Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Rocky Mountain Region / Black Hills National Forest June 2022

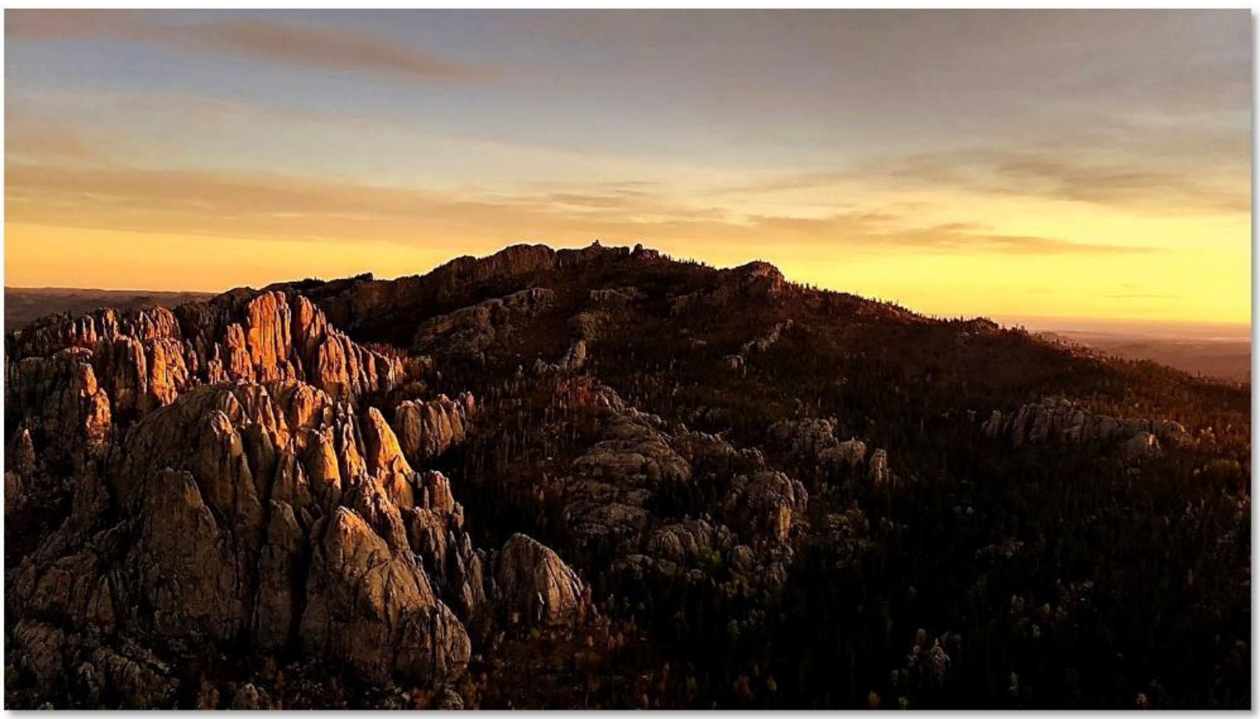
Black Hills National Forest

Draft Forest Assessments:

Air Quality

Custer, Fall River, Lawrence, Meade, and Pennington Counties, South Dakota

Crook and Weston Counties, Wyoming



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Chapter 1. Introduction

Key Issues for Air Quality Management

Located in the rural Northern Great Plains. the Black Hills National Forest is affected by some nearby and regional sources of air pollution, including oil and gas production, power plants, agriculture, and vehicles. Air pollutants blown into the national forest can harm natural and scenic resources such as soils, surface waters, plants, wildlife, and visibility.

Two key air quality issues concerning the Black Hills National Forest are air pollution (types of air pollutants and amounts) produced in and around the national forest on the airshed scale, and the effects of air pollution to human health and forest natural resources. The protection of human health is mandated and enforced by State implementation of the Clean Air Act. The U.S. Forest Service is responsible for establishing protection criteria, monitoring, and taking actions to protect air quality related values in Class I and Class II[1] wilderness areas. All other forest lands outside of the wilderness areas are classified as Class II. Protecting air quality in the wilderness areas serves as a proxy for the protection of forest natural resources outside of Class I and Class II wilderness areas. The Forest Service does not manage Class I areas within the boundary of the national forest, though it does manage the Black Elk Hills Sensitive Class II Wilderness Area. The southeast portion of Black Hills National Forest borders the Wind Cave National Park Class I area and is nearby to the Sage Creek Class I Wilderness Area in Badlands National Park. Additionally, Mt. Rushmore and Crazy Horse Memorial are areas nearby where air quality, particularly visibility, is an important component of visitor experience.

In 2012, the Forest Service released a revised planning rule that requires national forests and grasslands to consider air quality when developing plan components. Specifically, 2012 Planning Rule directives require an assessment of critical loads and any critical load exceedances (Nilsson and Grennfelt 1988). If critical loads have been exceeded, managers of national forests and grasslands are required to develop plan components to protect or restore key ecosystem characteristics. Although visibility is not measured by using the critical load metric, it is specifically identified in the Clean Air Act as important for protection. Information from the Wind Cave Interagency Monitoring of Protected Visual Environments (IMPROVE) station shows there are days when visibility is poor in Wind Cave National Park and the surrounding area. Although the worst visibility days are caused by wildfire emissions, other sources of pollution contribute and can exacerbate visibility impacts.

Information about greenhouse gas emissions is provided in this assessment. Climate change is discussed in more detail in the climate assessment.

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[1] The Clean Air Act gives special air quality and visibility protection to national parks larger than 6,000 acres and national wilderness areas larger than 5,000 acres that were in existence when it was amended in 1977. These are “Class I” areas. All other areas are “Class II” allowing for a moderate amount of air quality deterioration. Because air pollution is often regional in nature, reductions in pollution to improve visibility in Class I areas will also improve visibility in all areas in the surrounding area. Class I areas are managed by the National Park Service, U.S. Fish and Wildlife Service, U.S. Forest Service, and several Native American Tribes. Sensitive Class II Areas are areas for which Federal Land Managers have identified air quality and/or air quality related values as valued resources.

Summary of Public Input

To date the public has expressed concern over air quality at the project level as it relates to energy development, prescribed fire, and dust-on-snow events, and concerns about localized particulate matter as it relates to dust along roads and construction areas.

Use of Best Available Science

This air quality assessment relies entirely on existing and the most current analysis, research, and planning documents with key documents listed in the references section. The best available scientific information was used based on what is most accurate, reliable, and relevant to the issues of the assessment (FSH 1909.12 07.15a). Information from several government, academic, and private partnership consortiums that have conducted air quality emissions inventories, modeled pollution impacts, and worked on air quality planning on a regional scale in and around the Black Hills National Forest area. A great deal of extensive and complex data is available, and this assessment only summarizes information relevant to the Black Hills National Forest and environs. Where information specific to the national forest is lacking, other regional air quality studies are noted.

Chapter 2. Condition and Trends

Airsheds

The states of South Dakota and Wyoming manage air quality on a statewide basis, and the entire geographic area of each state comprises its airshed.

Sources of Air Pollution

This section discusses anthropogenic emissions that affect national ambient air quality standards and hazardous air pollution.

National Ambient Air Quality Standards

The Clean Air Act, which was last amended in 1990, requires the U.S. Environmental Protection Agency to set National Ambient Air Quality Standards (40 CFR part 50) for pollutants considered harmful to public health and the environment. The Clean Air Act identifies two types of National Ambient Air Quality Standards. Primary standards provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

The U.S. Environmental Protection Agency has set National Ambient Air Quality Standards (NAAQS) for six principal pollutants, which are called "criteria" air pollutants, and they include carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter less than 10 microns in size (PM10), particulate matter less than 2.5 microns in size (PM2.5), and sulfur dioxide. Periodically, the standards are reviewed and may be revised. The current standards are listed in table 8 in appendix A.

Nuisance Smoke

Smoke is produced from wildfires and prescribed fires. Prescribed fires are managed fires, including the burning of slash piles, that are used to provide ecological benefits and wildfire severity reduction. Wildland fires[2] in the Black Hills National Forest can cause nuisance smoke and result in public reports or complaints about smoke. Most of the prescribed fire smoke produced in the national forest is from commercial thinning pile burning. A few thousand large wood piles are burned every year and mostly in the winter when the atmosphere is most stable, and the resulting smoke emissions can cause short-term, localized air quality issues.

The smoke generally occurs in short lived pulses. On a rare occasion a community may be affected for a few to several hours. Nuisance smoke is defined differently by each person. Some people interpret seeing smoke on the horizon as nuisance smoke, while others are concerned about possibly being exposed to smoke. A higher threshold exists for some people who are not concerned until they feel the effects of smoke exposure and breathing smoke.

The South Dakota and Wyoming State Smoke Management Programs are tasked with overseeing the documentation and investigation of smoke complaints and with verifying the severity of smoke impacts and the potential for or actual occurrence of exceedances of the health standards. In addition, Pennington County and Rapid City governments have air quality programs and ordinances that focus on fugitive dust and smoke problems and dealing with complaints in and around primarily Rapid City (Pennington County 2013, Rapid City 2013). The Forest Service works closely with State regulators to plan and execute prescribed fires such that smoke impacts are minimized as much as possible.

Public tolerance for smoke, in addition to law, regulation, or policy, effectively sets a social limit to how many acres are treated with wildland fire. The States and other agencies respond to public inputs by trying to minimize impacts, even when the impacts are well within legal limits. Community public relations and education coupled with pre-burn notification greatly improve public acceptance of fire management programs. The public may tolerate several days in a row, and several weeks a year, but even the most supportive and educated have tolerance limits (Kleindienst 2012). To maintain public support for prescribed burns and the beneficial use of wildfires, land managers must be responsive to the public's tolerance thresholds.

Public acceptance of smoke varies greatly from year to year. Acceptance of smoke from prescribed fires is high following seasons with high profile, high severity wildfire events, and during extremely dry years when the threat of large, high severity incidents is elevated. Conversely, public acceptance of smoke wanes in years of low fire threat. However, prescribed burning is difficult to do in years of high fire threat due to the risk of fires escaping control, and prescribed burning is easier to do and more effective in years of low fire threat due to cooler or wetter conditions. Thus, public expectations for prescribed burning can be out of sync with the reality of the best opportunities to use the tool (Kleindienst 2012).

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[2] Wildland Fire: Any non-structure fire that occurs in vegetation or natural fuels.
Wildfire: A wildland fire originating from an unplanned ignition, such as lightning, volcanoes, unauthorized and accidental human caused fires, and prescribed fires that are declared wildfires.
Prescribed Fire: A wildland fire originating from a planned ignition in accordance with applicable laws, policies, and regulations to meet specific objectives.
Source: 2009 Guidance for Implementation Federal Wildland Fire Management Policy and Fire Management Board Memorandum 19-004a.

Several county-level emissions and air quality monitoring databases were used for this assessment. The Black Hills National Forest is in five counties in South Dakota: Custer, Fall River, Lawrence, Meade, and Pennington Counties (figure 1) and two counties in Wyoming: Crook and Weston Counties (figure 2).

Figure 1. South Dakota counties

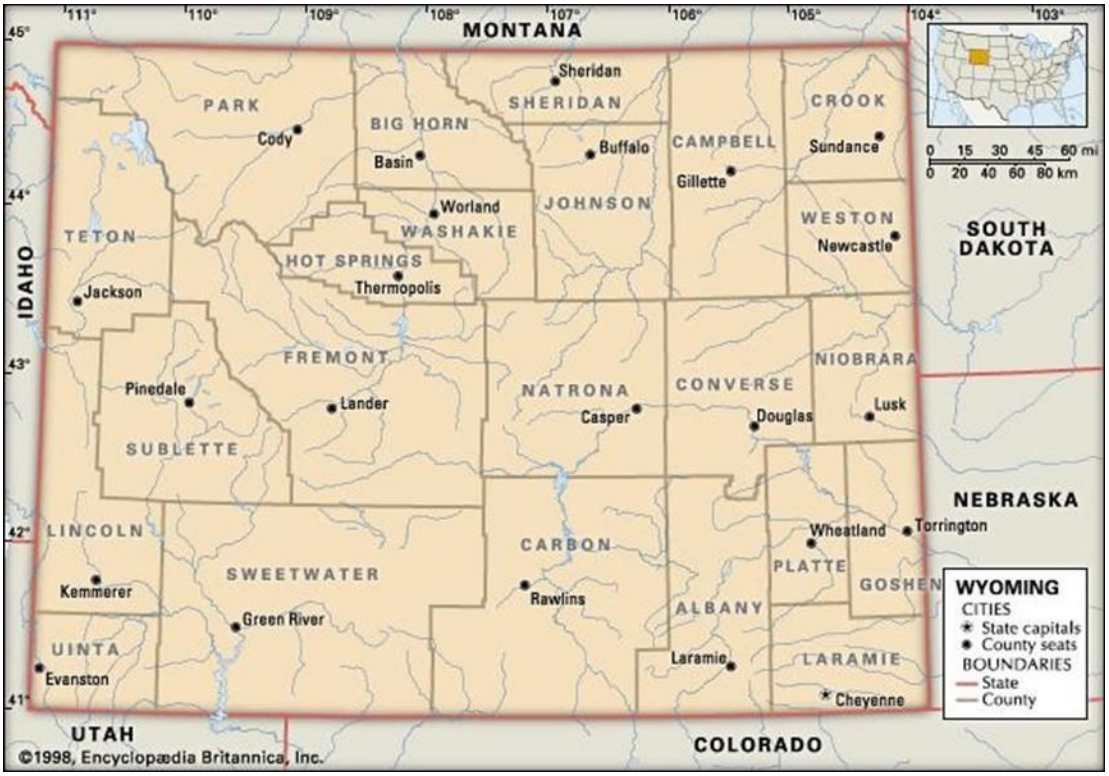


Figure 2. Wyoming counties

National Emissions Inventory

The Environmental Protection Agency's National Emissions Inventory (NEI) is a comprehensive and detailed estimate of air emissions of criteria pollutants, criteria pollutant precursors, and hazardous air pollutants from air emissions sources. The National Emissions Inventory is released every three years and is based primarily upon data provided by State, local, and Tribal air agencies for sources in their jurisdictions and supplemented by data developed by the Environmental Protection Agency. The information is useful for tracking the amounts of air pollutants emitted each year to determine trends and changes over time. Emissions inventory information cannot be solely used for estimating ambient air pollution concentrations. Emissions estimates are used in dispersion models that also use other environmental parameters such as meteorology, topography, and emission rates to forecast ground-level air pollution concentrations. Fire managers can use dispersion models such as BlueSky to forecast smoke emissions effects using up to 72-hour weather forecast information.

Several emissions sources are included in the National Emissions Inventory.

- **Point sources** include emissions estimates for larger sources that are located at a fixed, stationary location such as fossil fueled electricity generation stations, refineries, processing and manufacturing plants, and lumber mills.
- **Nonpoint sources** include residential heating, commercial combustion, asphalt paving, and commercial and consumer solvent use.
- **On road sources** include emissions from on road vehicles that use gasoline, diesel, and other fuels. These sources include light- and heavy-duty vehicle emissions from operation on roads, highway ramps, and during idling.

- **Nonroad sources** include off-road mobile sources that use gasoline, diesel, and other fuels. Source types include construction equipment, lawn and garden equipment, aircraft ground support equipment, locomotives, and commercial marine vessels.
- **Event sources** include wildfires and prescribed burns.

Annual data from the latest available 2017 National Emissions Inventory for all air pollution sources in the seven counties the Black Hills National Forest (table 1) include estimated emissions from the area. The inventory is based on the county level, and emissions specific to the Black Hills National Forest area are not available. Annual greenhouse gas emissions for the same counties are listed in table 2. Each county produces different amounts of emissions due to differences in population, types and amounts of emissions from wildfires, prescribed fires, fugitive dust, industry and agriculture, and miles traveled on roads, etc. (EPA 2017).

Table 1. Data from the 2017 National Emissions Inventory showing annual air pollutants from all sources at the county level

Geographic Area	Ammonia (tons per year)	Carbon Monoxide (tons per year)	Lead (tons per year)	Nitrogen Oxides (tons per year)	PM2.5 (tons per year)	PM10 (tons per year)	Sulfur Dioxide (tons per year)	Volatile Organic Compounds (tons per year)
South Dakota								
Custer County	3,280	186,640	21	3,405	15,884	20,099	1,277	51,090
Fall River County	592	4,437	41	2,166	539	2,193	13	4,279
Lawrence County	547	17,149	82	1,259	1,578	4,067	140	16,268
Meade County	1,279	7,801	85	2,789	1,166	5,503	32	9,653
Pennington County	1,193	36,220	272	5,732	2,787	7,807	577	23,882
Wyoming								
Crook County	949	31,255	35	3,738	3,650	12,326	363	17,369
Weston County	456	7,044	26	3,067	1,215	7,626	49	7,424

Table 2. Data from the 2017 National Emissions Inventory showing annual greenhouse gas emissions from all sources at the county level

Geographic Area	Carbon Dioxide (tons per year)	Methane (tons per year)	Nitrous Oxide (tons per year)	CO2e[1] (tons per year)
South Dakota				
Custer County	2,074,830	8,907	2	2,396,102
Fall River County	92,341	76	2	95,697
Lawrence County	360,915	581	6	383,691
Meade County	257,792	64	6	261,956
Pennington County	1,923,580	2,415	32	2,020,440
Wyoming				
Crook County	564,579	1,330	4	613,699
Weston County	308,831	233	4	318,459

1 Carbon dioxide equivalent emissions (CO2e) are based on the amount of carbon dioxide, methane, and nitrous oxide that would be produced. For this analysis, the conservative Global Warming Potential value of 36 is used for methane and 310 for nitrous oxide.

Compared to wildfire emissions in other counties, Custer County produces the most air pollution and greenhouse gas emissions. The other counties shown emit wildfire and prescribed fire emissions in lesser amounts. Annual wildfire and prescribed fire emissions data for the seven counties the Black Hills National Forest is in (table 3) include the estimated emissions from this national forest. Annual greenhouse gas emissions from wildfires and prescribed fires at the county level are listed in table 4.

Table 3. Data from the 2017 National Emissions Inventory showing annual wildfire and prescribed fire air pollution emissions at the county level

[Wildfire and prescribed fire emission estimates do not include lead.]

Geographic Area	Ammonia (tons per year)	Carbon Monoxide (tons per year)	Nitrogen Oxides (tons per year)	PM2.5 (tons per year)	PM10 (tons per year)	Sulfur Dioxide (tons per year)	Volatile Organic Compounds (tons per year)
South Dakota							
Custer County Wildfires	2,939	179,486	2,096	15,206	17,943	1,241	42,248
Custer County Prescribed Fires	64	3,862	65	342	404	33	915
Fall River County Wildfires	16	958	11	81	96	7	226
Fall River County Prescribed Fires	8	514	9	46	54	4	122
Lawrence County Wildfires	1	38	1	3	4	1	9
Lawrence County Prescribed Fires	188	11,383	194	1,010	1,192	97	2,696
Meade County Wildfires	2	102	2	9	11	1	24
Meade County Prescribed Fires	14	834	14	74	88	7	198
Pennington County Wildfires	12	735	13	66	78	7	174
Pennington County Prescribed Fires	258	15,693	260	1,388	1,638	132	3,715
Wyoming							
Crook County Wildfires	3	159	2	14	16	1	38
Crook County Prescribed Fires	434	26,319	442	2,332	2,752	223	6,233
Weston County Wildfires	1	50	1	4	5	1	12
Weston County Prescribed Fires	59	3,565	61	317	374	31	845

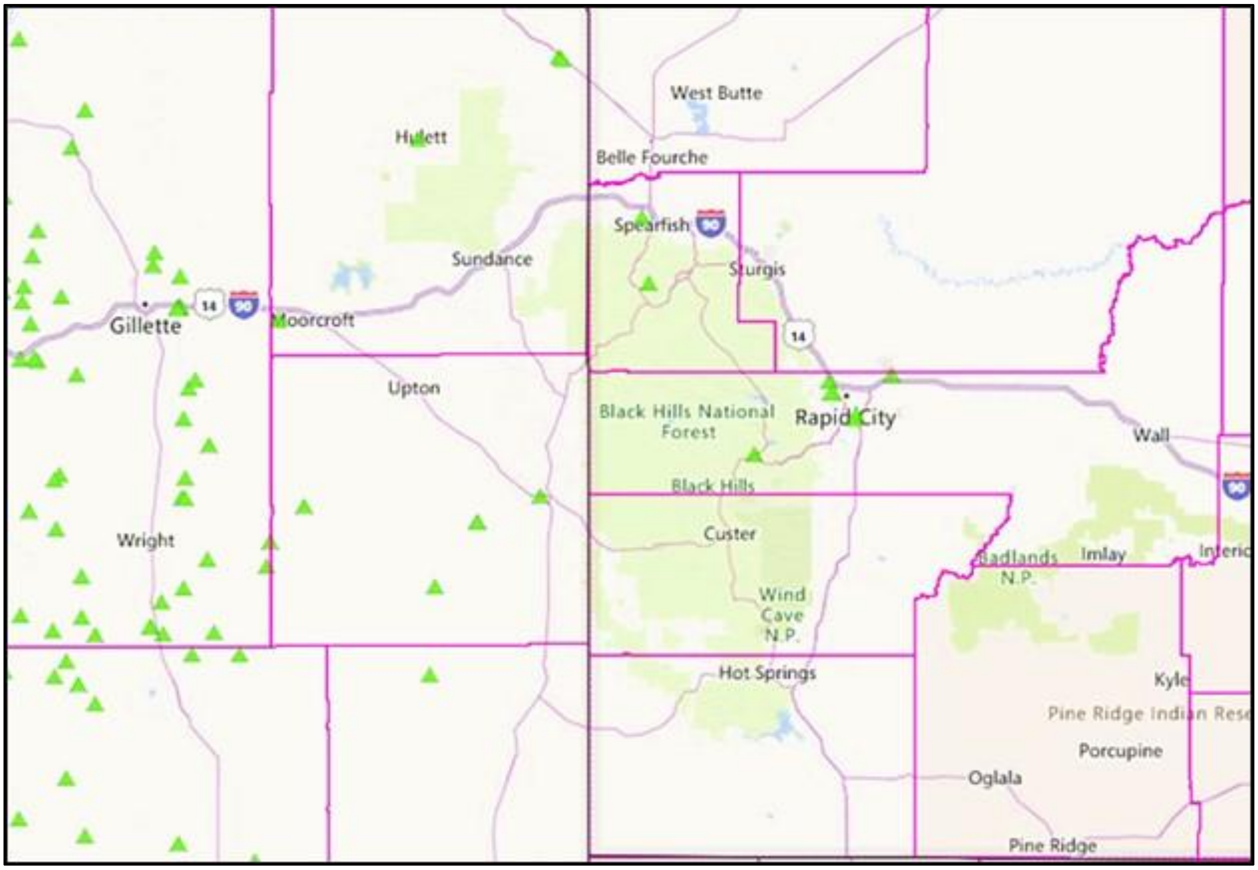
Table 4. Data from the 2017 National Emissions Inventory showing annual greenhouse gas emissions from wildfires and prescribed fires at the county level

[Wildfire and prescribed fire emission estimates do not include nitrous oxide.]

Geographic Area	Carbon Dioxide (tons per year)	Methane (tons per year)	CO2e (tons per year)
South Dakota			
Custer County Wildfires	1,924,255	8,710	2,237,815
Custer County Prescribed Fires	52,524	192	59,436
Fall River County Wildfires	10,933	47	12,625
Fall River County Prescribed Fires	7,144	26	8,080
Lawrence County Wildfires	155,829	2	155,901
Lawrence County Prescribed Fires	419	565	20,759
Meade County Wildfires	1,558	5	1,738
Meade County Prescribed Fires	11,555	41	13,031
Pennington County Wildfires	10,563	37	11,895
Pennington County Prescribed Fires	211,214	778	239,222
Wyoming			
Crook County Wildfires	1,934	8	2,222
Crook County Prescribed Fires	357,345	1,306	404,361
Weston County Wildfires	628	2	700
Weston County Prescribed Fires	49,229	177	55,601

Hazardous Air Pollutants

The National Air Toxics Assessment (NATA) is a screening tool, intended to help the Environmental Protection Agency and State, local and Tribal air agencies determine if areas, pollutants, or types of pollution sources need to be examined further to better understand risks to public health. The National Air Toxics Assessment provides broad estimates of the risk of developing cancer and other serious health effects over census tracts across the country. It does not estimate any person’s individual risk. The latest available 2014 National Air Toxics Assessment includes estimates of exposure and risk for 180 air toxics that the Environmental Protection Agency regulates under the Clean Air Act. Point sources of hazardous air pollutants in and around the Black Hills National Forest are shown in figure 3. Point sources are one type of source.



Point sources of hazardous air pollutants are indicated by green triangles.

Figure 3. 2014 National Air Toxics Assessment emissions point-source facilities in the Black Hills National Forest area

For the 2014 National Air Toxics Assessment, the Environmental Protection Agency assessed 180 air toxics regulated under the Clean Air Act, from the following types of emissions sources:

- **Point sources** – are typically industrial facilities such as lumber mills, coke ovens for the steel industry, large waste incinerators and refineries, but also include some smaller sources such as dry cleaners.
- **Nonpoint sources** – examples include small manufacturers and gas stations.
- **Mobile sources** – including cars, trucks, and off-road vehicles like construction equipment and trains.
- **Fires** – including wildfires, prescribed wildland fires, and agricultural burning,
- **Biogenics** – naturally occurring emissions from trees, plants, and soil microbes.

In addition, the National Air Toxics Assessment includes estimated pollution from:

- **Secondary formation** – refers to pollutants that form in the air through chemical reactions; secondary air toxics often form via reactions between human-emitted and naturally occurring compounds.
- **Background concentrations** – representing emissions from distant sources, emissions from prior years that persist in the environment, and natural source emissions other than those modeled as biogenics.

When the National Air Toxics Assessment shows a potential cancer risk of greater than 100 in 1 million at a census tract, it means there may be an elevated cancer risk in that tract. A risk level of 100 in 1 million refers to the likelihood that 100 in 1 million (1 in 10,000) people will develop cancer if they breathe contaminated air over 70 years. This risk would be in addition to the cancer risk a person would have without being exposed to the hazardous air. The Black Hills National Forest region has a low cancer risk from exposure to hazardous air pollutants in comparison to other parts of the country (figure 4). The Black Hills National Forest area in Wyoming and South Dakota shows a risk of 6-25 people per million (yellow) developing cancer from breathing contaminated air over 70 years.

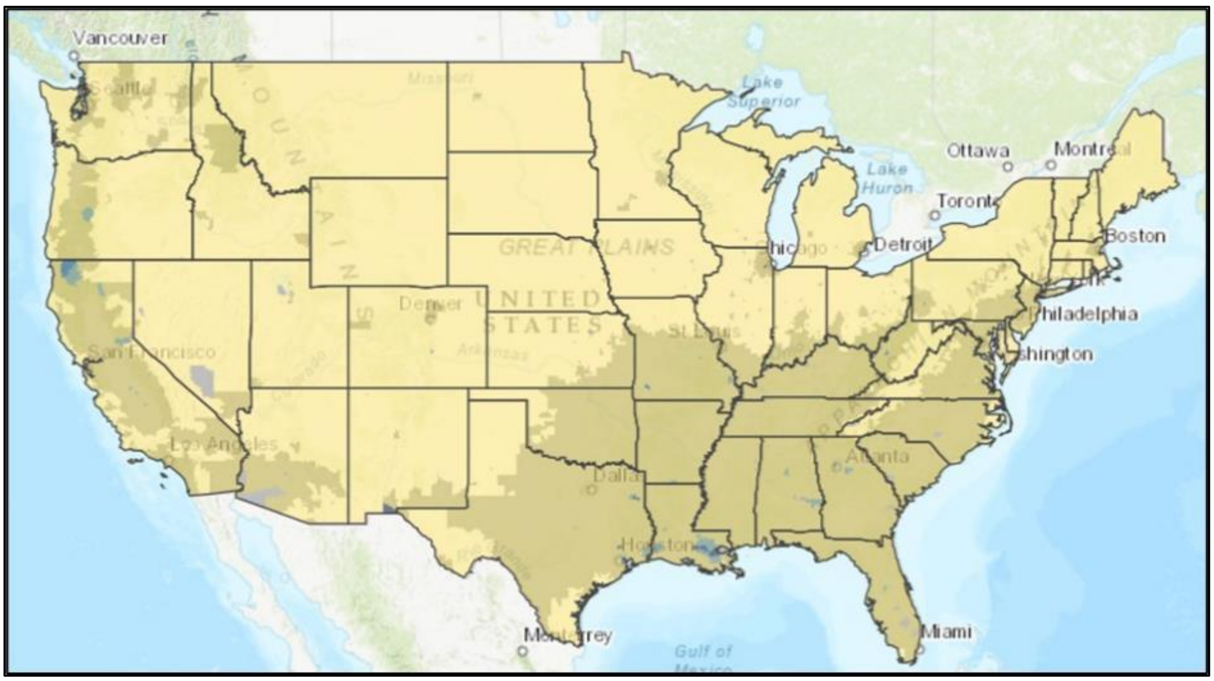


Figure 4. Total risk of people developing cancers in one million people

Table 5. Shading legend for figure 4

Shading	Risk Factor
dark gray	Over 100
blue	75 to 100
green	50 to 75
gold	25 to 50
yellow	6 to 25
light gray	0 population

Environmental Justice – Power Plants and Neighboring Communities

Burning fossil fuels at power plants creates emissions of sulfur dioxide, nitrogen oxides, particulate matter, carbon dioxide, mercury, and other pollutants. Nitrogen oxides and sulfur dioxide emissions contribute to the formation of ground-level ozone and fine particulates, which can lead to respiratory and cardiovascular problems, and exposure to mercury can increase the possibility of health issues ranging from cancer to immune system damage. Power plants in the Black Hills National Forest region are shown in figure 5. The two plants shown located at Rapid City are gas-powered electric generation plants (EPA 2021a).

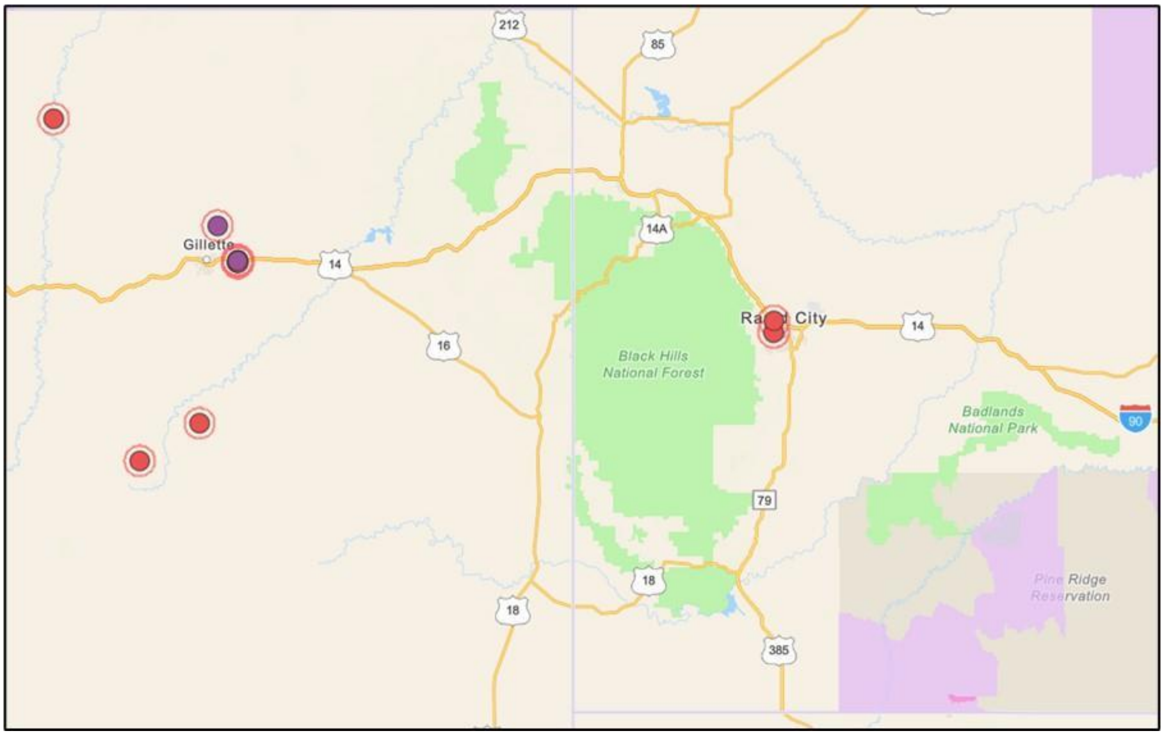


Figure 5. Power plants in the Black Hills National Forest region

Minority, low-income, and indigenous populations typically bear a disproportionate burden of environmental harms and adverse health outcomes, including the development of heart or lung diseases, such as asthma and bronchitis, increased susceptibility to respiratory and cardiac symptoms, greater numbers of emergency room visits and hospital admissions, and premature deaths (EPA 2021a).

The following key demographics and information about nearby fossil fuel power plants can be used as a general indicator of the potential susceptibility of a community to these types of environmental exposures.

- Low-income population,
- People of color,
- Population with less than high school education,
- Linguistically isolated population,
- Population under age 5, and
- Population over age 64.

Three census tract areas east of the Rapid City power plants are potentially susceptible to environmental exposures (figure 6). No communities inside the Black Hills National Forest area are known to be impacted (EPA 2021a).

Figure 6. Three census tract areas east of the Rapid City power plants that are potentially susceptible to environmental exposures (shown in pink shading)

Air Quality Monitoring in Southwestern South Dakota

Given South Dakota's population distribution, most of the air monitoring efforts of the State have in the past been concentrated in the areas of high population. Within these areas of high population, monitoring sites are chosen that will determine areas of high pollution concentration; determine if the National Ambient Air Quality Standards are being met; identify and attempt to quantify pollutant concentrations emitted by industries; and identify sources that have the potential to release the highest amounts of pollutants. A majority of the air monitoring sites are currently being operated in or near the five largest cities and seven largest counties in the state. However, as the Environmental Protection Agency continues to lower the National Ambient Air Quality Standards, the South Dakota Department of Environment and Natural Resources (SDDENR) has established some of the monitoring sites in rural areas such as Wind Cave National Park, Badlands National Park, Union County, and Pierre. These sites are helping to determine long-range impacts from other states and countries in rural and urban areas South Dakota (SDDENR 2020).

The South Dakota Department of Environment and Natural Resources develops an annual ambient air monitoring network plan, which is a review of the ambient air monitoring network each year. The results of the monitoring show that all areas of the state are in attainment with the Environmental Protection Agency's National Ambient Air Quality Standards.

In calendar year 2019, the ambient air monitoring network included 13 sites run by the department. There were three sites in Rapid City, two sites in Pierre, and one site in each of the remaining eight locations.

The general location of ambient air monitoring sites in relation to cities in South Dakota in 2019 is shown in figure 7.

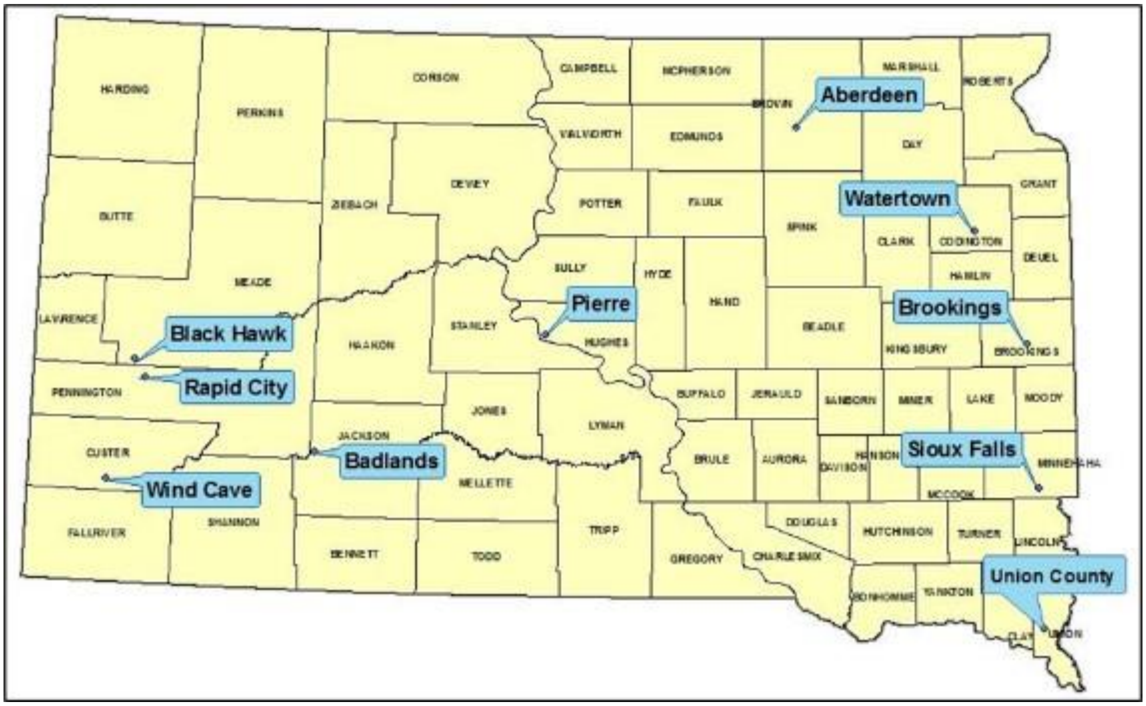


Figure 7. South Dakota air monitoring sites, 2019

The following types of ambient air monitors and monitoring sites may be operated in South Dakota:

- State and local air monitoring stations,
- Special purpose monitors,
- Prevention of Significant Deterioration (PSD) monitors,
- Interagency Monitoring of Protected Visual Environments (IMPROVE) sites,
- Environmental Radiation Network (RadNet) ambient monitoring systems, and
- National Core multi-pollutant sites.

Two IMPROVE sites are being operated by the National Park Service in South Dakota. The site locations are at the Badlands and Wind Cave National Parks. Information from the Wind Cave site is shown below in the *Air Quality Related Values* section (NPS 2013).

In South Dakota the National Atmospheric Deposition Program, National Trends Network (NTN) maintains a monitoring station at Wind Cave National Park adjacent to the Black Hills National Forest area. NTN Site SD04 has been in operation since 2002 and the station monitors concentration, equivalent, and deposition of pH (potential of hydrogen), H (hydrogen), SO4 (sulfate), NO3 (nitrate), NH4 (ammonia), Ca (calcium), Mg (magnesium), K (potassium), Na (sodium), Cl (chlorine), and total nitrogen deposition. The station also monitors precipitation.

Rapid City experiences PM10 exceedances that could lead to violations of the National Ambient Air Quality Standards. Data analysis has shown that most of these exceedances occur from blowing dust during high wind events. In 1997, the South Dakota Department of Environment and Natural Resources began to develop a Natural Events Action Plan. A coordinated effort between the department, the Pennington County Air Quality Board, the City of Rapid City, Pennington County, and the industries in the Northwest Industrial Complex was undertaken to complete the plan. The plan was finalized in 1998 (SDDENR 1998, SDDENR 2021).

The plan covers West Rapid City where the PM10 exceedances have occurred. West Rapid City lies in the middle of the geological formation termed the limestone racetrack that surrounds the Black Hills National Forest. It is bordered on the west and south by the Black Hills National Forest and on the east by a series of hogback hills, creating a bowl-like formation ideal for air pollution problems. The main industrial and mining complex of the city is in this area. The implementation area for the plan is between a line extending north and south from the "Gap" to 5 miles west of the city's western city limit. The "Gap" is a geographic marker that is a drainage for Rapid Creek, which runs through Rapid City out of the Black Hills National Forest. The action plan extends out over parts of the eastern portion of the national forest (figure 8).

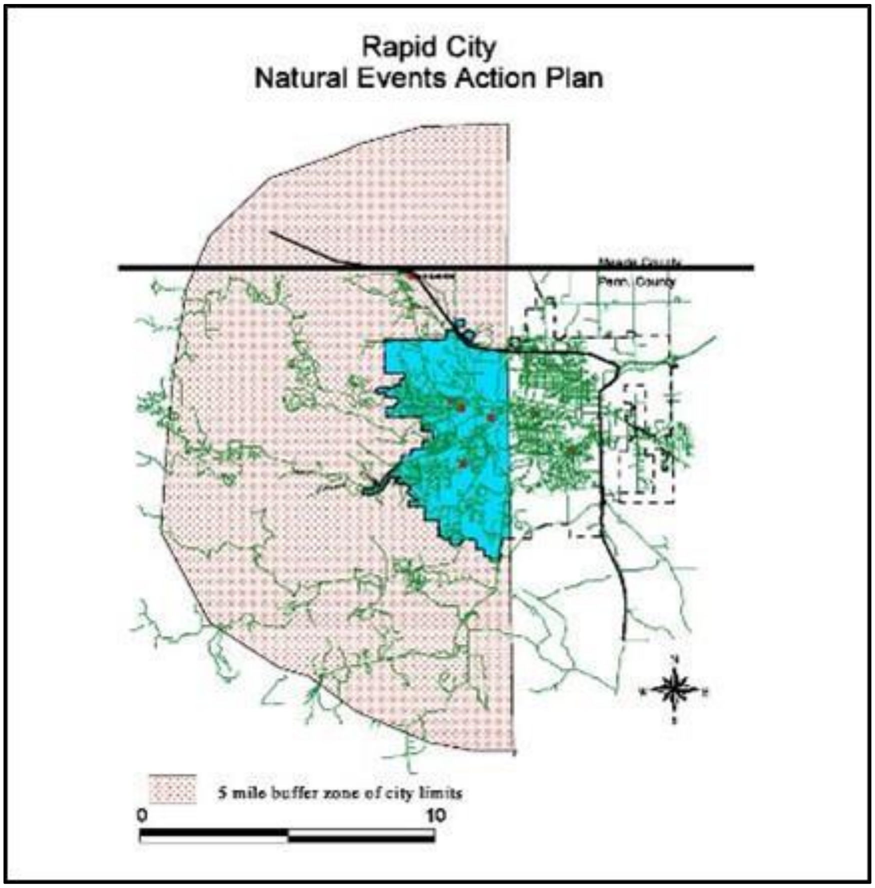


Figure 8. Natural Events Action Plan for Rapid City, South Dakota

In addition, according to the Black Hills National Forest FY 2013-14 Monitoring and Evaluation Report (the most current report that is available), Rapid City remains the key area of concern because it is close to being designated as a non-attainment area for PM2.5, which is a pollutant typically produced by smoke and dust. The concern for air quality in the Rapid City area has resulted in the Forest Service working jointly with the Rapid City Air Quality Office on guidelines for all prescribed burning activities on National Forest System lands (USDA Forest Service 2015).

Class I and Class II Areas

South Dakota has developed a plan to implement the regional haze regulations required by the federal Clean Air Act. Implementation of these regulations will put more importance on air pollution levels in the state's two class I areas: Badlands and Wind Cave National Parks. Ambient air monitors in these areas are used to determine background levels and the impact of long-range transport of air pollutants like particulate matter and ozone.

Continuous data are needed for modeling purposes to help determine air quality permit requirements. Interagency Monitoring of Protected Visual Environments (IMPROVE) monitors in the national park sites collect data for PM10, PM2.5, and chemical analysis of the collected particulates. The South Dakota Department of Environment and Natural Resources collects PM10, PM2.5, sulfur dioxide, nitrogen dioxide, and ozone data at the Badlands site and PM10, PM2.5, and ozone data at the Wind Cave site. However, with the development of coal bed methane and oil and gas production in North Dakota, Wyoming, Montana, and Colorado, there is still a need for more air pollution monitoring data in rural and small cities in the western part of the state. The data would improve our understanding of the effects of the air pollution to the Class I and Class II areas in and adjacent to the Black Hills National Forest (SDDENR 2020).

Air Quality Monitoring Results

The U.S. Air Quality Index is the Environmental Protection Agency index for reporting air quality to the public. Think of the air quality index as a yardstick that runs from 0 to 500. The higher the index value, the greater the level of air pollution and the greater the health concern. For example, an index value of 50 or below represents good air quality, while an index value over 300 represents hazardous air quality (table 6) (EPA 2021b)

Table 6. Air quality index for ozone and particulate pollution

AQI LEVELS	AQI VALUE	MEANING
0-50	Good	Everyone can enjoy the outside.
51-100	Moderate	People unusually sensitive to air pollution should consider reducing prolonged outdoor exertion.
101-150	Unhealthy for Sensitive Groups	Sensitive groups (people with respiratory diseases, older adults and children) should reduce prolonged outdoor exertion.
151-200	Unhealthy	Sensitive groups should avoid prolonged outdoor exertion. Everyone else should limit prolonged outdoor exertion.
201-300	Very Unhealthy	Sensitive groups should avoid all outdoor exertion. Everyone else should limit prolonged outdoor exertion.
301-500	Hazardous	Health warnings of emergency conditions. The entire population is more likely to be affected.

For each pollutant, an air quality index value of 100 generally corresponds to an ambient air concentration that equals the level of the short-term national ambient air quality standard for protection of public health.

Index values at or below 100 are generally thought of as satisfactory. When index values are above 100, air quality is unhealthy: at first for certain sensitive groups of people, and then for everyone as index values increase.

The air quality index is divided into six categories. Each category corresponds to a different level of health concern. Each category also has a specific color. The color makes it easy for people to quickly determine whether air quality is reaching unhealthy levels in their communities. The Environmental Protection Agency establishes an index for five major air pollutants regulated by the Clean Air Act. Each of these pollutants has a national air quality standard set by the Environmental Protection Agency to protect public health:

- ground-level ozone,
- particle pollution (also known as particulate matter, including PM2.5 and PM10),
- carbon monoxide,
- sulfur dioxide, and
- nitrogen dioxide.

Available air quality index information for all monitored criteria air pollutants during 1996-2021 is shown for Custer County (figure 9), Meade County (figure 10), and Pennington County (figure 11). The data for each county show good overall air quality with increases in air pollution mostly during the summer months (EPA 2021c).

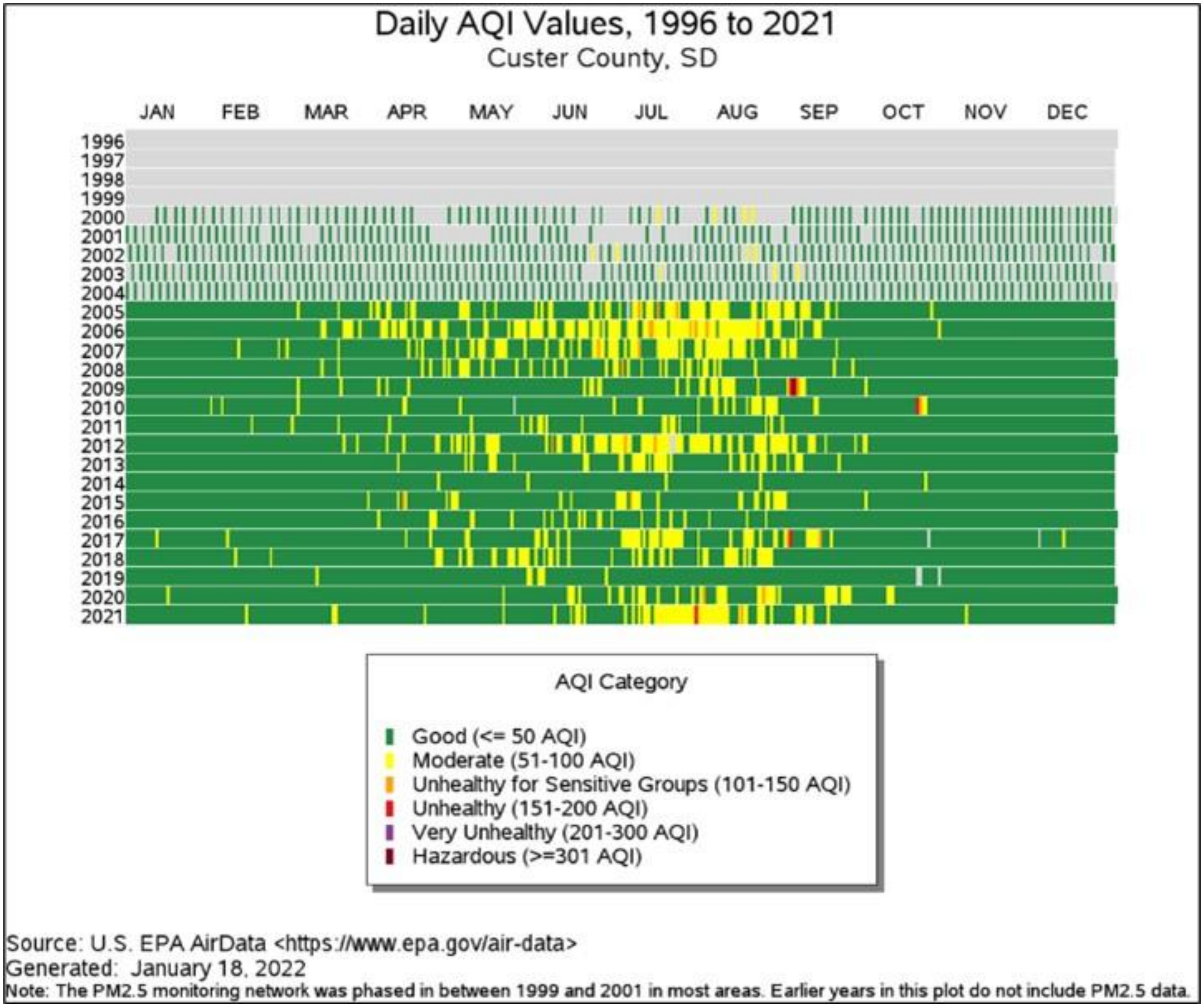


Figure 9. Air quality index data for Custer County, 1996-2021

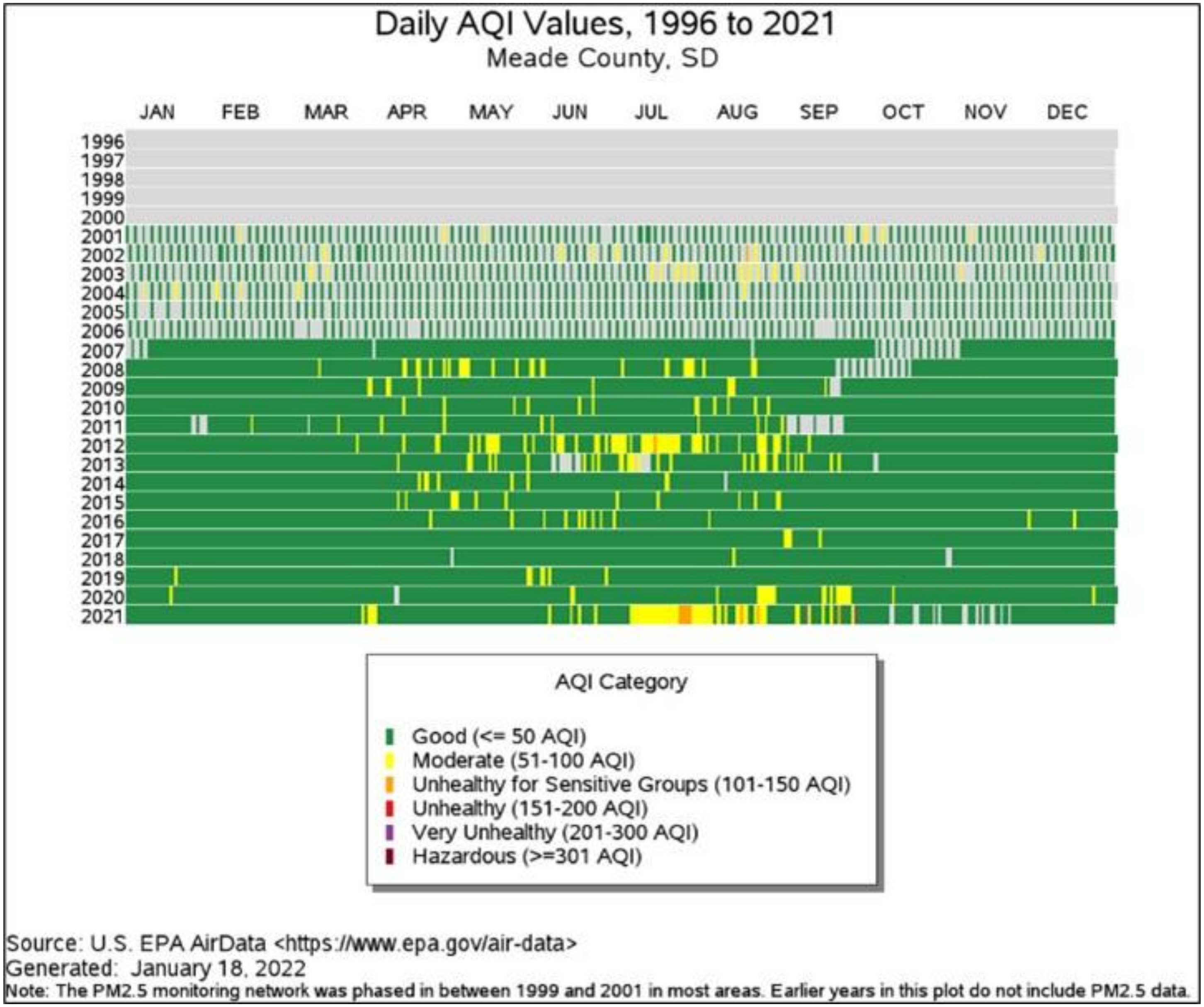


Figure 10. Air quality index data for Mead County, 1996-2021

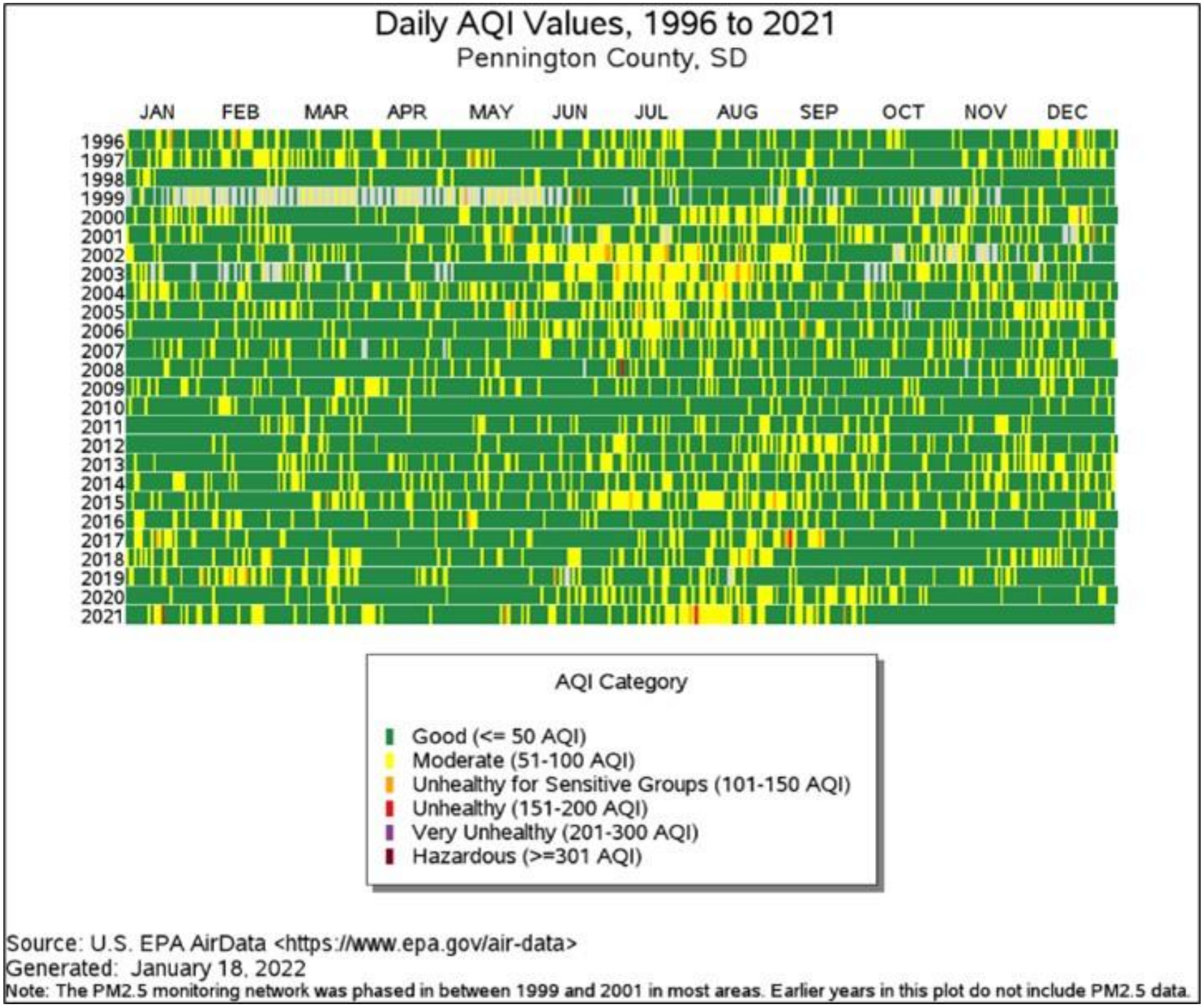


Figure 11. Air quality index data for Pennington County, 1996-2021

Summary of South Dakota Air Quality Monitoring

- **Carbon Monoxide -** The carbon monoxide concentrations are very low, and the area is attaining the 1-hour and 8-hour average standards.
- **Lead -** Lead sampling in the past and current emissions levels indicates that South Dakota is attaining the new lead standard.
- **Nitrogen Dioxide -** All four nitrogen dioxide monitoring sites in South Dakota are attaining the nitrogen dioxide standards.
- **Ozone -** The data collected in the past three years demonstrates that South Dakota is attaining the national ozone standard, but half of the sites are at least 90 percent of the ozone design value (i.e., standards).
- **PM2.5 and PM10** – All 10 PM2.5 and PM10 monitoring sites in South Dakota are demonstrating attainment of or attaining the PM2.5 and PM10 standards.
- **Sulfur Dioxide -** All four sulfur dioxide monitoring sites in South Dakota are attaining the sulfur dioxide standards.

Air Quality Monitoring in Southeastern Wyoming

The Wyoming Department of Environmental Quality last updated their Annual Network Plan in 2020. The plan provides a comprehensive review of the ambient monitoring stations maintained by the Air Quality Division of the Wyoming Department of Environmental Quality. These stations are the State and Local Air Monitoring Stations, and Special Purpose Monitors stations (WDEQ 2020).

The State and Local Air Monitoring Stations are sited in populated areas to monitor public health and demonstrate compliance with the National Ambient Air Quality Standards, but may serve other purposes such as:

- provide air pollution data to the public in a timely manner,
- support compliance with air quality standards and emissions strategy development, and
- support air pollution research studies.

The Special Purpose Monitoring stations collectively have multiple objectives. These objectives include:

- provide air pollution data to the public in a timely manner,
- monitor public health,
- investigate pollutant concentrations downwind of sources, and
- determine background pollutant concentrations.

The Air Quality Division also provides support and cooperation to other special monitoring programs in collaboration with Federal land management agencies including the Forest Service (Black Hills National Forest) and National Park Service (Wind Cave National Park). The Interagency Monitoring of Protected Visual Environments (IMPROVE) network investigates current visibility and aerosol conditions for the broad, regional categorization of visibility in Class I areas. The Air Quality Division also helps fund and evaluate data from air quality related value monitoring within Wyoming, such as acid deposition, as well as overseeing industrial monitoring required by air quality permits. The location of monitoring sites operated or overseen by the Wyoming Air Quality Division from 2009 to May of 2020 is shown in figure 12.

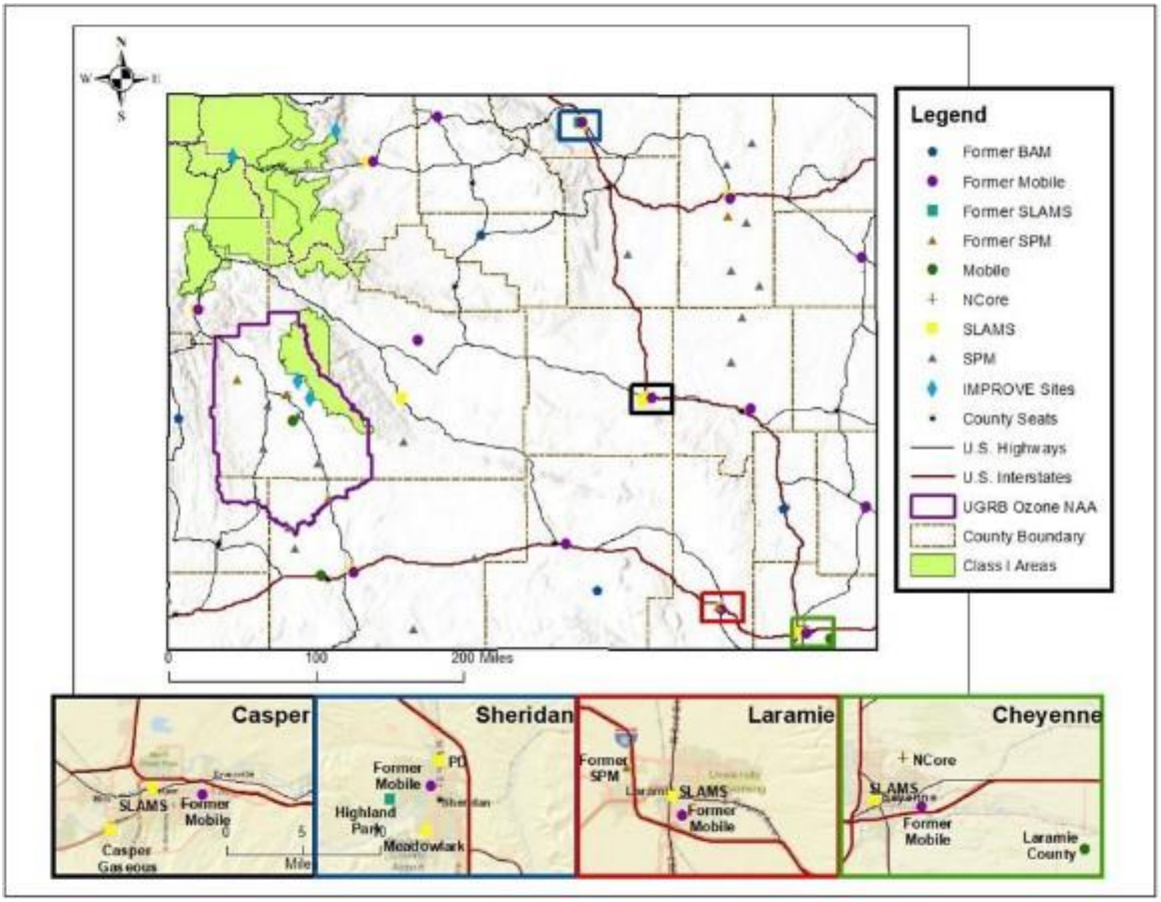


Figure 12. Location of past and present Wyoming air quality monitoring sites

Class I and Class II Areas

There are four Interagency Monitoring of Protected Visual Environments (IMPROVE) locations in Wyoming: Yellowstone National Park, established in 1988; Bridger Wilderness Area, established in 1988; North Absaroka Wilderness Area, established in 2000; and Boulder Lake, established in 2009 (WDEQ 2020).

In Wyoming the National Atmospheric Deposition Program, National Trends Network (NTN), maintains a monitoring station at Newcastle along the southwest area of the Black Hills National Forest. NTN Site WY99 has been in operation starting in 1981 and the station monitors concentration, equivalent, and deposition of pH (potential of hydrogen), H (hydrogen), SO4 (sulfate), NO3 (nitrate), NH4 (ammonia), Ca (calcium), Mg (magnesium), K (potassium), Na (sodium), and Cl (chlorine). The site also monitors precipitation.

Air Quality Monitoring Results

Available air quality index information for all monitored criteria air pollutants for 1996-2021 is shown for Cook County (figure 13) and Weston County (figure 14). The Cook County data are incomplete. Weston County shows good overall air quality. The data show an increase in Weston County's air quality index starting in 2013, and the increase may be the result of changes to the types of air pollutants that were monitored (EPA 2021c).

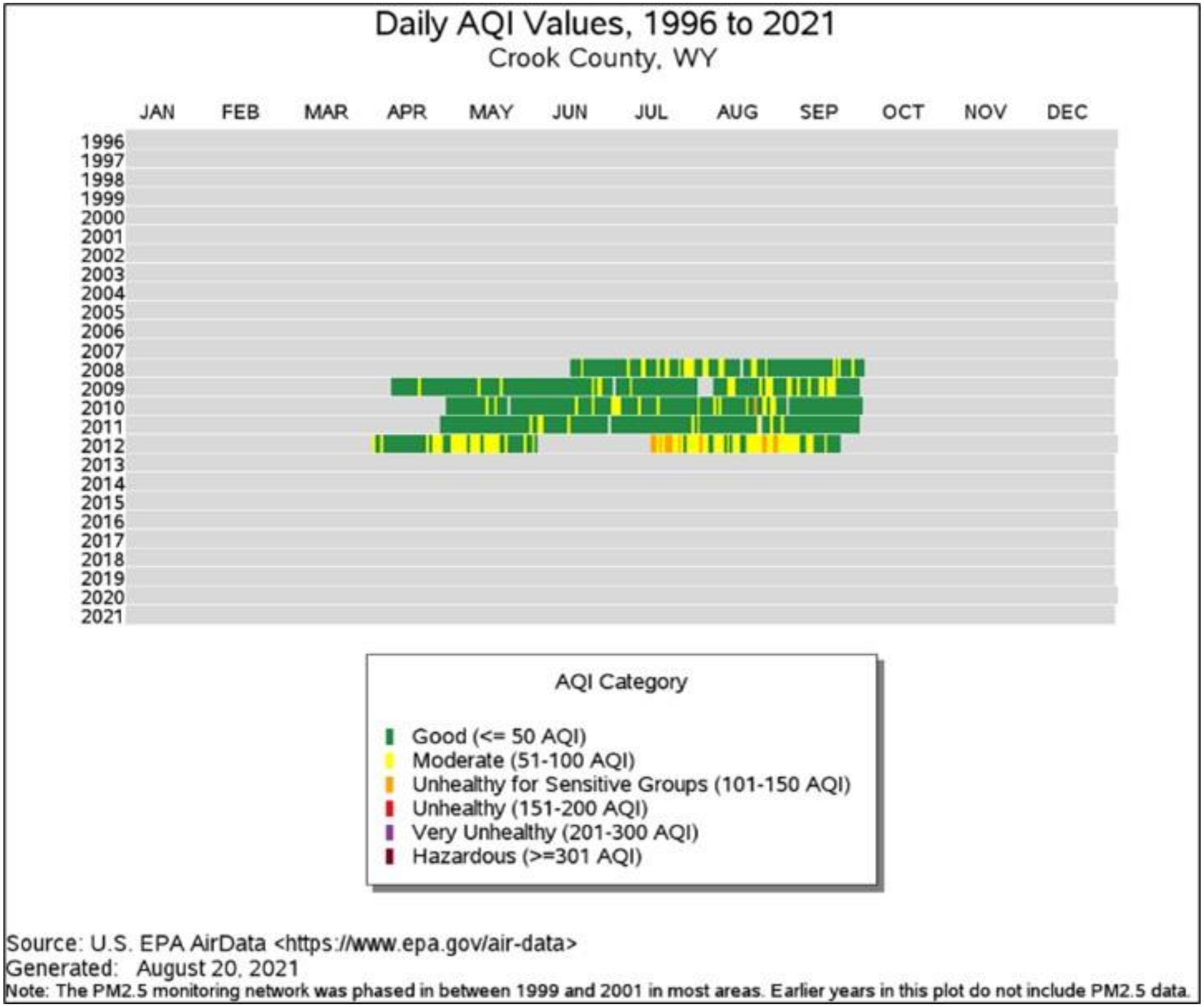


Figure 13. Air quality index data for Cook County, 1996-2021

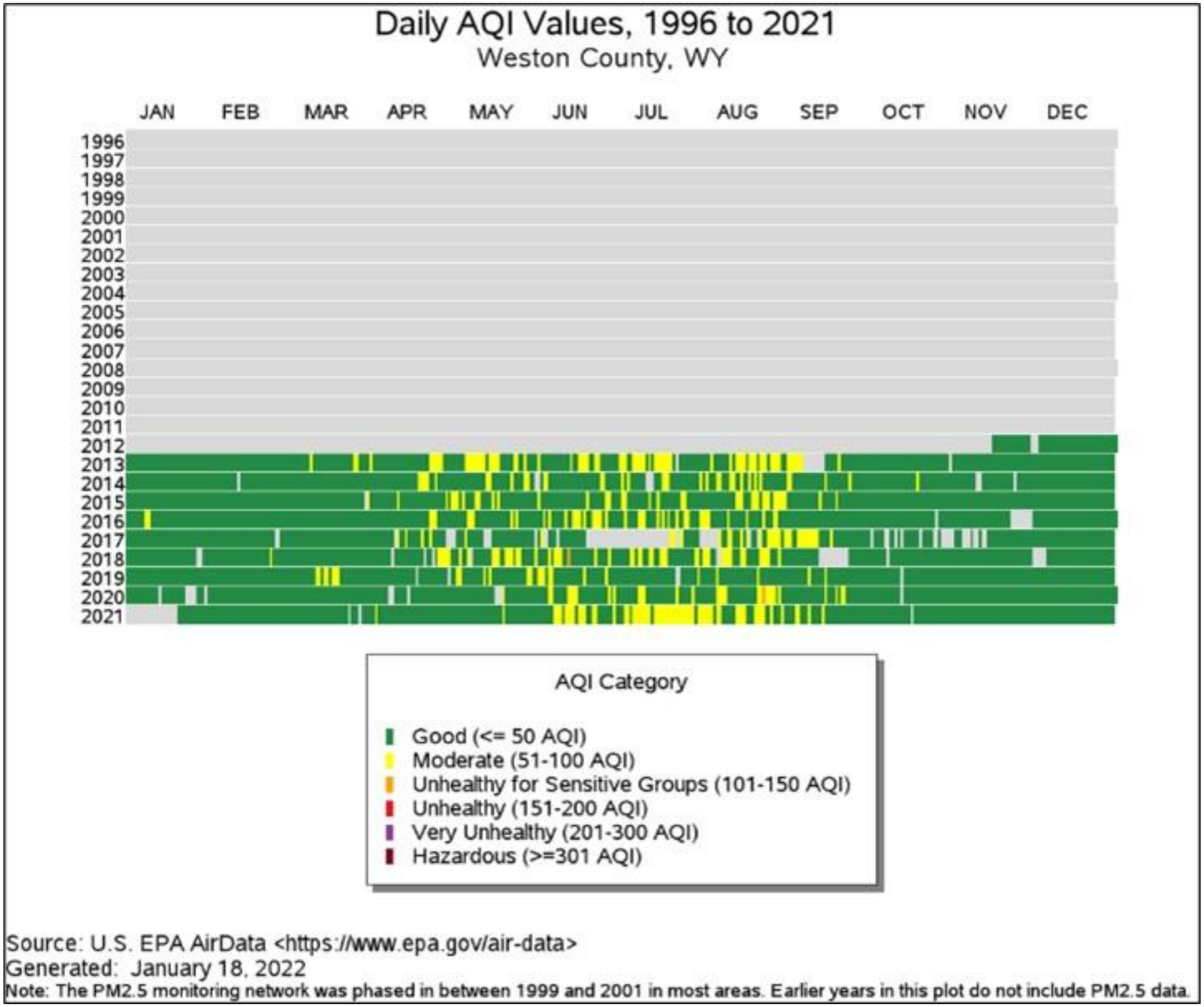


Figure 14. Air quality index data for Weston County, 1996-2021

Summary of Wyoming Air Quality Monitoring

- **Carbon Monoxide -** The carbon monoxide concentrations are very low, and Wyoming is attaining the 1-hour and 8-hour average standards.
- **Lead -** Lead sampling in the past and current emissions levels indicates that Wyoming is attaining the new lead standard.
- **Nitrogen Dioxide -** All 15 nitrogen dioxide monitoring sites in Wyoming are attaining the nitrogen dioxide standards.
- **Ozone** – Most of the 18 ozone monitoring stations show compliance with the ozone standards. On July 20, 2012, the Environmental Protection Agency designated all of Sublette County and parts of Lincoln and Sweetwater Counties (i.e., the Upper Green River Basin) as a Marginal non-attainment area for the 2008 Ozone National Ambient Air Quality Standards (NAAQS) of 0.075 ppm. The remaining portion of Wyoming is designated Attainment/Unclassifiable for the 2008 Ozone NAAQS. In 2018, the Environmental Protection Agency designated all the counties in Wyoming as Attainment/Unclassifiable according to the 2015 Ozone NAAQS of 0.070 ppm.
- **PM2.5 -** All sixteen PM2.5 monitoring sites in Wyoming are demonstrating attainment of or attaining the PM2.5 standards.
- **PM10 -** All eighteen PM10 monitoring sites in Wyoming are demonstrating attainment of or attaining the PM10 standards.
- **Sulfur Dioxide -** All two sulfur dioxide monitoring sites in Wyoming are attaining the sulfur dioxide standards.

Gap in Air Quality Monitoring

According to an article published by the Associated Press (Brown and Rama 2021), there are large gaps in the Midwest and in other remote western portions of the country where few air quality monitors are located due to low populations. The gaps in monitoring data during wildfire events has led to a lack of air pollution monitoring information that could cause a disproportionate exposure of rural or remote communities to smoke. The location of permanent and temporary monitors and low-cost sensors in the lower 48 states is shown in figure 15 and in the Black Hills National Forest area in figure 16. Only two permanent and two low-cost sensors are located in the Black Hills National Forest area (figure 16) (AirNow website). In both figures, circles represent permanent monitoring stations, triangles represent temporary stations, and squares represent low-cost sensors that are not used for regulatory purposes.

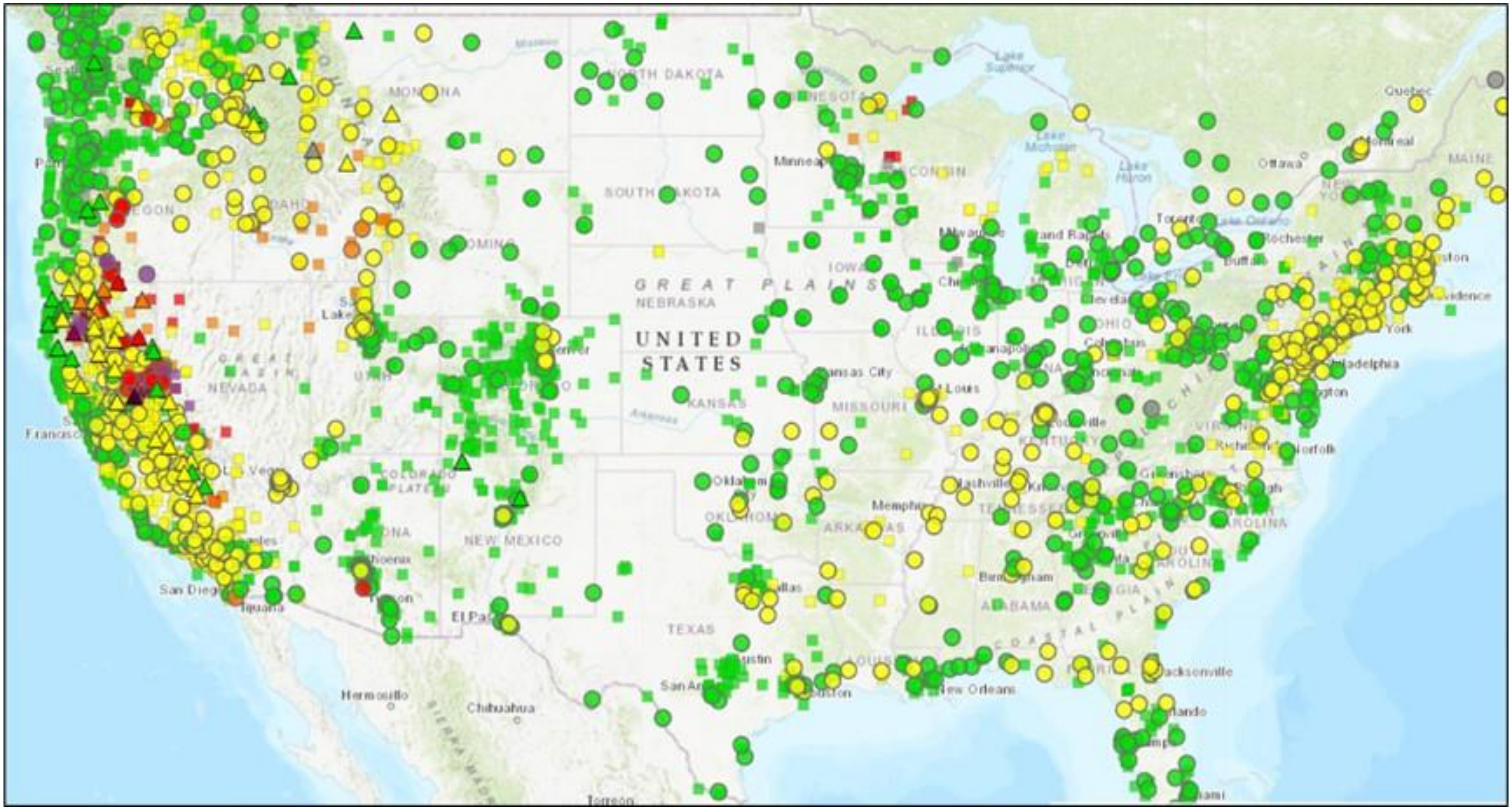
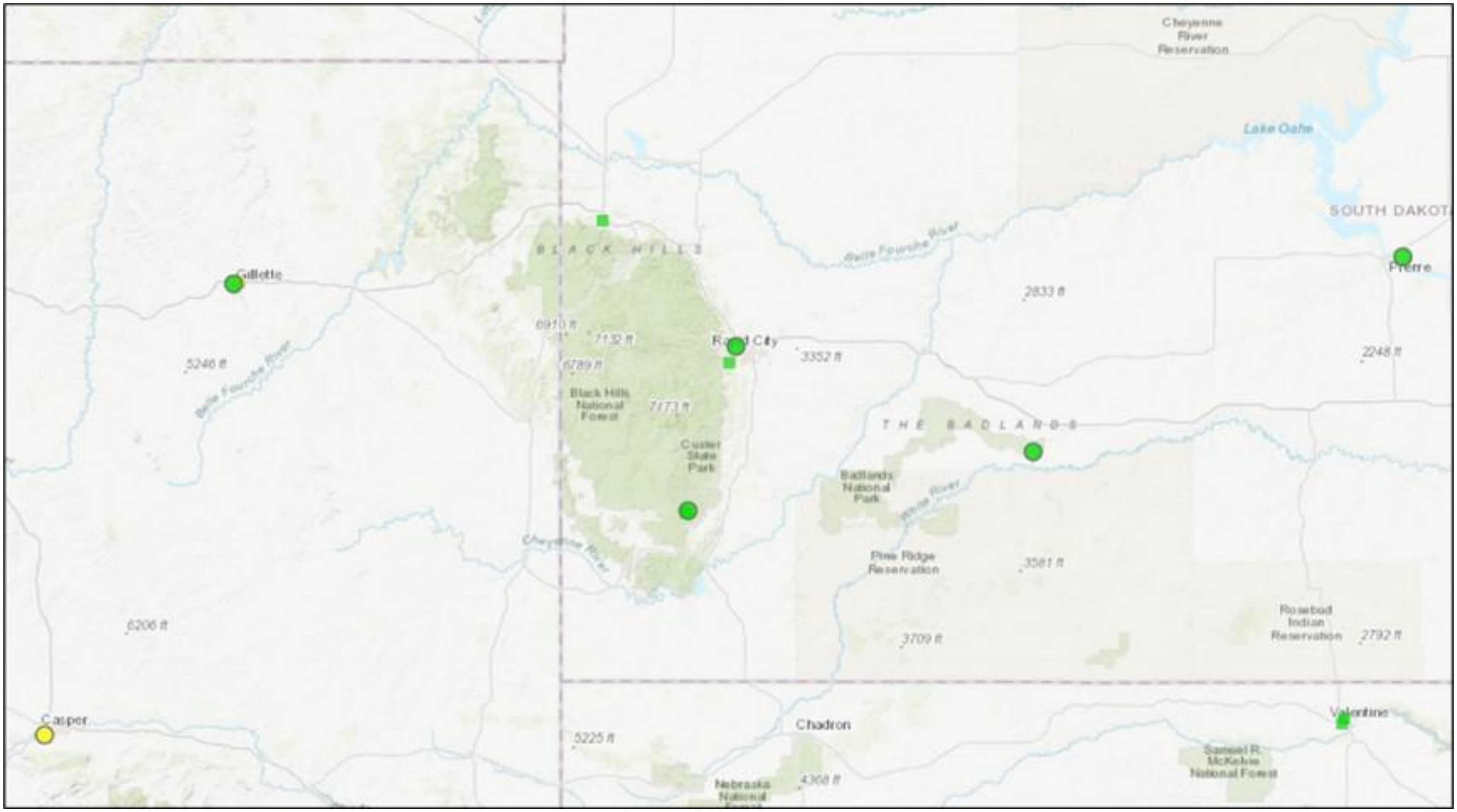


Figure 15. Fire and smoke map showing location of permanent and temporary monitors and low-cost sensors in the lower 48 states, August 26, 2021



Circles indicate permanent monitors, and squares indicate low-cost monitors. Note that there are few monitors and sensors in the Black Hills region.

Figure 16. Fire and smoke monitoring sites in the Black Hills National Forest area

Air Quality Related Values

Air pollution affects the natural quality of National Forest System lands, particularly wilderness areas, and air quality related values. High ozone concentrations can injure sensitive vegetation. Fossil fuel burning emits particulate matter, sulfur dioxide, and nitrogen oxides into the atmosphere. Certain types of agricultural activities emit ammonia to the atmosphere. Such emissions can lead to atmospheric deposition of sulfuric acids, nitric acids, and ammonium into forest ecosystems. Atmospheric deposition can cause lake water acidification, eutrophication, and hypoxia, soil nutrient changes, and vegetation impacts. Deposition of toxic metals such as mercury and lead can be harmful to both aquatic and terrestrial ecosystems. Visibility in the Black Hills National Forest can be obscured by anthropogenic haze of fine pollutant particles during certain times of the year. In addition, the Clean Air Act requires that Forest Service administrative and permitted operations such as prescribed burning, fossil fuels development and production, and mining comply with the National Ambient Air Quality Standards, Hazardous Air Pollutants standards, and the protection of air quality related values (Nick and McCorison 2012).

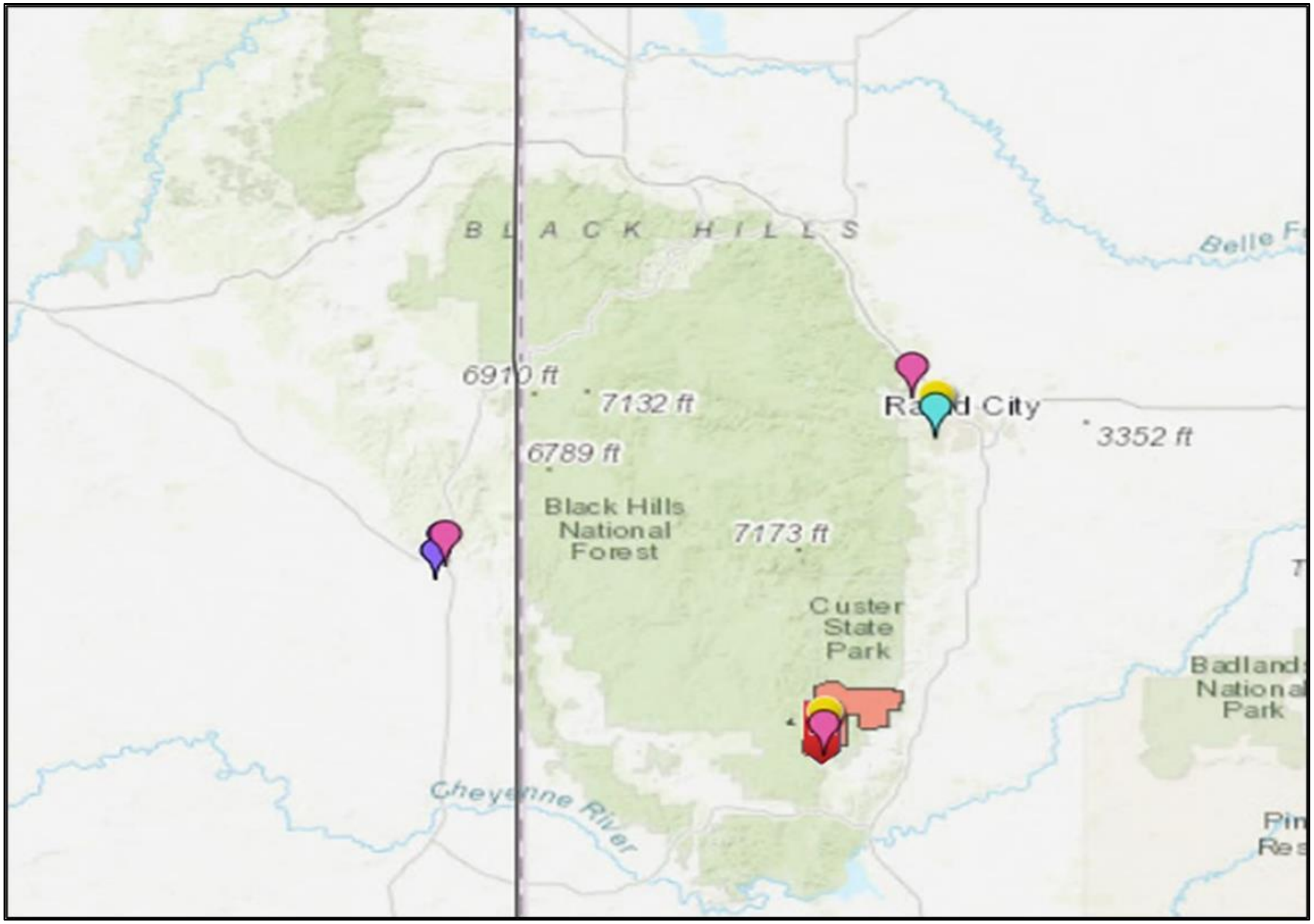
Per the Clean Air Act, Federal land managers have an affirmative responsibility to protect Class I air quality related values from degradation. And per the Wilderness Act, congressionally designated wilderness areas are to be managed for their protection and preservation from human-caused degradation, including air quality. The Prevention of Significant Deterioration Program is a Clean Air Act requirement that, establishes limits to pollutants in Class I and Class II areas.

In 2009 the Forest Service established a water chemistry sampling site along the southern boundary of the Black Elk Wilderness at Lost Cabin Creek. The sampling program is being used to measure air pollution effects to water quality. Lake and stream chemistry are generally considered good indicators of air pollution because they integrate the effect of acid deposition across a watershed. Snowpack contains the winter accumulation of atmospheric deposition. When spring snowmelt occurs, an acid pulse is released as acidic or contaminated runoff from the snow as it drains to streams and lakes (Smith and Malon 2009). Sampling results from the Lost Cabin Creek site are summarized in the ecosystems and watersheds assessment report.

The National Park Service manages Wind Cave National Park and the Badlands/Sage Creek Wilderness areas that are designated as Class I airsheds. The Forest Service manages the Black Elk Wilderness with a Sensitive Class II designation, and the remainder of the Black Hills National Forest airshed is managed as Class II. The location of the Black Hills National Forest and the Badlands/Sage Creek Wilderness areas is shown in figure 17.

The location of Wind Cave National Park and the Badlands/Sage Creek Wilderness Class I areas, and the location and types of air pollution monitoring stations in an around the Black Hills National Forest, are shown in figure 18. Two Interagency Monitoring of Protected Visual Environments (IMPROVE) sites are located at Wind Cave and the Badlands (red shield shapes, table 7).

Figure 17. Black Elk and Badlands Wilderness areas in and near the Black Hills National Forest



See table 7 for the legend key.

Figure 18. Wind Cave National Park (southeast Back Hills National Forest) and Badlands/Sage Creek (northeast Badlands National Park) Class I Wilderness areas, and air quality monitoring stations in and around the Black Hills National Forest

Table 7. Legend for figure 18

Icon	Station Type and Class 1 Areas
Blue pin	NO2 - Active
Pink pin	Ozone - Active
Orange pin	PM10 - Active
Yellow pin	PM2.5 - Active
Purple pin	SO2 - Active
Red shield	Interagency Monitoring of Protected Visual Environments (IMPROVE) - Active
pink shading	Federal Class 1 Areas: National Park Service

Air Pollutants and Effects

The nearest extensive air pollution studies relevant to the Black Hills National Forest are from Wind Cave National Park, and the data are based on the Wind Cave Interagency Monitoring of Protected Visual Environments (IMPROVE) station. Because this site is close to the Black Elk Wilderness and adjacent to the Black Hills National Forest, the Wind Cave studies were used as a proxy to show the effects of air pollution to the Black Elk Wilderness and the Black Hills National Forest (NPS 2021). The Wind Cave Interagency Monitoring of Protected Visual Environments (IMPROVE) site became operational in 1999 and is at an elevation of 4,252 feet (figure 19).

Figure 19. Wind Cave Interagency Monitoring of Protected Visual Environments (IMPROVE) site

Overall Air Quality at Wind Cave National Park

- **Condition:** Overall air quality at Wind Cave National Park is in fair condition. This is based on available conditions (visibility, ozone for human health, ozone for vegetation health, nitrogen deposition, sulfur deposition, and particulate matter) as defined in the National Park Service air quality analysis methods.
- **Trend:** The overall air quality trend at Wind Cave National Park is varied. This is based on available trends (visibility, ozone for human health, ozone for vegetation health, nitrogen deposition, sulfur deposition, and particulate matter) as defined in the National Park Service air quality analysis methods.
- **Confidence:** The degree of confidence at Wind Cave National Park is high. Data for all the parameters used to determine the overall condition come from in-park or nearby representative IMPROVE monitors.

Ozone

Oxides of nitrogen and volatile organic compounds are precursor pollutants that form ozone in the presence of sunlight. The primary sources of these precursor pollutants in and around the Black Hills National Forest area are wildfires, biogenics (vegetation and soil), locomotives, on- and off-road vehicles, prescribed burning, and the use of solvents.

At ground level, ozone is harmful to human health and the environment. Ground-level ozone does not come directly from smokestacks or vehicles, but instead is formed when other pollutants, mainly nitrogen oxides and volatile organic compounds, react in the presence of sunlight. Over the course of a growing season, ozone can damage plant tissues and make it harder for plants to produce and store food. It also weakens plants, making them less resistant to disease and insect infestations. Some plants are more sensitive to ozone than others. Information about ozone sensitive plants at Wind Cave National Park is provided by the National Park Service.

A risk assessment that considered ozone exposure, soil moisture, and sensitive plant species concluded that plants at Wind Cave National Park are at low risk of ozone injury (Kohut 2004). The park's arid to semi-arid conditions limit ozone uptake by plants. In other parks, scientists have found that plants in moist areas along streams and seeps may have higher ozone uptake and subsequent injury (Kohut et al. 2012).

- **Condition:** Ground-level ozone concentrations are not harmful for vegetation health at Wind Cave National Park. This is based on National Park Service Air Resources Division benchmarks and the 5-year average (2014–2018) estimated 3-month W126 metric of 6.0 parts per million-hours (ppm-hrs.). The W126 metric relates plant response to cumulative ozone exposure. Vegetation at Wind Cave National Park has a low risk of damage from ozone based on environmental conditions (Kohut 2007, Kohut 2004). Some plant species are sensitive to the effects of ozone in the park; please refer to the list of ozone-sensitive plant species.
- **Trend:** For 2009–2018, the 10-year trend in the W126 metric at Wind Cave National Park remained relatively unchanged (no statistically significant trend) (appendix A, figure 20 and figure 21).

Nitrogen and Sulfur

Nitrogen and sulfur compounds deposited from the air may have harmful effects, including acidification, on soils, lakes, ponds, and streams. Some plants are sensitive to acidification. Nitrogen and sulfur air pollution travels to the Black Hills National Forest with the wind, depositing nitrogen and sulfur compounds that can acidify or artificially fertilize (enrich) soils and surface waters. Deposited nitrogen comes from both natural (wildfires and lightning) and human sources (power plants, industrial facilities, and agriculture). The largest sources of deposited sulfur are sulfur dioxide emissions from fossil fuel combustion at power plants and other industrial facilities.

Excess nitrogen can also lead to nutrient enrichment, a process that changes nutrient cycling and alters plant communities. Plants in grassland ecosystems are generally nitrogen-limited, making them vulnerable to changes caused by nitrogen deposition. Invasive grasses tend to thrive in areas with elevated nitrogen deposition, displacing native vegetation adapted to low nitrogen conditions. Cheatgrass, a non-native weed, is now common in the Northern Great Plains (Ogle and Reiners 2002). Other non-native weeds at Wind Cave National Park include Canada thistle, leafy spurge, and purple loosestrife. Nitrogen increases may also exacerbate water use in plants like sagebrush (Inouye 2006). Sensitive mixed-grass prairies cover about 75 percent of Wind Cave National Park (NPS 2022). Ecosystem sensitivity to nutrient enrichment at Wind Cave National Park relative to other national parks is very high (Sullivan et al. 2011a, Sullivan et al. 2011b).

Healthy ecosystems can naturally buffer a certain amount of pollution, but as nitrogen and sulfur accumulate, a threshold is passed where the ecosystem is harmed. "Critical load"[3] is a term used to describe the amount of pollution below which no harmful changes in sensitive ecosystems occur (Porter et al. 2005). Nitrogen deposition exceeds the critical load for one or more park ecosystems (NPS 2021) (appendix A, figures 22 to 28). Critical load assessments for Wind Cave National Park can be considered representative of similar ecosystem types on the Black Hills National Forest.

Information about acid sensitive plants at Wind Cave National Park is provided by the National Park Service.

Nitrogen Deposition

- **Condition:** Wet nitrogen deposition levels create poor conditions for ecosystem health at Wind Cave National Park. This is based on National Park Service Air Resources Division critical load thresholds and the 5-year average (2014–2018), estimated 2.6 to 2.8 kilograms per hectare per year range of wet nitrogen deposition. To maintain the highest level of protection, the maximum of this range (2.8 kilograms per hectare per year) is used. A level of 2.8 kilograms per hectare per year normally indicates fair condition. However, the condition has been reduced to poor because ecosystems at Wind Cave National Park may be very highly sensitive to nitrogen-enrichment effects relative to all inventory and monitoring parks (Sullivan 2016). The combined wet and dry nitrogen deposition at Wind Cave National Park is estimated between 4.6 and 5.3 kilograms per hectare per year. This amount of deposition exceeds one or more critical loads for ecosystem health. Nitrogen-enrichment effects may include disruption of soil nutrient cycling and reduced biodiversity of some plant communities, including grassland and wetland plants at the park (Sullivan and McDonnell 2014).
- **Trend:** For 2009–2018, the 10-year trend in total wet nitrogen concentrations in rain and snow at Wind Cave National Park remained relatively unchanged (no statistically significant trend).
- The NTN trends for sites SD04 and WY99 show slight increases in nitrogen deposition. For the SD04 site from 2004 to 2018, nitrogen in kilograms/hectare increased slightly from about 2.25 to 2.75 kilograms per hectare. For the WY99 site from 1983 to 2017 nitrogen also increased slightly from about 1.5 to 2.0 kilograms per hectare.

[3] Critical Load: the quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge. This level is unique for each ecosystem and resource, depending on its sensitivity to air pollution.

Sulfur Deposition

- **Condition:** Wet sulfur deposition levels are in a fair condition for ecosystem health at Wind Cave National Park. This is based on National Park Service Air Resources Division benchmarks and the 5-year average (2014–2018) estimated wet sulfur deposition of 0.6 kilograms per hectare per year, a level that normally indicates good condition. However, the condition has been reduced to fair because ecosystems at Wind Cave National Park may be very highly sensitive to acidification effects relative to all inventory and monitoring parks (Sullivan et al. 2011a, Sullivan et al. 2011b). Acidification effects can include changes in water and soil chemistry that impact ecosystem health. Some plant species are sensitive to the effects of acidification in the park; please refer to the list of acid-sensitive plant species.
- **Trend:** For 2009–2018, the 10-year trend in total wet sulfur concentrations in rain and snow at Wind Cave National Park improved.
- The NTN trends for sites SD04 and WY99 show decreases in sulfur concentration and deposition. For the SD04 site from 2004 to 2018, sulfur concentration decreased from about 0.71 to 0.33 milligrams per liter, and sulfur deposition decreased from about 2.6 to 1.7 kilograms per hectare. For the WY99 site from 1983 to 2017, sulfur concentration decreased from about 1.10 to 0.35 milligrams per liter, and sulfur deposition decreased from about 3.75 to 1.5 kilograms per hectare.

Mercury and Toxics

When deposited, airborne mercury, and other toxic air contaminants, are known to harm birds, salamanders, fish, and other wildlife, and cause human health concerns. These substances enter the food chain and accumulate in the tissue of organisms causing reduced reproductive success, impaired growth and development, and decreased survival.

A study of mercury in precipitation from the Northern Great Plains indicated that mean mercury deposition rates at Wind Cave National Park were high compared to other national parks, including nearby Badlands and Theodore Roosevelt National Parks (Stone at al. 2011). Annual deposition rates were comparable to studies performed at similar latitudes and to estimates from the Mercury Deposition Network (Lupo and Stone 2013).

Particulate Matter

The major sources of particulate matter affecting the Black Hills National Forest area are generated from wildfires, prescribed burning, and fugitive or windblown dust.

- **Condition:** Particulate matter (PM2.5 and PM10) concentrations are fair at Wind Cave National Park. This is based on the Environmental Protection Agency human health-based air quality index breakpoints and the most conservative of the measured particulate metrics.
- **Trend:** For 2009–2018, the overall trend in particulate matter concentrations at Wind Cave National Park remained relatively unchanged (no statistically significant trend) (appendix A figures 29 to 32).

Visibility

Forest vistas are sometimes obscured by haze, reducing how well and how far people can see. Visibility-reducing haze is caused by tiny particles that are suspended in the air, and these particles can also affect human health. Many of the same pollutants that ultimately fall out as nitrogen and sulfur deposition contribute to this haze. Organic compounds, soot, dust, and wood smoke reduce visibility as well. Significant improvements in visibility have been documented since the 2000s due to reductions in vehicle and industrial emissions. Overall, visibility in the Black Hills National Forest and Wind Cave National Park still needs improvement to reach the Clean Air Act goal of no human-caused impairment (appendix A, figures 33 to 35).

- **Condition:** Visibility is fair at Wind Cave National Park based on National Park Service Air Resources Division benchmarks and the 5-year average (2014–2018) measured visibility (haze index) on mid-range days of 7.9 deciviews[4]. This is 4.2 deciviews above the estimated natural condition of 3.7 deciviews. In 2018, the measured visual range is between 55 and 171 miles. Without the effects of pollution, estimated visual range would be from 114 to 201 miles.
- **Trend:** For 2009–2018, the 10-year trend in visibility at Wind Cave National Park remained relatively unchanged (no statistically significant trend) on the 20-percent clearest days and 20-percent haziest days, resulting in an overall unchanged visibility trend. The Clean Air Act visibility goal requires visibility improvement on the 20-percent haziest days, with no degradation on the 20-percent clearest days.

Chapter 3. Sustainability

Environmental, Economic, and Social Sustainability of Air Quality

Overall, the Black Hills area currently has good air quality, as defined by meeting National Ambient Air Quality Standards (there are no chronic exceedances of National Ambient Air Quality Standards). The states of South Dakota and Wyoming are forecasting improving air quality conditions in the Black Hills National Forest area (based on improving vehicle emissions efficiency and industrial processes). Three western Wyoming counties, or portions of these counties, are designated as marginal non-attainment for ozone. However, these counties are about 300 miles west of the Black Hills National Forest region bounded by the Wind River Mountain Range to the east, and therefore, the effects of ozone from the western portion of Wyoming to the Black Hills National Forest is minor. In addition, there are only about three or four particulate monitors or low-cost sensors in and around the Black Hills National Forest area. During severe wildfire events throughout the western portions of the United States, there could be adverse health effects to communities and impacts to recreational activities in the Black Hills National Forest area. Significant smoke impacts can affect recreation-related income in the area.

Visibility is good and has been forecasted to improve in the future. Air pollution effects to Class I and Class II airsheds are generally low, although some research shows exceedances of critical loads (nitrogen deposition) in the Black Hills National Forest area as measured at Wind Cave National Park.

Climate change could increase air pollution. Warmer, drier summers, earlier springs, and decreasing snowpack could increase the occurrence, size, and intensity of wildfires that produce increasing amounts of particulates, carbon monoxide, ozone, hazardous air pollutants, and greenhouse gases. Increasing daytime temperature could increase ozone impacts to human health and the environment during hot days.

[4] The unit of measurement of haze, or "haze index." Deciview is a measure of visibility derived from light extinction that is designed so that incremental changes in the haze index correspond to uniform incremental changes in visual perception, across the entire range of conditions from pristine to highly impaired.

Chapter 4. Current Forest Plan and its Context within the Broader Landscape

Existing Forest Plan Management Direction for Air Quality

Existing air quality direction in the 2006 forest plan, as amended, is very brief and mainly concerns management of wilderness areas and fuel treatment projects. Existing direction is that management actions comply with State and Federal air quality standards.

The Clean Air Act and Wilderness Act require the Forest Service to comply with clean air standards managed by the State, and to monitor air quality related values in Class 1 wilderness. Currently, air quality in the Black Hills National Forest is in compliance with State clean air laws, and the Forest Service monitors for impacts to air quality related values.

Forest Plan Consistency with External Plans for Air Quality

Monitoring Air Quality and Enforcement of National Ambient Air Quality Standards

Under the Clean Air Act, the Forest Service and its permitted operations are required to comply with all applicable Federal, State, and local air quality regulations. The South Dakota Department of Environment and Natural Resources and Wyoming Department of Natural Resources oversee the development and adoption of State air quality regulation programs and monitor air quality. The departments can set their own Ambient Air Quality Standards that are equal to, or more stringent than, Federal air quality standards. The departments implement the air management programs adopted by the States and enforce compliance with the National Ambient Air Quality Standards, prevent significant deterioration increments, and regulate smoke emissions from prescribed burning in accordance with State regulations. The Forest Service is required by law to assure compliance with State air quality rules.

The Clean Air Act and Wilderness Act also require the Forest Service to monitor air quality related values in Class 1 wilderness to determine if adverse impacts to air quality related values are occurring. The Forest Service monitors for air pollution effects to air quality related values at the Lost Cabin Creek sampling site relating to the Sensitive Class II Black Elk Wilderness. Monitoring at the nearby national parks provides additional information considered representative of conditions on the Black Hills National Forest.

Implementation of the Prevention of Significant Deterioration Program

The Prevention of Significant Deterioration Program is a Clean Air Act requirement that sets emission limitations for major new or modified stationary sources of air pollution such as coal-fired electrical power generation plants and sets limits to an increase of pollutants in Class I and Class II areas. A permittee wishing to build a major new (or significantly modify an existing) facility in a clean air region must obtain a prevention of significant deterioration permit from the State. Where emissions from new or modified facilities might affect Class I areas, the “Federal Land Manager” must be notified. For the Black Hills National Forest, the Regional Forester is the designated Federal Land Manager. The manager reviews the prevention of significant deterioration permit to ensure that air quality related values are not adversely affected, that National Ambient Air Quality Standards (NAAQS) and prevention of significant deterioration increments are not violated, and that best available control technology is used to minimize facility emissions. If the land manager determines that the facility’s emissions will “adversely impact” air quality related values, the Federal Land Manager will recommend that the permit not be issued or that mitigations be adopted. It is important to remember that notification of permit applications is not required for facilities that may affect Class II areas. However, the Federal Land Manager may provide input regarding any anticipated impacts on air quality related values to the permitting authority. Additional methods of protecting wilderness values in Class II areas include participation in regional assessments and State Implementation Plan revisions. In non-attainment areas, Federal Land Managers can also provide feedback to the permitting authority during the facility permitting and air quality planning processes (Nick and McCorison). Currently there are no proposals of major new or modified stationary sources that could affect the Black Hills National Forest area.

Chapter 5. Potential Need for Forest Plan Changes

Based on actual air quality monitoring and predictive air quality modeling, the States of South Dakota and Wyoming are forecasting continuing improvement in compliance with National Ambient Air Quality Standards and visibility in Class I and II areas in the Black Hills National Forest area into the foreseeable future.

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Appendix A: Air Quality Background Information

Forest Plan Direction

(1997) Revision – Forest National Forest Land and Resource Management Plan Record of Decision

Clean Air Standards

As discussed in the FEIS beginning on page III-15, the activities in the Forest Plan are not expected to violate National Ambient Air Quality Standards. Conformance with air quality statutes is directed in the Plan on page II-1 and in Appendix C.

(2005) Forest National Forest Phase II Amendment Record of Decision

Section X. Findings Required by Other Laws

Clean Air Act

As disclosed in Chapter 3, Section 3-13.1 of the FEIS the Forest Plan is in compliance with the Clean Air Act. Management activities are planned at the project level to meet local air quality standards. My decision does not change the direction approved in the 1997 Revised Forest Plan.

(2006) 1997 Revision Phase II Amendment Forest National Forest Land and Resource Management Plan

Objectives:

101. Maintain air quality standards in accordance with state implementation plans.

(2007) Land and Resource Management Plan, Monitoring and Evaluation

Table 8. 2007 Land and resource management plan, monitoring and evaluation, p. IV-4

II. The status of select ecological conditions			
Monitoring item, Monitoring Question(s) and Indicator(s)	**Related Forest Plan Components**	**Frequency of Reporting**	**Data – Protocol – Database**
II-1) Air quality {1} Monitoring Question: To what degree are objectives for management of the air quality resource being met? Indicator: Number of days that implementation of Forest activities (i.e. prescribed burning) meets air quality standards	Obj. 101.	2 years	SD DENR, EPA

National Ambient Air Quality Standards

The Clean Air Act, which was last amended in 1990, requires the Environmental Protection Agency to set National Ambient Air Quality Standards (40 CFR part 50) for six principal pollutants ("criteria" air pollutants), which can be harmful to public health and the environment. The Clean Air Act identifies two types of national ambient air quality standards. ***Primary standards*** provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. ***Secondary standards*** provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

Periodically, the standards are reviewed and sometimes may be revised, establishing new standards. The most recently established standards are listed below. In some areas of the United States, certain regulatory requirements may also remain for implementation of previously established standards.

Units of measure for the National Ambient Air Quality Standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, and micrograms per cubic meter of air (μg/m^3).

Table 9. National Ambient Air Quality Standards (2021)

Pollutant [links to historical tables of NAAQS reviews]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)		primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)		primary and secondary	Rolling 3 month average	0.15 μg/m^3 [1]	Not to be exceeded
Nitrogen Dioxide (NO_2)		primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	1 year	53 ppb [2]	Annual Mean
Ozone (O_3)		primary and secondary	8 hours	0.070 ppm [3]	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	$PM_{2.5}$	primary	1 year	12.0 μg/m^3	annual mean, averaged over 3 years
		secondary	1 year	15.0 μg/m^3	annual mean, averaged over 3 years
		primary and secondary	24 hours	35 μg/m^3	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24 hours	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)		primary	1 hour	75 ppb [4]	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

(1) In areas designated non-attainment for the Pb standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 μg/m^3 as a calendar quarter average) also remain in effect.

(2) The level of the annual NO_2 standard is 0.053 ppm. It is shown here in terms of ppb for the purposes of clearer comparison to the 1-hour standard level.

(3) Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) O_3 standards are not revoked and remain in effect for designated areas. Additionally, some areas may have certain continuing implementation obligations under the prior revoked 1-hour (1979) and 8-hour (1997) O_3 standards.

(4) The previous SO_2 standards (0.14 ppm 24-hour and 0.03 ppm annual) will additionally remain in effect in certain areas:

1. any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and
2. any area for which an implementation plan providing for attainment of the current (2010) standard has not been submitted and approved and which is designated non-attainment under the previous SO_2 standards or is not meeting the requirements of a SIP call under the previous SO_2 standards (40 CFR 50.4(3)). A SIP call is an Environmental Protection Agency action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the required National Ambient Air Quality Standards.

Menu of Control Measures for NAAQS Implementation

The Menu of Control Measures (MCM) provides State, local and Tribal air quality agencies with the existing emission reduction measures as well as relevant information concerning the efficiency and cost effectiveness of the measures. State, local, and Tribal agencies will be able to use this information in developing emission reduction strategies, plans, and programs to assure that they attain and maintain the National Ambient Air Quality Standards (NAAQS). The MCM is a living document that can be updated with newly available or more current data as it becomes available.

Wind Cave National Park IMPROVE Data

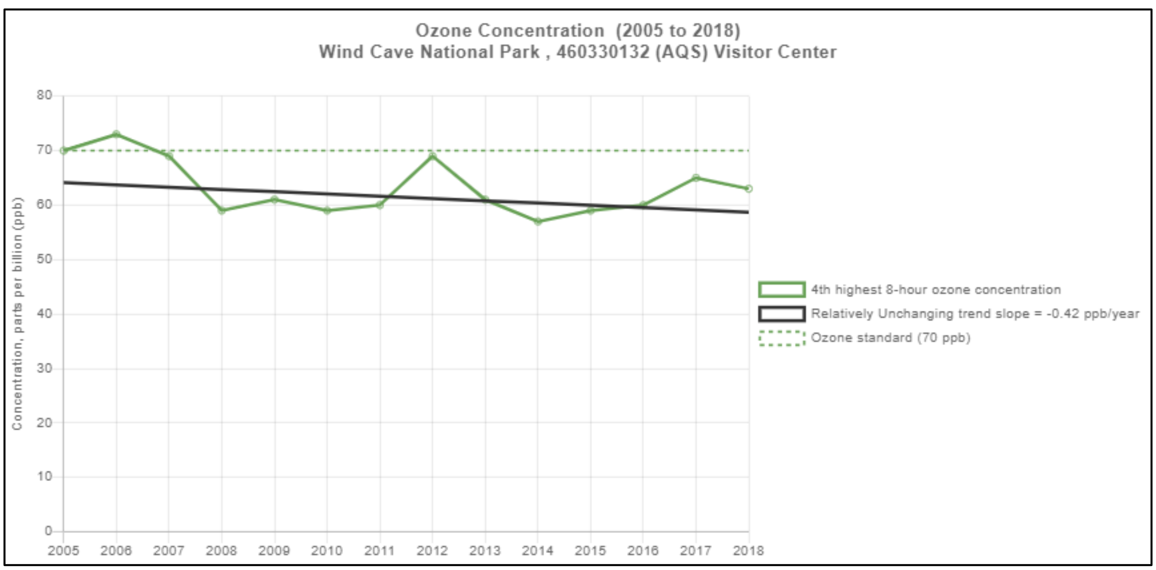

Figure 20. Ozone concentration trend 2005-2018 (parts per billion)

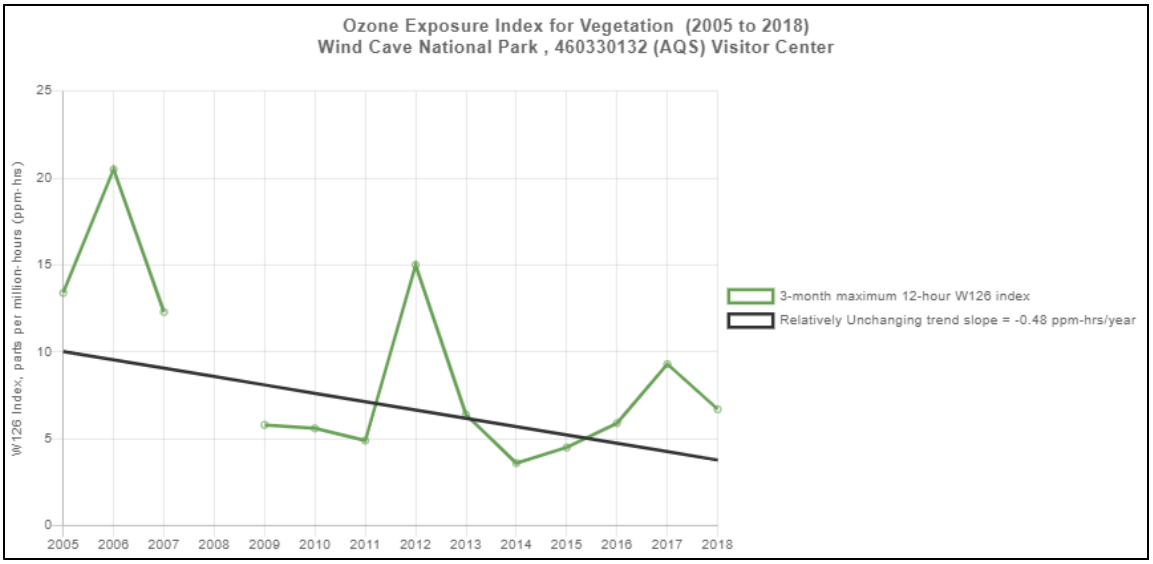

Figure 21. Ozone exposure index for vegetation trend 2005-2018 (parts per million – hours)

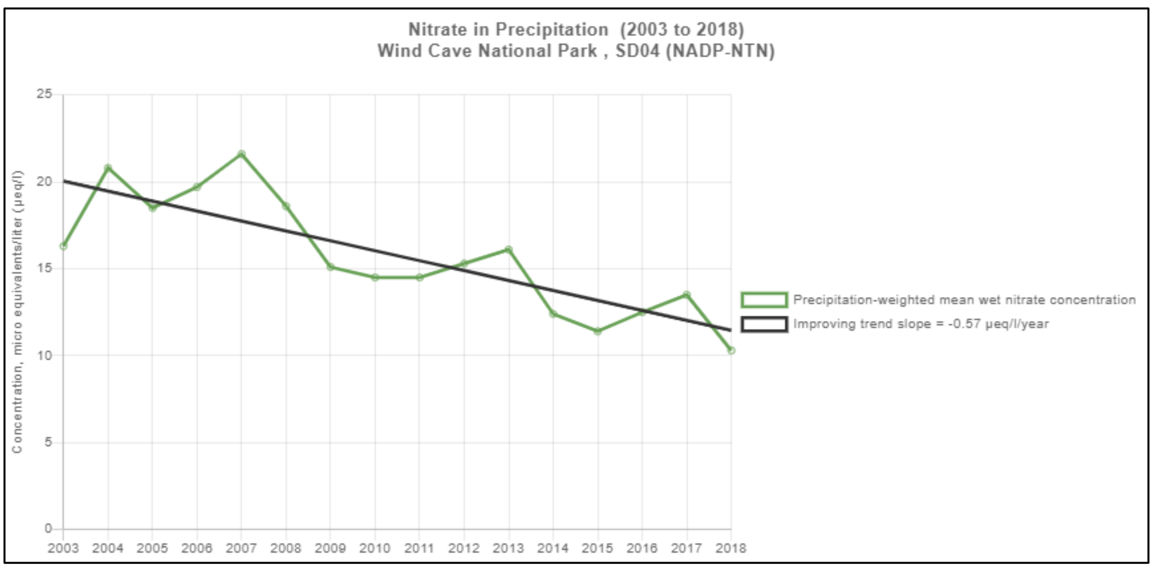

Figure 22. Nitrate in precipitation trend 2003-2018 (micro equivalents per liter)

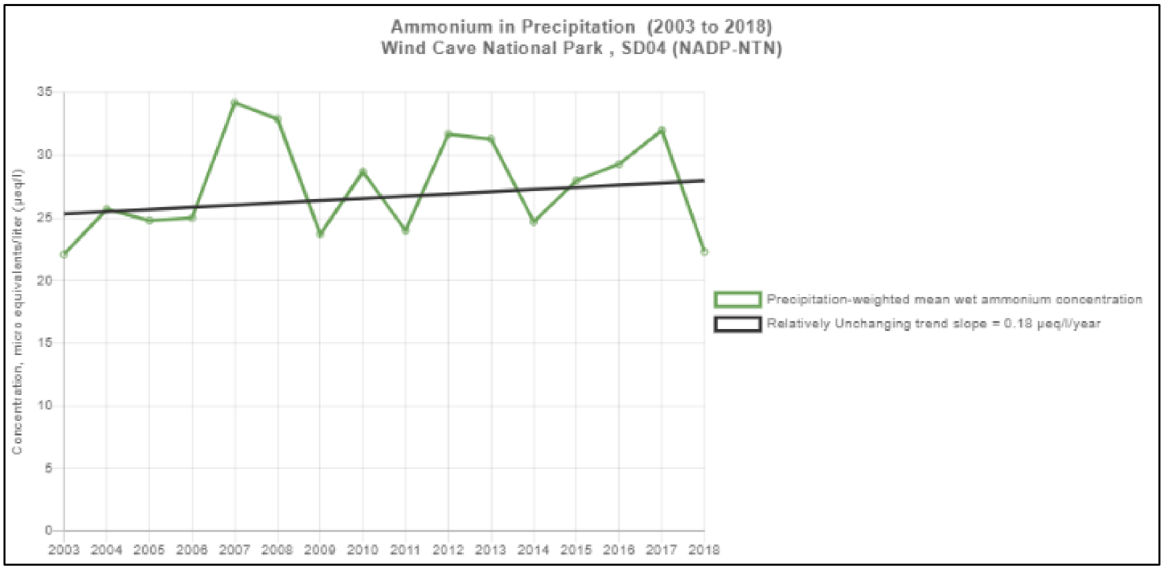

Figure 23. Ammonium in precipitation trend 2003-2018 (micro equivalents per liter)

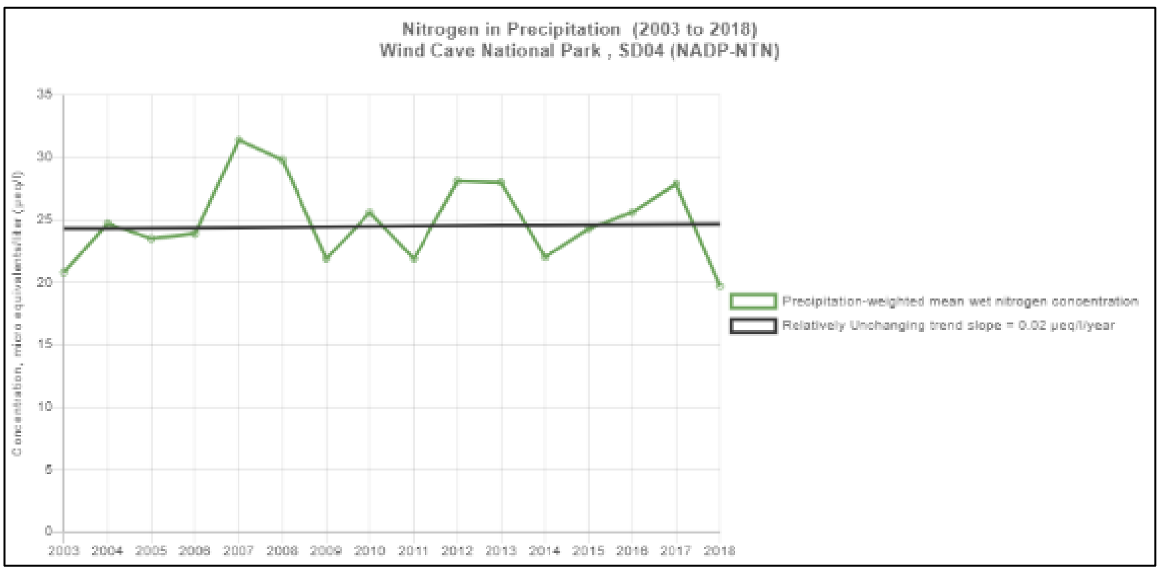

Figure 24. Nitrogen in precipitation trend 2003-2018 (micro equivalents per liter)

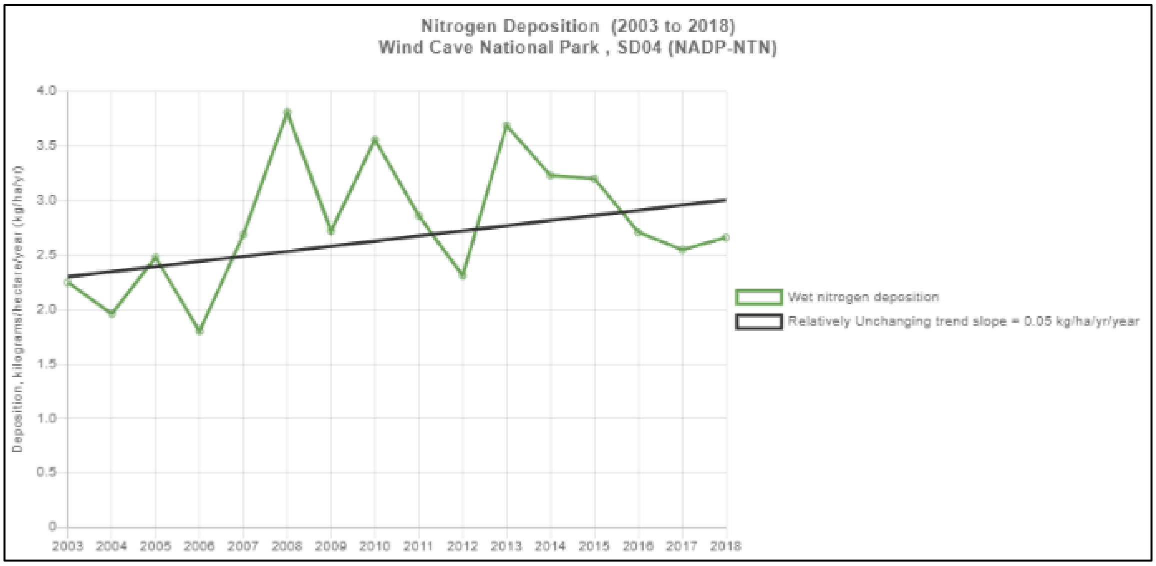

Figure 25. Nitrogen deposition trend 2003-2018 (kilograms per hectare per year)

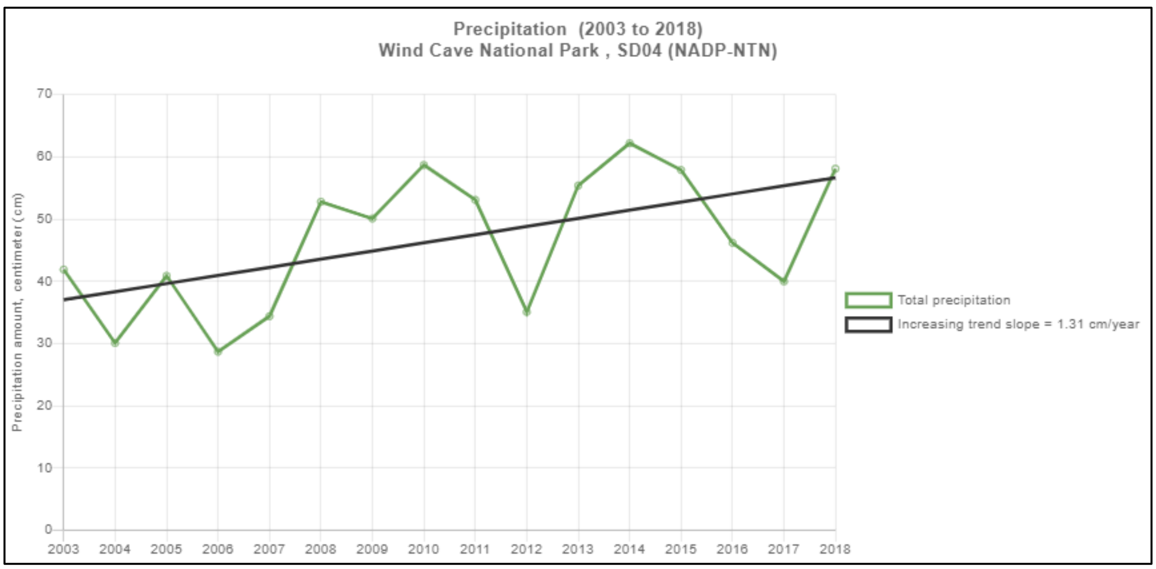

Figure 26. Precipitation trend 2003-2018 (centimeters)

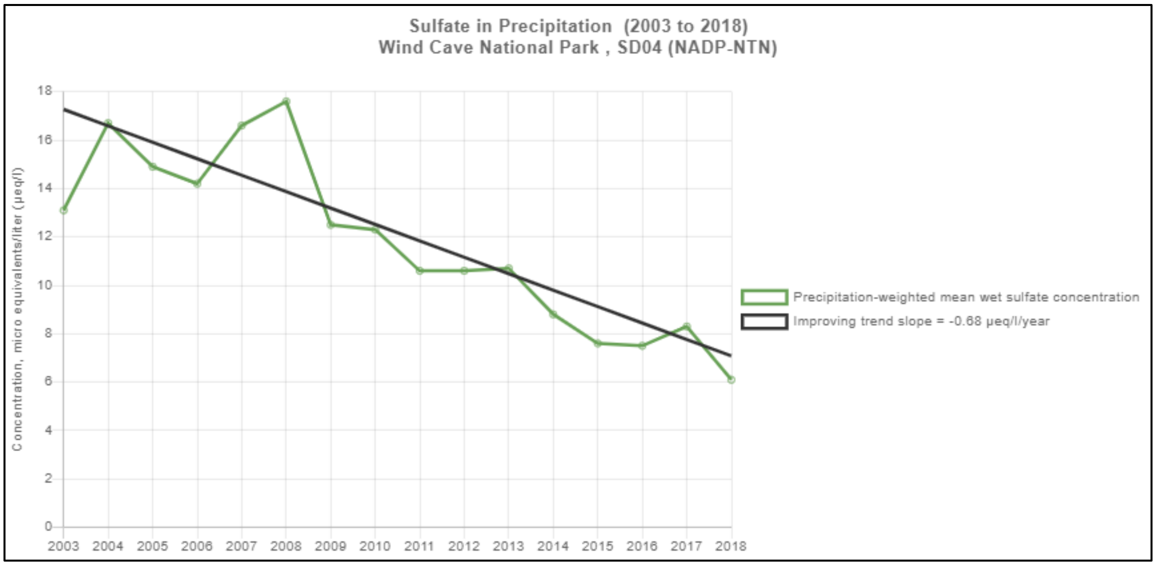

Figure 27. Sulfate in precipitation trend 2003-2018 (micro equivalents per liter)

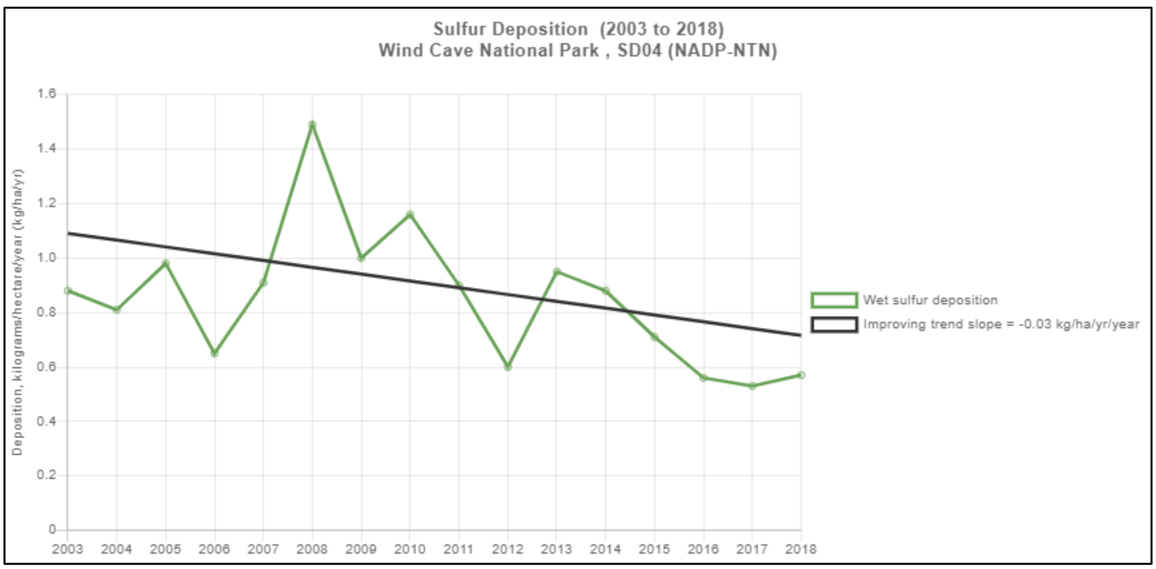

Figure 28. Sulfur deposition trend 2003-2018 (micro equivalents per liter)

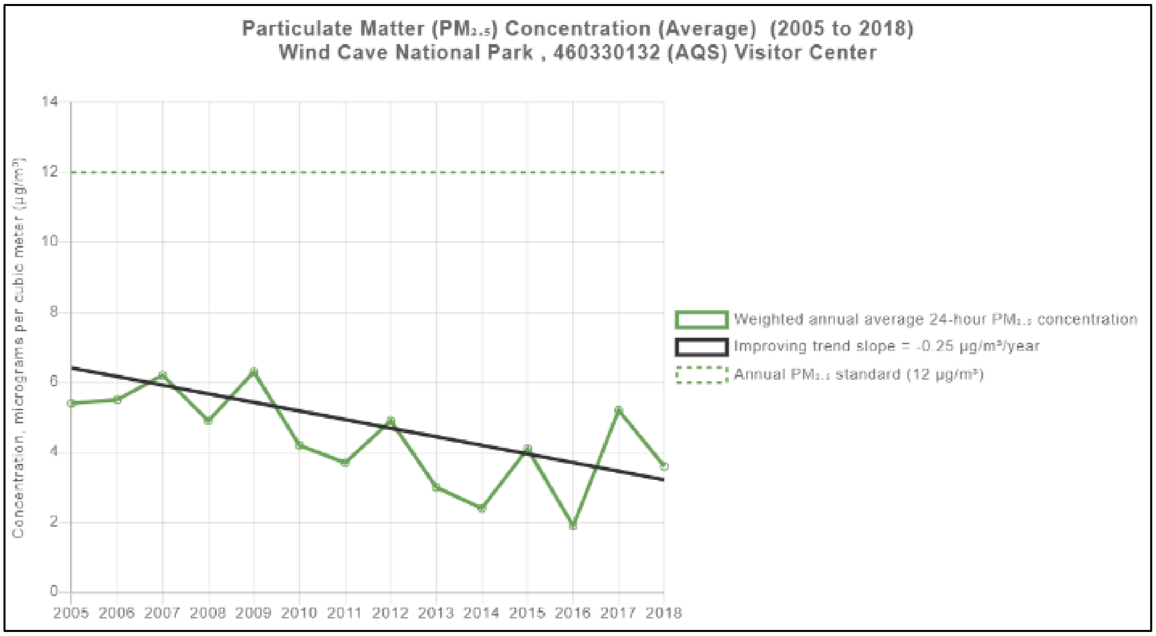

Figure 29. PM2.5 average concentration trend 2005-2018 (micrograms per cubic meter)

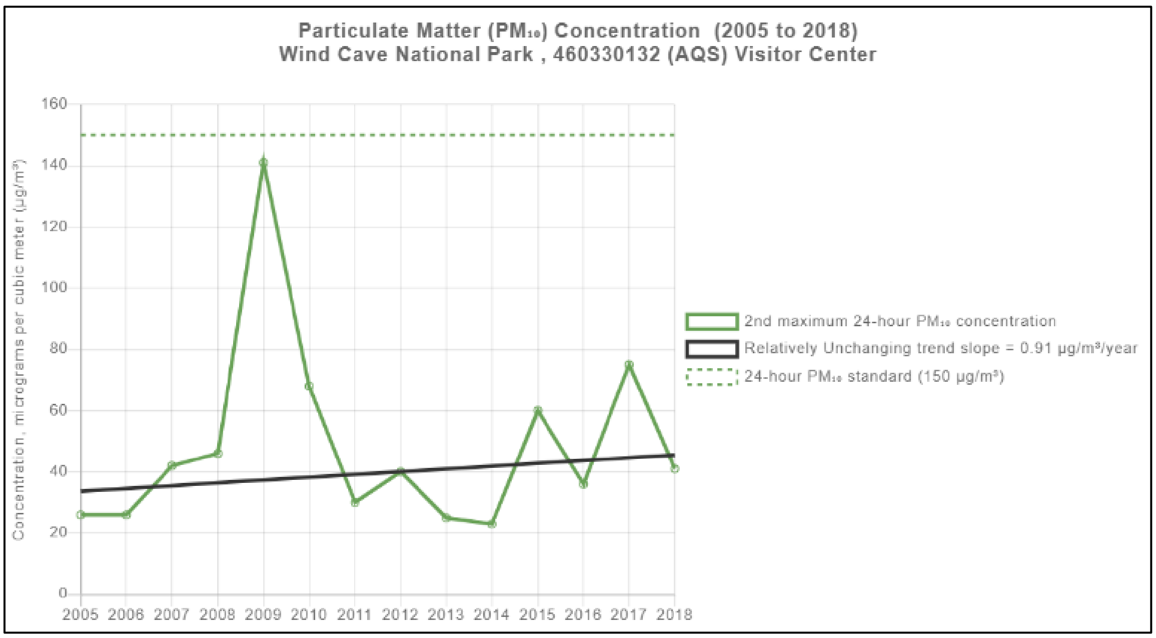

Figure 30. PM10 concentration trend 2005-2018 (micrograms per cubic meter)

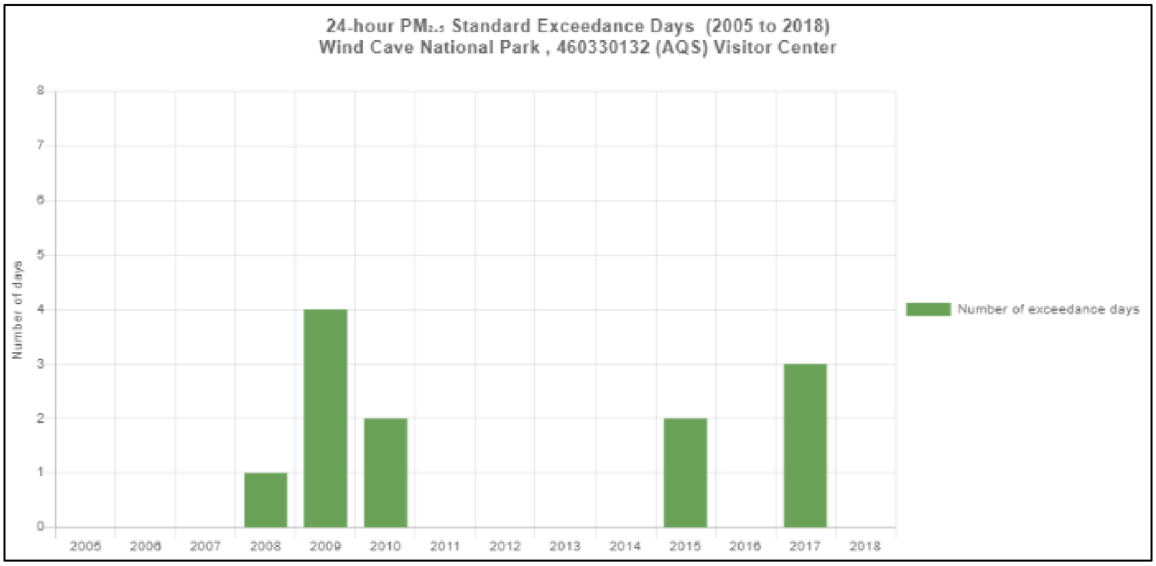

Figure 31. 24-hour PM2.5 standard exceedance days 2005-2018

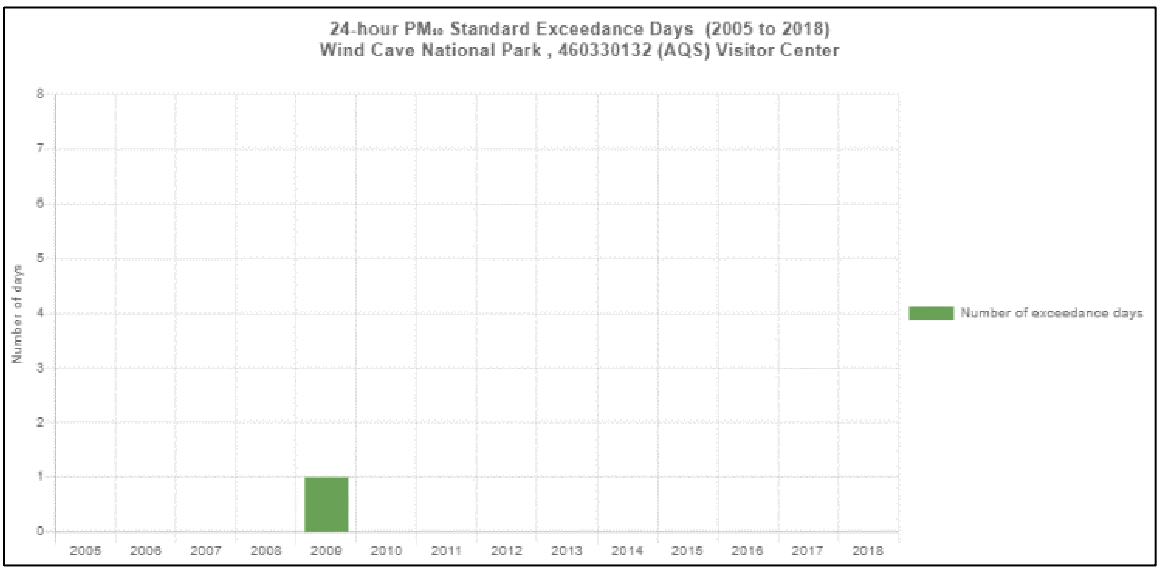

Figure 32. 24-hour PM10 standard exceedance days 2005-2018

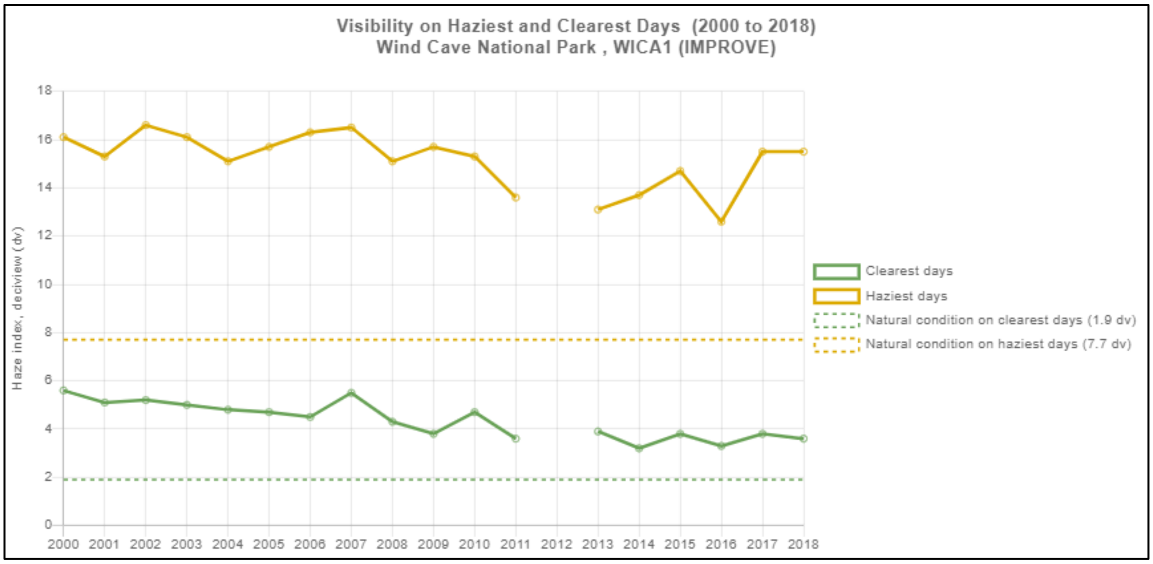

Figure 33. Visibility on haziest and clearest days 2000-2018 (deciviews)

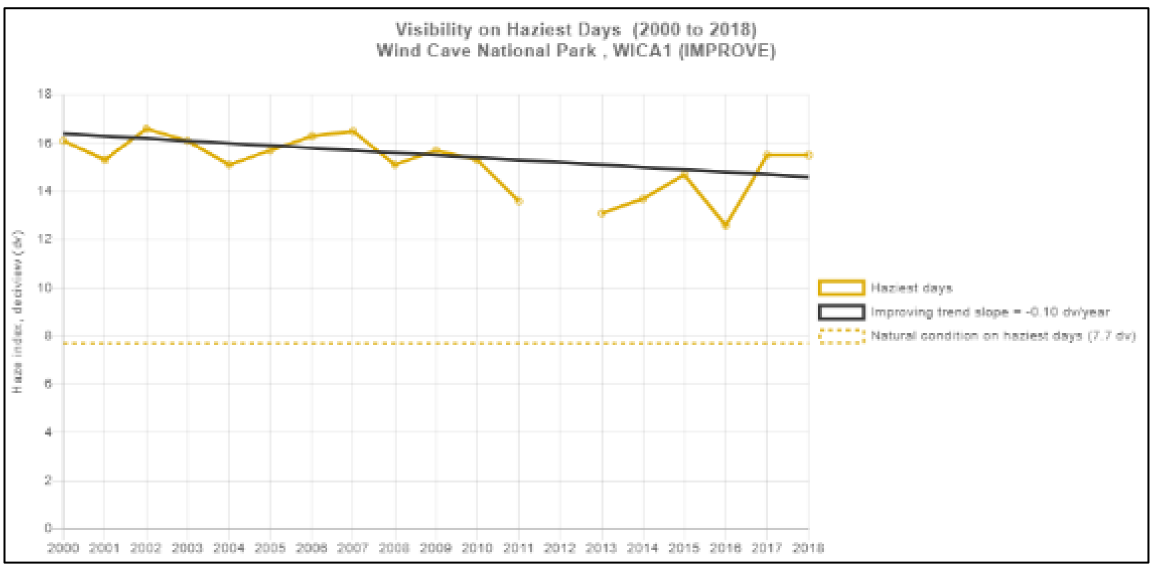

Figure 34. Visibility on haziest days trend 2000-2018 (deciviews)

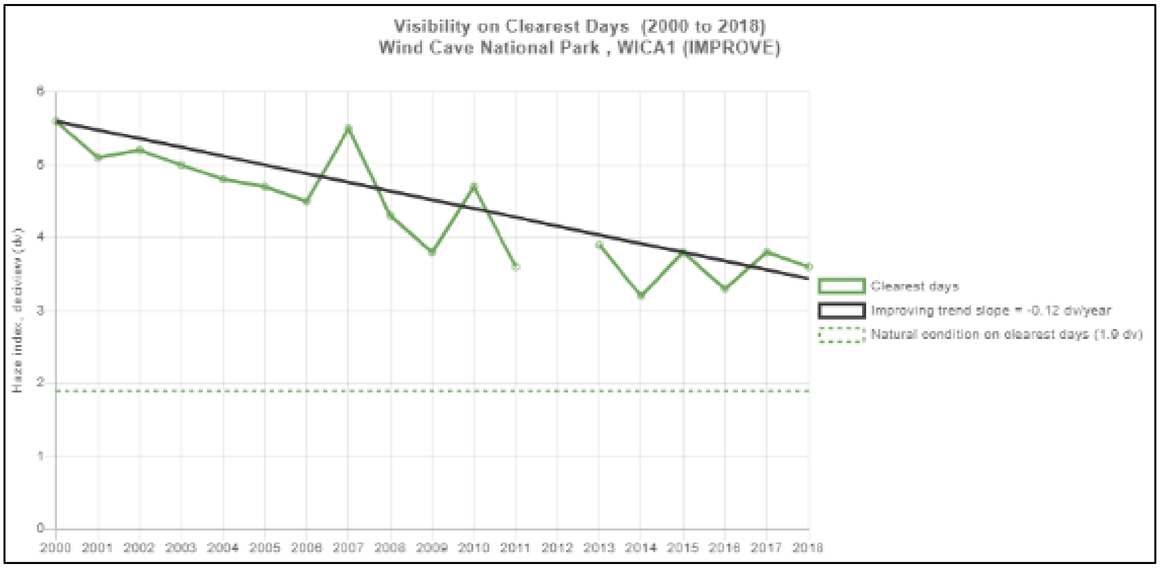

Figure 35. Visibility on clearest days trend 2000-2018 (deciviews)