present in the atmosphere in small amounts. Vehicle exhaust is a major producer of carbon monoxide emissions as is anthropogenic and natural fire. Overall, an increase of 236,740 tons per year of carbon monoxide was seen between the periods of 2014 and the average from 2014-2018. The vast majority of these increases were seen as a result of an increase in natural wildfire emissions.

Table 7-23 -- Changes in Carbon Monoxide Emissions (tons per year)

South Dakota Carbon Monoxide tons/year				
State Emissions	Source Category	2014v2 Actual	Representative Baseline 2	Difference
Anthropogenic	Electric Generating Units (EGU)	19	45	26
Anthropogenic	Oil and Gas - Point	145	145	0
Anthropogenic	Industrial and Non-EGU Point	4,461	4,494	33
Anthropogenic	Oil and Gas - Non-point	1,191	1,342	151
Anthropogenic	Residential Wood Combustion	10,693	10,693	0
Anthropogenic	Fugitive dust[2]	0	0	0
Anthropogenic	Agriculture[1]	0	0	0
Anthropogenic	Remaining Non-point	5,250	5,250	0
Anthropogenic	On-Road Mobile	122,683	122,683	0
Anthropogenic	Non-road Mobile	52,311	46,855	-5,456
Anthropogenic	Rail	606	606	0
Anthropogenic	Commercial Marine[3]	0	0	0
Anthropogenic	Agricultural Fire	9,657	9,657	0
Anthropogenic	Wildland Prescribed Fire	110,042	112,234	2,192
	Total Anthropogenic	**317,058**	**314,004**	**2,192**
Natural	Wildfire	18,925	258,719	239,794
Natural	Biogenic[4]	87,934	87,934	0
	Total Natural	**106,859**	**346,653**	**239,794**
	Total Emissions	**423,917**	**660,657**	**236,740**

1. The Agricultural emissions sector includes only NH3 emissions from nonpoint livestock and fertilizer application.
2. The Fugitive Dust sector contains only PM10 and PM2.5 emissions from area-source anthropogenic dust sources.
3. Commercial Marine Shipping C1, C2, and C3 emissions within and offshore of the state.
4. Biogenic emissions are reported for CO, NOx, and VOC.

7.2.5 Significant Changes In Anthropogenic Emissions

40 CFR § 51.308(g) and 40 CFR § 51.308(g)(5) state: "Requirements for periodic reports describing progress towards the reasonable progress goals. Each State identified in §51.300(b) must periodically submit a report to the Administrator evaluating progress towards the reasonable progress goal for each mandatory Class I Federal area located within the State and in each mandatory Class I Federal area located outside the State that may be affected by emissions from within the State. The first progress report is due 5 years from submittal of the initial implementation plan addressing paragraphs (d) and (e) of this section. The first progress reports must be in the form of implementation plan revisions that comply with the procedural requirements of §51.102 and §51.103. Subsequent progress reports are due by January 31, 2025, July 31, 2033, and every 10 years thereafter. Subsequent progress reports must be made available for public inspection and comment for at least 30 days prior to submission to EPA and all comments received from the public must be submitted to EPA along with the subsequent progress report, along with an explanation of any changes to the progress report made in response to these comments. ***Periodic progress reports must contain at a minimum the following elements: An assessment of any significant changes in anthropogenic emissions within or outside the State that have occurred since the period addressed in the most recent plan required under paragraph (f) of this section including*** whether or not these changes in anthropogenic emissions were anticipated in that most recent plan and whether they have limited or impeded progress in reducing pollutant emissions and improving visibility."

Figure 7-1 presents a sum of annual nitrogen oxide and sulfur dioxide emissions as reported for South Dakota's electrical generating unit (Big Stone Power Plant) starting in 2001. While these types of facilities are targeted for controls in state regional haze state implementation plans, it should be noted that many of the controls planned for electrical generating units in the WRAP states just starting taking effect at the end of the first implementation period. The new air pollution controls installed at Big Stone Power Plant were operational in the winter of 2015 and the new limits are reflected in Figure 7-1. This change in anthropogenic emissions was anticipated to occur in the most recent plan, and it has not impeded or limited progress in reducing pollutant emissions and improving visibility.

Figure 7-2 puts into perspective how insignificant the NOx emissions generated from South Dakota's Electric Generating Units are, when compared to all other western states.

Figure 7-1 -- Annual Electric Generating Unit Emissions for South Dakota

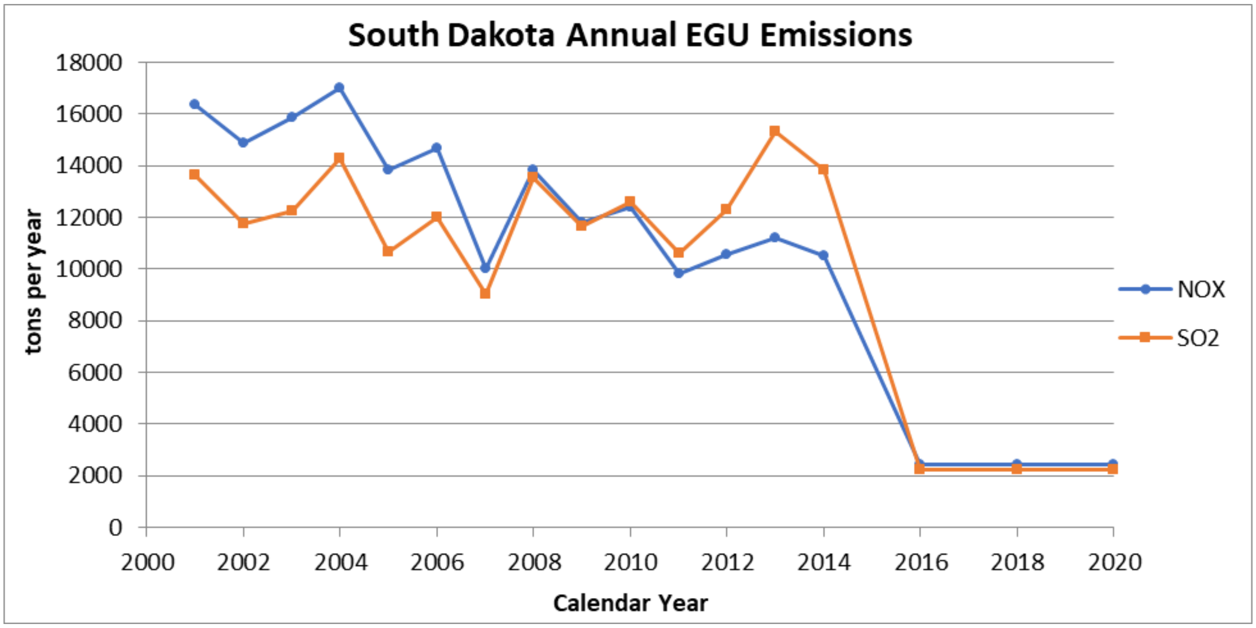
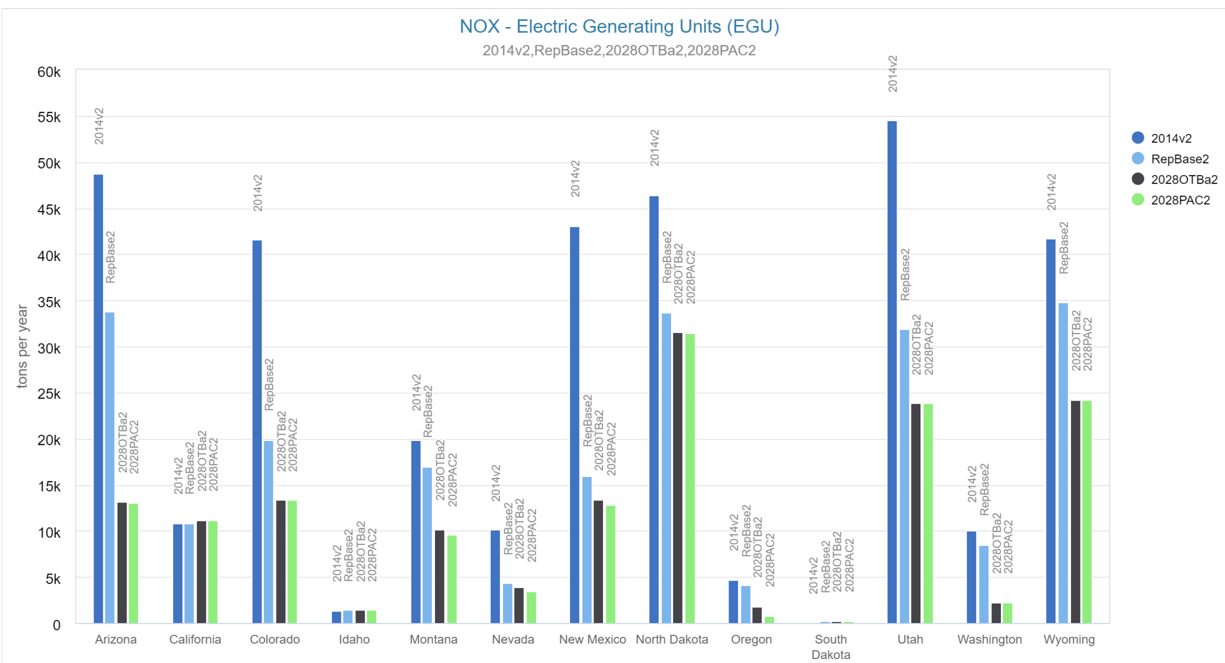


Figure 7-2 -- Electric Generating Unit NOx emissions by state and by model scenario



WRAP Technical Support System (TSS); The Western Regional Air Partnership (WRAP) and the Cooperative Institute for Research in the Atmosphere (CIRA), 13 Jul 2021, https://views.cira.colostate.edu/tssv2

As noted throughout this report, progress is being made to improve the visibility at both Badlands National Park and Wind Cave National Park for the 20% Most Impaired Days and the 20% Least Impaired Days.

7.2.6 Current Implementation Plan Assessment

40 CFR § 51.308(g) and 40 CFR § 51.308(g)(6) state: "Requirements for periodic reports describing progress towards the reasonable progress goals. Each State identified in §51.300(b) must periodically submit a report to the Administrator evaluating progress towards the reasonable progress goal for each mandatory Class I Federal area located within the State and in each mandatory Class I Federal area located outside the State that may be affected by emissions from within the State. The first progress report is due 5 years from submittal of the initial implementation plan addressing paragraphs (d) and (e) of this section. The first progress reports must be in the form of implementation plan revisions that comply with the procedural requirements of §51.102 and §51.103. Subsequent progress reports are due by January 31, 2025, July 31, 2033, and every 10 years thereafter. Subsequent progress reports must be made available for public inspection and comment for at least 30 days prior to submission to EPA and all comments received from the public must be submitted to EPA along with the subsequent progress report, along with an explanation of any changes to the progress report made in response to these comments. ***Periodic progress reports must contain at a minimum the following elements: An assessment of whether the current implementation plan elements and strategies are sufficient to enable the State, or other States with mandatory Class I Federal areas affected by emissions from the State, to meet all established reasonable progress goals for the period covered by the most recent plan required under paragraph (f) of this section.***

WRAP's modeling indicates the majority of the emissions that impact the Class I areas in South Dakota are transported in from outside of the state. The occurrence of the same or similar days making up the 20% most impaired days at South Dakota's two Class I areas supports this conclusion. The areas impacting South Dakota's two Class I areas include the CENRAP states, outside domain, the eastern United States and Canada. There are also impacts from some of the WRAP states and non-WRAP states bordering South Dakota. In addition, the 2015 wildfires occurring in California, Oregon, Washington, Idaho, Montana, and Canada have impacted not only the two Class I areas but all of South Dakota.

The WRAP modeling conducted for this second Regional Haze State Implementation Plan Period identifies large decreases that are expected to continue into 2028 from many of the emissions reductions from the implementation of the BART rules on point sources during the first implementation period. One of the large decreases during the first implementation period occurred in South Dakota-- controls were installed on Big Stone Power Plant in 2015, and resulted in close to a 90% decrease in nitrogen oxide emissions on an annual basis. This decrease in emissions is in addition to reductions associated with other federal and state regulations, some of which have already been realized will continue to improve South Dakota's air quality.

No additional control measures are planned by South Dakota on South Dakota emission sources during this second implementation period, due to the assessment provided in this document. Despite this, South Dakota feels the current implementation plan elements and strategies are sufficient to enable the State, or other States with mandatory Class I Federal areas affected by emissions from the State, to meet all established reasonable progress goals for the period covered by the most recent plan.

7.3 Determination Of Adequacy

40 CFR § 51.308(h) states: "Determination of the adequacy of existing implementation plan. At the same time the State is required to submit any progress report to EPA in accordance with paragraph (g) of this section, ***the State must also take one of the following actions based upon the information presented in the progress report:"***

40 CFR § 51.308(h)(1) states: ***"If the State determines that the existing implementation plan requires no further substantive revision at this time in order to achieve established goals for visibility improvement and emissions reductions, the State must provide to the Administrator a declaration that revision of the existing implementation plan is not needed at this time."***

40 CFR § 51.308(h)(2) states: ***"If the State determines that the implementation plan is or may be inadequate to ensure reasonable progress due to emissions from sources in another State(s) which participated in a regional planning process, the State must provide notification to the Administrator and to the other State(s) which participated in the regional planning process with the States. The State must also collaborate with the other State(s) through the regional planning process for the purpose of developing additional strategies to address the plan's deficiencies."***

40 CFR § 51.308(h)(3) states: ***"Where the State determines that the implementation plan is or may be inadequate to ensure reasonable progress due to emissions from sources in another country, the State shall provide notification, along with available information, to the Administrator."***

40 CFR § 51.308(h)(4) states: ***"Where the State determines that the implementation plan is or may be inadequate to ensure reasonable progress due to emissions from sources within the State, the State shall revise its implementation plan to address the plan's deficiencies within one year."***

DANR's declaration is that the existing implementation plan requires no further substantive revision at this time in order to achieve established goals for visibility improvement and emissions reductions, and therefore that revision of the existing implementation plan is not needed at this time.

APPENDIX A

SOUTH DAKOTA REGIONAL HAZE STATE IMPLEMENTATION PLAN: FEDERAL LAND MANAGER COMMENTS

APPENDIX B

SOUTH DAKOTA REGIONAL HAZE STATE IMPLEMENTATION PLAN: PUBLIC COMMENTS

APPENDIX C

SOUTH DAKOTA REGIONAL HAZE STATE IMPLEMENTATION PLAN: GCC DACOTAH FOUR FACTOR ANALYSIS

APPENDIX D

SOUTH DAKOTA REGIONAL HAZE STATE IMPLEMENTATION PLAN: PETE LIEN AND SONS FOUR FACTOR ANALYSIS

APPENDIX E

SOUTH DAKOTA REGIONAL HAZE STATE IMPLEMENTATION PLAN: THE WRAP MODELLING DELAYS MEMO

APPENDIX F

SOUTH DAKOTA REGIONAL HAZE STATE IMPLEMENTATION PLAN: SOUTH DAKOTA'S MEMORANDUMS OF UNDERSTANDING WITH THE US FOREST SERVICE AND WITH THE CITY OF RAPID CITY, SOUTH DAKOTA