WYOMING STATE IMPLEMENTATION PLAN

Regional Haze

Addressing Regional Haze Requirements for Wyoming Mandatory Federal Class I Areas Under 40 CFR 51.309(g)

Grand Teton National Park
Yellowstone National Park
Bridger Wilderness
Fitzpatrick Wilderness
North Absaroka Wilderness
Teton Wilderness
Washakie Wilderness

January 7, 2011

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CHAPTER 1
GENERAL PLAN PROVISIONS

Section 169A of the Clean Air Act establishes a national goal for protecting visibility in Federally-protected scenic areas. These Class I areas include national parks and wilderness areas. Regional haze is a type of visibility impairment caused by air pollutants emitted by numerous sources across a broad region. On July 1, 1999, the Environmental Protection Agency (EPA) issued regional haze rules to comply with requirements of the Clean Air Act. Under 40 CFR 51.308, the rule requires the State of Wyoming to develop State Implementation Plans (SIPs) which include visibility progress goals for each of the seven Class I areas in Wyoming, as well as emission reduction strategies and other measures to meet these goals. Under 40 CFR 51.309, the rule also provided an optional approach to Wyoming and eight other western states to incorporate emission reduction strategies issued by the Grand Canyon Visibility Transport Commission (GCVTC) designed primarily to improve visibility in 16 Class I areas on the Colorado Plateau.

On December 29, 2003, the State of Wyoming submitted a visibility SIP to meet the requirements of 40 CFR 51.309. The 2003 309 SIP and subsequent revisions to the 309 SIP address the first phase of requirements, with an emphasis on stationary source SO_2 emission reductions and a focus on improving visibility on the Colorado Plateau. In the 2003 submittal, Wyoming committed to addressing the next phase of visibility requirements and additional visibility improvement in Wyoming's seven Class I areas by means of a State Implementation Plan meeting the requirements in 309(g).

Since the 2003 submittal of the 309 SIP, EPA has revised both 40 CFR 51.308 and 309 in response to numerous judicial challenges. As a result of revisions to the Federal rules, the State of Wyoming submitted revisions to the December 29, 2003, 309 SIP under separate cover, on November 21, 2008.

This 309(g) SIP submission serves as a supplement to the 309 SIP submittal. Pursuant to the requirements of 51.309(g), the State of Wyoming submits this Plan with: a demonstration of expected visibility conditions for the most impaired and least impaired days at the additional mandatory Class I areas; provisions for establishing reasonable progress goals for Wyoming's seven Class I areas complying with 51.308(d)(1)-(4); long-term strategies that build upon emission reduction strategies developed in the first 309 SIP submittal; and finally provisions to address long-term strategies and Best Available Retrofit Technology (BART) requirements for stationary source Particulate Matter (PM) and Nitrogen Oxide (NO_x) emissions pursuant to 51.308(e).

The State of Wyoming commits to participate in a Regional Planning Process with Alaska, Arizona, California, Colorado, Idaho, Montana, New Mexico, North Dakota, Oregon, South Dakota, Utah, and Washington, and commits to continue participation through future SIPs. The Regional Planning Process describes the process, goals, objectives, management and decision making structure, deadlines for completing significant technical analyses and developing emission management strategies and a regulation implementing the recommendations of the regional group. All Western Regional Air Partnership (WRAP) Work Plans and the WRAP

2008-2012 Strategic Plan, which document the Regional Planning Process, are contained in Chapter 1 of the Wyoming Technical Support Document (TSD).

Pursuant to the Tribal Authority Rule, any Tribe whose lands are surrounded by the State of Wyoming have the option to develop a regional haze TIP for their lands to assure reasonable progress in the seven Class I areas in Wyoming. As such, no provisions of this Implementation Plan shall be construed as being applicable to Indian Country.

CHAPTER 2
WYOMING CLASS I AREAS; BASELINE, NATURAL AND CURRENT VISIBILITY CONDITIONS

2.1 Description of the Yellowstone Monitoring Site (YELL2) Class I Areas

The monitoring site designated as "YELL2" is the representative regional haze monitoring station for three Wyoming Class I areas (Grand Teton National Park, Yellowstone National Park and Teton Wilderness). Each of these Class I areas are described below.

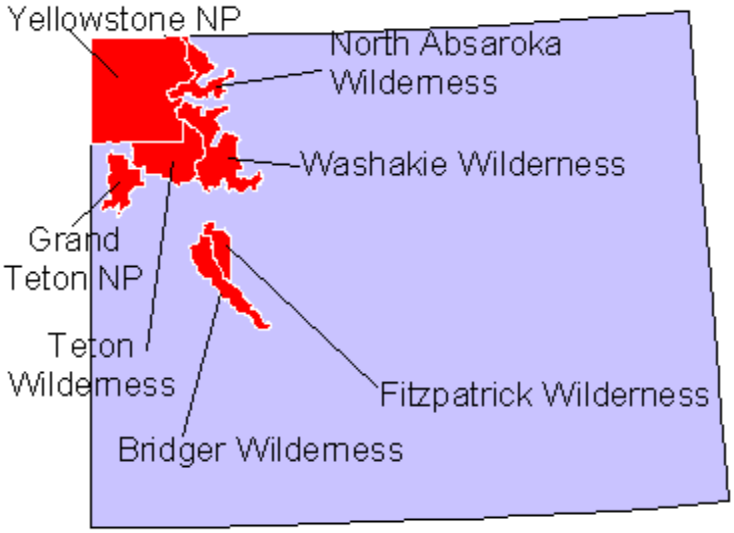


Figure 2.1-1. National Parks and Wilderness Areas in Wyoming (Class I Areas)
(http://www.coha.dri.edu/web/state_analysis/Wyoming/Wyoming.html)

2.1.1 Grand Teton National Park

Figure 2.1.1-1. Mormon Row (Courtesy of National Park Service)

Grand Teton National Park occupies 309,995 acres along the Teton Range and adjacent Jackson Lake. The Teton Range borders the west side of the National Park, with elevations exceeding 12,000 feet, and 13,770 feet at the summit of the Grand Teton. The Teton Range, a 40-mile-long mountain front, was formed from earthquakes that occurred over the past 13 million years along a fault line. The eastern half of the Park consists of Jackson Lake and valley of the upper Snake River. Where the Snake River exits the Park at the south boundary, the elevation is the lowest at 6,800 feet. The Park is adjacent to the Teton Wilderness to the northeast and is 6 miles south of Yellowstone National Park and the headwaters of the Snake River (Figure 2.1-1). Seven glacial lakes lie at the base of the range, while over 100 alpine lakes can be found in the backcountry. Elk, moose, mule deer, bison, pronghorn and black bears can be found in the Park. Grizzlies can also be found, but are located in more remote areas. Over 300 species of birds, including bald eagles, peregrine falcons and trumpeter swans can be observed in the Park.

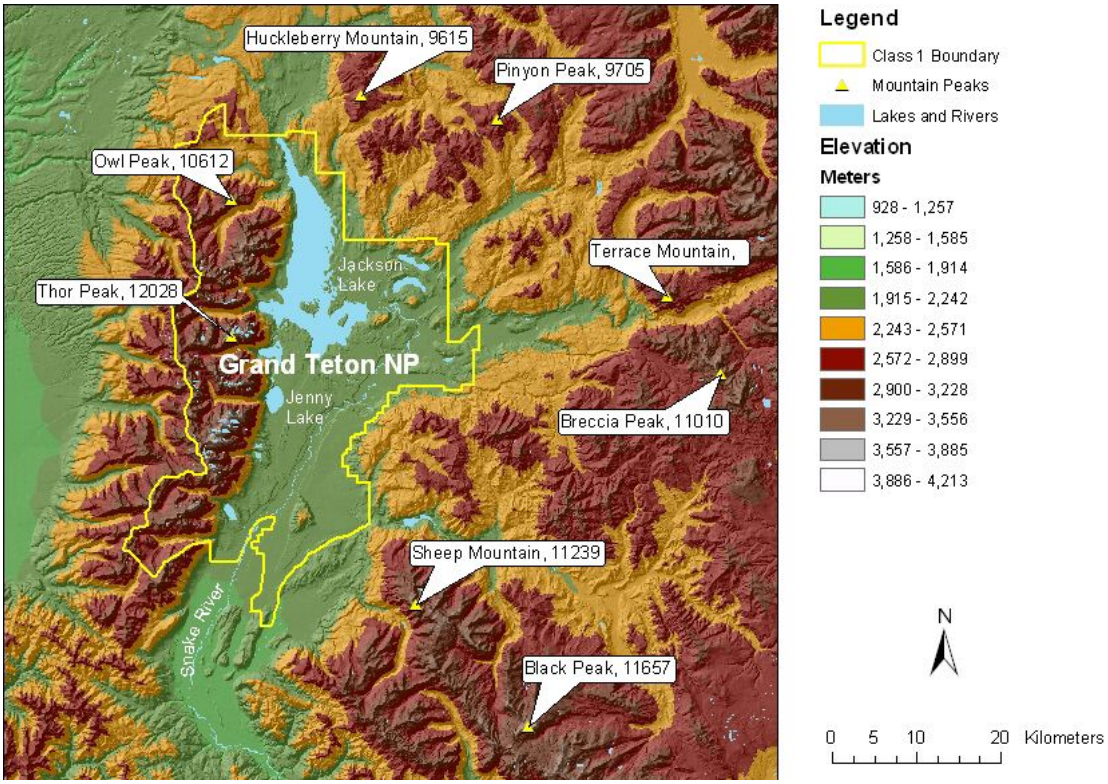


Figure 2.1.1-2. Grand Teton NP Class I Boundary
(http://www.coha.dri.edu/images/clipart/wy_20km_terrain_grandteton.jpg)

2.1.2 Teton Wilderness

Figure 2.1.2-1. Gravel Creek in 1996. Burned in giant Huck Fire of 1988. (Courtesy of Ralph Maughan)
(http://www.forwolves.org/ralph/wpages/tetonwld.htm)

Figure 2.1.2-2. Pendergraft Peak 1991 (Courtesy of U.S. Forest Service)
(http://www.fsvisimages.com/gallery/TETO/start.htm)

The Teton Wilderness encompasses 585,468 acres which straddle the Continental Divide in western Wyoming. It is bordered by Yellowstone National Park to the north, Grand Teton National Park to the west, and the Washakie Wilderness to the east (Figure 2.1-1). Elevations

range from 7,500 to 9,675 feet west of the Continental Divide, while east of the Continental Divide elevations are generally higher with the summit of Younts Peak reaching 12,165 feet. At Two Ocean Pass, Two Ocean Creek straddles the Continental Divide, sending waters to both the Atlantic and the Pacific Oceans. As with Grand Teton National Park, elk, moose, mule deer, bison, pronghorn and black bears can be found in the Teton Wilderness. Bighorn sheep, mountain lions, wolves, grizzlies and at least 75 other mammal species are also found here, as well as over 300 species of birds and 30 species of fish.

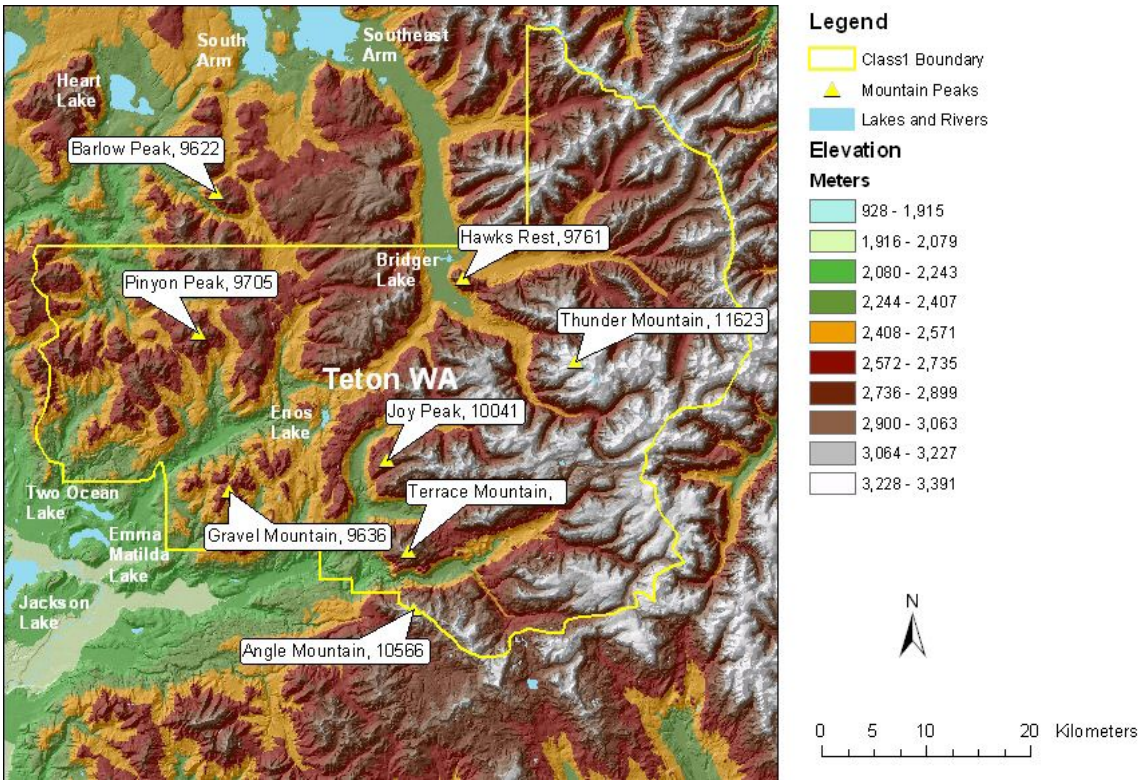


Figure 2.1.2-3. Teton Wilderness Class I Boundary
(http://www.coha.dri.edu/images/clipart/wy_20km_terrain_teton.jpg)

2.1.3 Yellowstone National Park

Figure 2.1.3-1. Hot Pool Near Red Cone Geyser (Courtesy National Park Service)
(http://www.nps.gov/archive/yell/slidefile/thermalfeatures/hotspringsterraces/others/Images/06202.jpg)

Yellowstone National Park became the world's first national park on March 1, 1872, and occupies 2,221,766 acres in northwestern Wyoming, overlapping into Montana and Idaho (Figure 2.1-1). The highest elevation is 11,358 feet at the summit of Eagle Peak on the southeastern Park boundary, while the lowest elevations (5,314 feet) are found where the Yellowstone River exits the Park on the north boundary. Yellowstone Lake is the largest high-altitude lake in North America and is centered over the Yellowstone Caldera, the largest supervolcano on the continent. The caldera, considered an active volcano, has erupted several times in the last two million years. Fifty percent of the world's geothermal features are in Yellowstone, fueled by this ongoing volcanic activity. Wildlife abounds in the Park, with the more common species being elk, bison, grizzlies and wolves. In 2007, approximately 3,151,373 people visited Yellowstone National Park, bringing the total number of visitors to over 142,681,000 since the park opened in 1872.

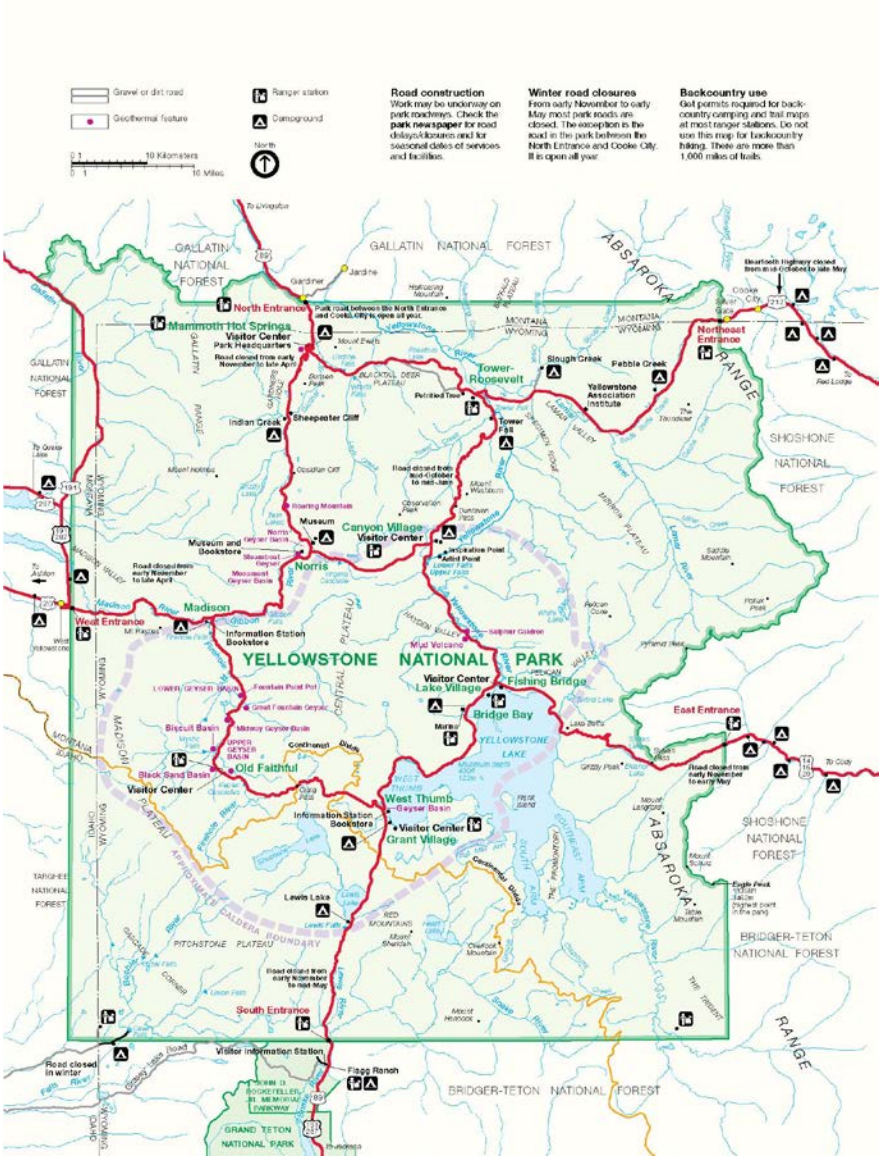


Figure 2.1.3-2. Yellowstone National Park Boundary (Courtesy of National Park Service)
(http://www.nps.gov/carto/PDF/YELLmap2.pdf)

2.1.4 Monitoring Strategy and Location - YELL2 Monitoring Site

The IMPROVE site designated as the monitor representing Grand Teton National Park, Teton Wilderness and Yellowstone National Park is YELL2. The Wyoming Department of Environmental Quality, Air Quality Division (the Division), considers the YELL2 site as adequate for assessing reasonable progress goals of the three above-mentioned Class I areas and no additional monitoring sites or equipment are necessary at this time.

The Air Quality Division routinely participates in the IMPROVE monitoring program by attending Western States Air Resources Council (WESTAR) and Western Regional Air Partnership (WRAP) meetings and maintaining memberships in both organizations.

YELL2 is located in central Yellowstone National Park near the north shore of Yellowstone Lake. It is 37 miles north of Grand Teton National Park, across the Continental headwaters divide between the Yellowstone River and Snake River watersheds. YELL2 is 30 miles north and west of the nearest Teton Wilderness boundary. The YELL2 site elevation is 7,954 feet, which is 220 feet above Yellowstone Lake.

The nearest metropolitan area to the YELL2 monitor, Billings, Montana (over 149,650 population), is situated approximately 124 miles northeast of the monitor. The metropolitan area of Boise, Idaho (over 635,450 population) lies approximately 295 miles to the southwest of the monitor and the metropolitan area of Salt Lake City, Utah (over 1,099,000) is located approximately 273 miles to the southwest.

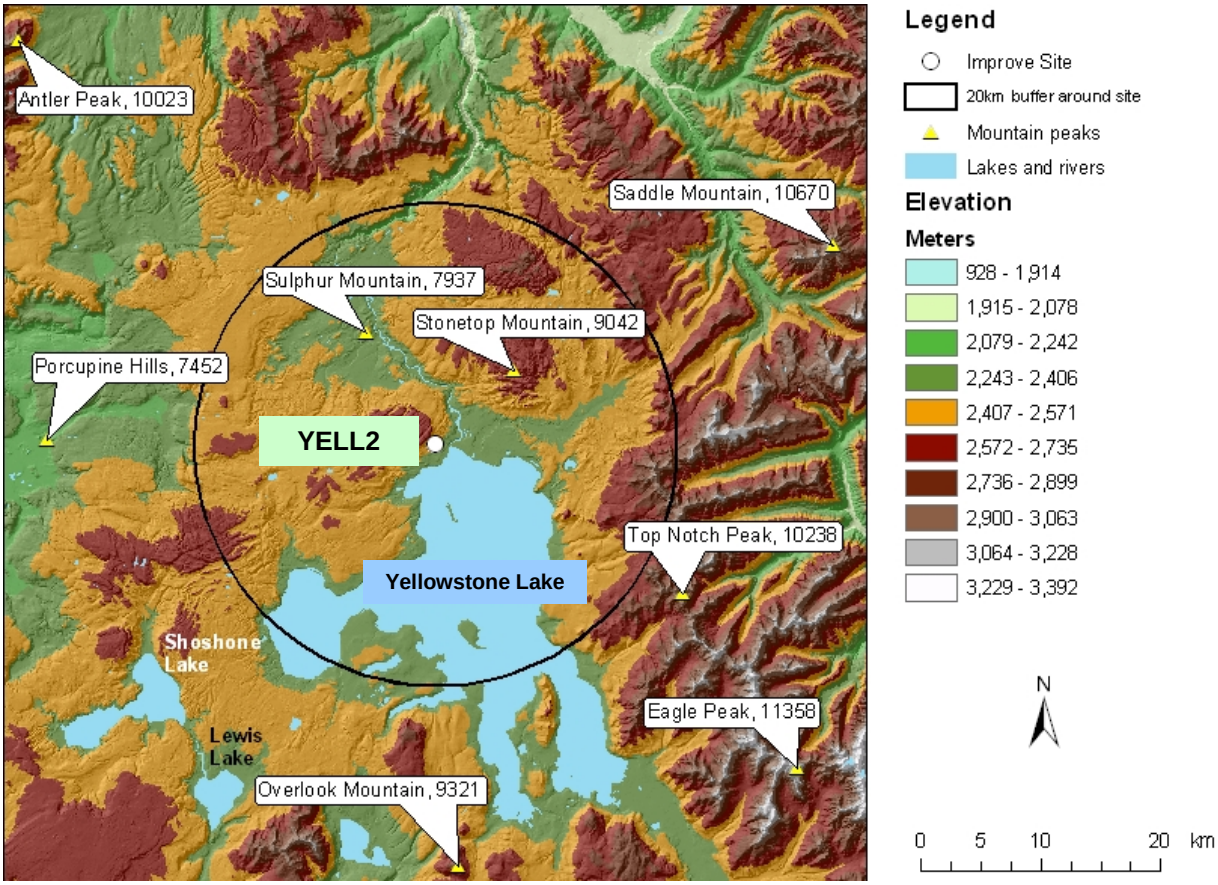


Figure 2.1.4-1. YELL2 Monitoring Site Location
(http://www.coha.dri.edu/images/clipart/wy_20km_terrain_yellowstone.jpg)

Figure 2.1.4-2. Looking South Toward the YELL2 Monitor
(http://vista.cira.colostate.edu/views/Web/SiteBrowser/SiteBrowser.aspx)

2.1.5 Assessment of Baseline, Natural and Current Conditions - YELL2 Class I Areas

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, Grand Teton National Park, Teton Wilderness and Yellowstone National Park Class I areas have an established natural visibility of 0.43 deciviews for the 20 percent best days and 6.44 deciviews for the 20 percent worst days. This is based on on-site data at the YELL2 IMPROVE monitoring site.

Baseline visibility is determined from the YELL2 monitoring site (located in central Yellowstone Park) for the 20 percent best and 20 percent worst days for the years 2000 through 2004 as specified in the Regional Haze regulations under 40 CFR 51.308(d)(2)(i). The baseline visibility for Grand Teton National Park, Teton Wilderness and Yellowstone National Park Class I areas is 2.58 deciviews for the 20 percent best days and 11.76 deciviews for the 20 percent worst days, which, for this first SIP submittal, is also the same as the current visibility. These best and worst 20 percent conditions are also calculated based on EPA guidance. This technical information was obtained from the "Haze Planning" section of the Western Regional Air Partnership (WRAP) Technical Support System (TSS) by choosing the "Monitoring" section followed by the "Deciview Glide Slope" information at http://vista.cira.colostate.edu/tss/. Further description of this technical information can be found in Chapter 13.

Photographs representing similar visibility conditions on best and worst days for baseline and natural conditions are included in Figures 2.1.5-1 through 2.1.5-4.

Baseline Best Days

Vista Reference: Avalanche Peak (Yellowstone National Park)

Photo Taken at 9:00 AM

Haze Index (HI) = 3 Deciviews

B_{ext} = 14 Mm^{-1}

Visual Range = 280 km/174 mi

Figure 2.1.5-1. YELL2 Monitor - Baseline Best Days
http://vista.cira.colostate.edu/Datawarehouse/IMPROVE/Data/Photos/YELL/start.htm

Baseline Worst Days

Vista Reference: Avalanche Peak (Yellowstone National Park)

Photo Taken at 9:00 AM

Haze Index (HI) = 12 Deciviews

B_{ext} = 33 Mm^{-1}

Visual Range = 120 km/75 mi

Figure 2.1.5-2. YELL2 Monitor - Baseline Worst Days
http://vista.cira.colostate.edu/Datawarehouse/IMPROVE/Data/Photos/YELL/start.htm

Natural Best Days

Vista Reference: Avalanche Peak (Yellowstone National Park)

Photo Taken at 9:00 AM

Haze Index (HI) = 0 Deciview

B_{ext} = 10 Mm^{-1}

Visual Range = 390 km/242 mi

Figure 2.1.5-3. YELL2 Monitor - Natural Best Days
http://vista.cira.colostate.edu/Datawarehouse/IMPROVE/Data/Photos/YELL/start.htm

Natural Worst Days

Vista Reference: Avalanche Peak (Yellowstone National Park)

Photo Taken at 9:00 AM

Haze Index (HI) = 6 Deciviews

B_{ext} = 18 Mm^{-1}

Visual Range = 220 km/137 mi

Figure 2.1.5-4. YELL2 Monitor - Natural Worst Days
http://vista.cira.colostate.edu/Datawarehouse/IMPROVE/Data/Photos/YELL/start.htm

2.2 Description of the North Absaroka Monitoring Site (NOAB1) Class I Areas

The monitoring site designated as "NOAB1" is the representative regional haze monitoring station for two Wyoming Class I areas (North Absaroka Wilderness and Washakie Wilderness). Each of these Class I areas are described below.

2.2.1 North Absaroka Wilderness

Figure 2.2.1-1. Pilot and Index Peaks (Courtesy of Wikipedia and National Park Service)
(http://commons.wikimedia.org/wiki/User:MONGO/Public_Domain_Images)

The North Absaroka Wilderness is part of the Greater Yellowstone Area of northwestern Wyoming, located along the northeastern boundary of Yellowstone National Park, east of the Continental Divide, and occupies 350,488 acres (Figure 2.1-1). Elevations range from approximately 7,200 feet to more than 10,000 feet on several summits, with the highest elevation being 12, 216 feet on Dead Indian Peak. The terrain is very rugged and mountainous and dissected by numerous creeks. Only a few lakes exist, but the streams contain cutthroat, brown, brook, and rainbow trout. The wilderness is home to grizzly bears, and big-game hunters come by the hundreds for bighorn sheep, elk, and moose. Marmots and pikas dominate many of the talus slopes.

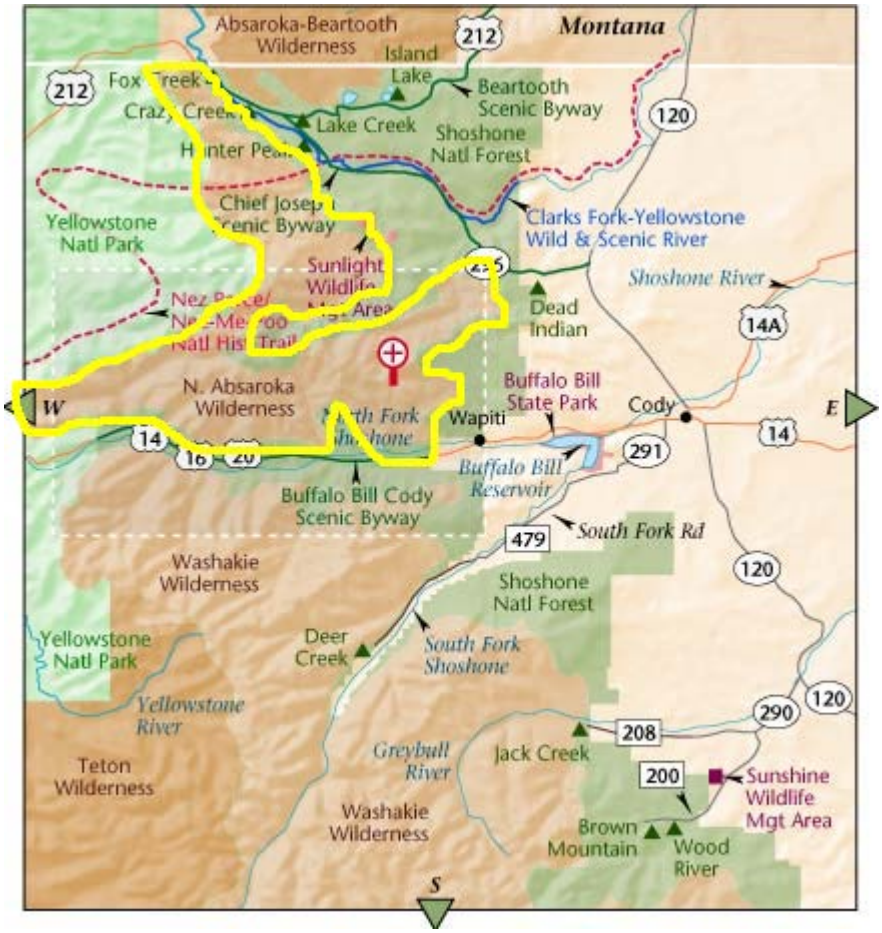


Figure 2.2.1-2. North Absaroka Wilderness Boundary

http://www.publiclands.org/explore/quadrant_map.php?id=1560&site_name=North%20Absaroka%20Wilderness&quad=WY_Q2&PHPSESSID=23cfeb7c9

2.2.2 Washakie Wilderness

Figure 2.2.2-1. Piney Creek With Part of Carter Mountain at Head of Canyon (Courtesy of Ralph Maughan)
(http://www.forwolves.org/ralph/wpages/washakie.htm)

The Washakie Wilderness Area encompasses 704,529 acres around the headwaters of the South Fork of the Shoshone River in northwestern Wyoming. It is bordered on the west by the Teton Wilderness and Yellowstone National Park, and the North Absaroka Wilderness Area lies to the north across the North Fork of the Shoshone River (Figure 2.1-1). Elevations range from approximately 6,000 feet to 13,153 feet (Francs Peak) on the eastern boundary. Terrain is rugged and difficult to maneuver in many areas of this wilderness. Wildlife is bountiful, with mule deer, white-tailed deer, moose, elk, grizzly and black bear, pronghorns and bighorn sheep being some of the more common species. This area has fewer lakes than some of the other areas, so fishing opportunities are more limited. However, there are several streams and rivers which do support trout.

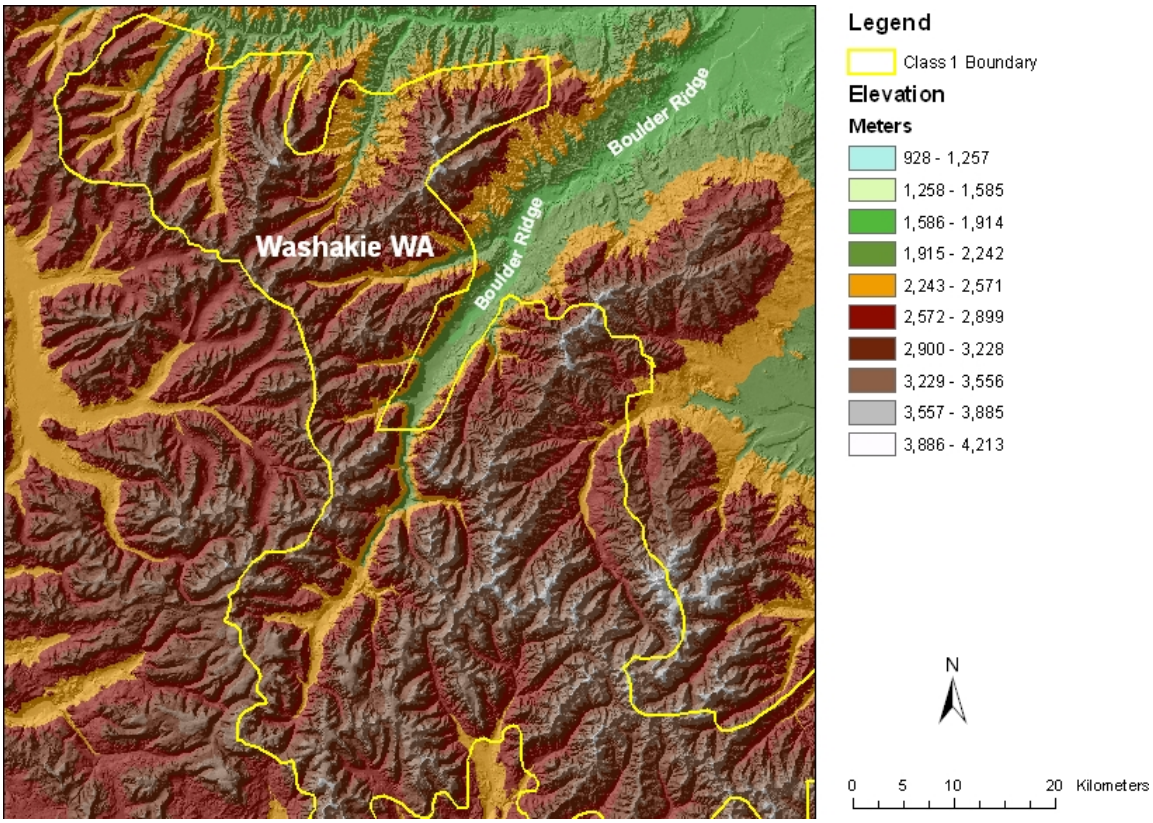


Figure 2.2.2-2. Washakie Wilderness Class I Area Boundary
(http://www.coha.dri.edu/images/clipart/wy_20km_terrain_washakie.jpg)

2.2.3 Monitoring Strategy and Location - NOAB1 Monitoring Site

The IMPROVE site designated as the monitor representing the North Absaroka and Washakie Wilderness Areas is NOAB1. Collection of data at the NOAB1 monitoring site is subsidized by the Wyoming Department of Environmental Quality. The Division considers the NOAB1 site as adequate for assessing reasonable progress goals of the two above-mentioned Class I areas and no additional monitoring sites or equipment are necessary at this time.

The Air Quality Division routinely participates in the IMPROVE monitoring program by attending Western States Air Resources Council (WESTAR) and Western Regional Air Partnership (WRAP) meetings and maintaining memberships in both organizations.

NOAB1 is located in Dead Indian Pass, approximately 25 miles northwest of Cody, Wyoming and about 3 miles northeast of the closest North Absaroka Wilderness Area boundary. It is 25 miles north of the Washakie Wilderness boundary. The NOAB1 monitoring site elevation is 8,134 feet, which is 538 feet below the summit of Dead Indian Hill to the northeast and 66 feet above Dead Indian Pass and State Highway SR 296.

The nearest metropolitan area to the NOAB1 monitor, Billings, Montana (over 149,650 population), is situated approximately 83 miles northeast of the monitor. The metropolitan area of Boise, Idaho (over 635,450 population) lies approximately 348 miles to the southwest of the

monitor and the metropolitan area of Salt Lake City, Utah (over 1,099,000) is located approximately 301 miles to the southwest.

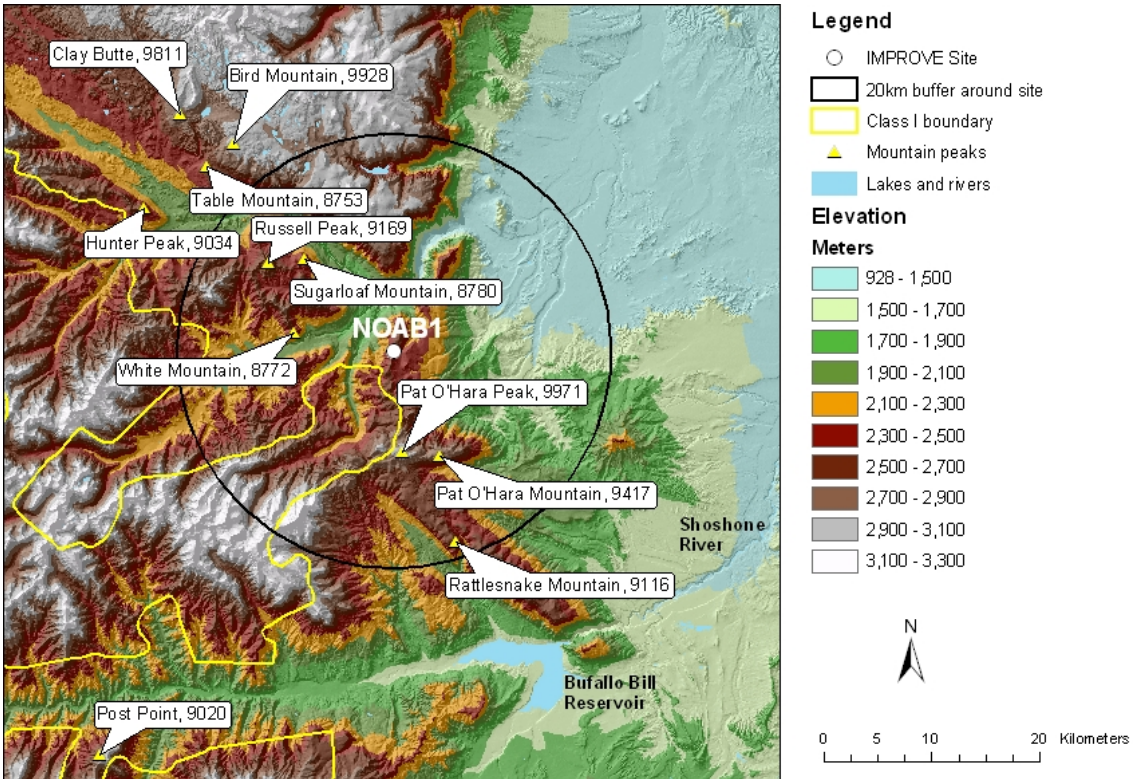


Figure 2.2.3-1. NOAB1 Monitoring Site
http://www.coha.dri.edu/images/clipart/wy_20km_terrain_northabsaroka.jpg

Figure 2.2.3-2. Looking South Toward the NOAB1 Monitor
(http://vista.cira.colostate.edu/views/Web/SiteBrowser/SiteBrowser.aspx)

2.2.4 Assessment of Baseline, Natural and Current Conditions - NOAB1 Class I Areas

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the North Absaroka Wilderness and Washakie Wilderness Class I areas have an established natural visibility of 0.58 deciviews for the 20 percent best days and 6.83 deciviews for the 20 percent worst days. This is based on on-site data at the NOAB1 IMPROVE monitoring site.

Baseline visibility is determined from the NOAB1 monitoring site (located in Dead Indian Pass, about 25 miles northwest of Cody, Wyoming) for the 20 percent best and 20 percent worst days for the years 2002 through 2004 as specified in the Regional Haze regulations under 40 CFR 51.308(d)(2)(i). The baseline visibility for the North Absaroka and Washakie Wilderness Class I areas is 2.02 deciviews for the 20 percent best days and 11.45 deciviews for the 20 percent worst days, which, for this first SIP submittal, is also the same as the current visibility. These best and worst 20 percent conditions are also calculated based on EPA guidance. This technical information was obtained from the "Haze Planning" section of the Western Regional Air Partnership (WRAP) Technical Support System (TSS) by choosing the "Monitoring" section followed by the "Deciview Glide Slope" information at http://vista.cira.colostate.edu/tss/. Further description of this technical information can be found in Chapter 13.

The historic visibility photo record is limited and does not include the North Absaroka or Washakie Wilderness areas. Photos depicting similar visibility scenarios from the Bridger Wilderness (Mt. Bonneville) have been substituted as Figures 2.2.4-1 through 2.2.4-4 for the baseline and natural conditions on the best and worst days.

Baseline Best Days

Vista Reference: Mt. Bonneville (Bridger Wilderness)

Photo Taken at 9:00 AM

Haze Index (HI) = 2 Deciviews

B_{ext} = 12 Mm^{-1}

Visual Range = 330 km/205 mi

Figure 2.2.4-1. BRID1 Monitor - Baseline Best Days
http://vista.cira.colostate.edu/Datawarehouse/IMPROVE/Data/Photos/BRID/start.htm

Baseline Worst Days

Vista Reference: Mt. Bonneville (Bridger Wilderness)

Photo Taken at 9:00 AM

Haze Index (HI) = 11 Deciviews

B_{ext} = 30 Mm^{-1}

Visual Range = 130 km/81 mi

Figure 2.2.4-2. BRID1 Monitor - Baseline Worst Days
http://vista.cira.colostate.edu/Datawarehouse/IMPROVE/Data/Photos/BRID/start.htm

Natural Best Days

Vista Reference: Mt. Bonneville (Bridger Wilderness)

Photo Taken at 9:00 AM

Haze Index (HI) = 1 Deciview

B_{ext} = 11 Mm^{-1}

Visual Range = 350 km/217 mi

Figure 2.2.4-3. BRID1 Monitor - Natural Best Days
http://vista.cira.colostate.edu/Datawarehouse/IMPROVE/Data/Photos/BRID/start.htm

Natural Worst Days

Vista Reference: Mt. Bonneville (Bridger Wilderness)

Photo Taken at 9:00 AM

Haze Index (HI) = 7 Deciviews

B_{ext} = 20 Mm^{-1}

Visual Range = 200 km/124 mi

Figure 2.2.4-4. BRID1 Monitor - Natural Worst Days
http://vista.cira.colostate.edu/Datawarehouse/IMPROVE/Data/Photos/BRID/start.htm

2.3 Description of the Bridger Monitoring Site (BRID1) Class I Areas

The monitoring site designated as "BRID1" is the representative regional haze monitoring station for two Wyoming Class I areas (Bridger Wilderness and Fitzpatrick Wilderness). Each of these Class I areas are described below.

2.3.1 Bridger Wilderness

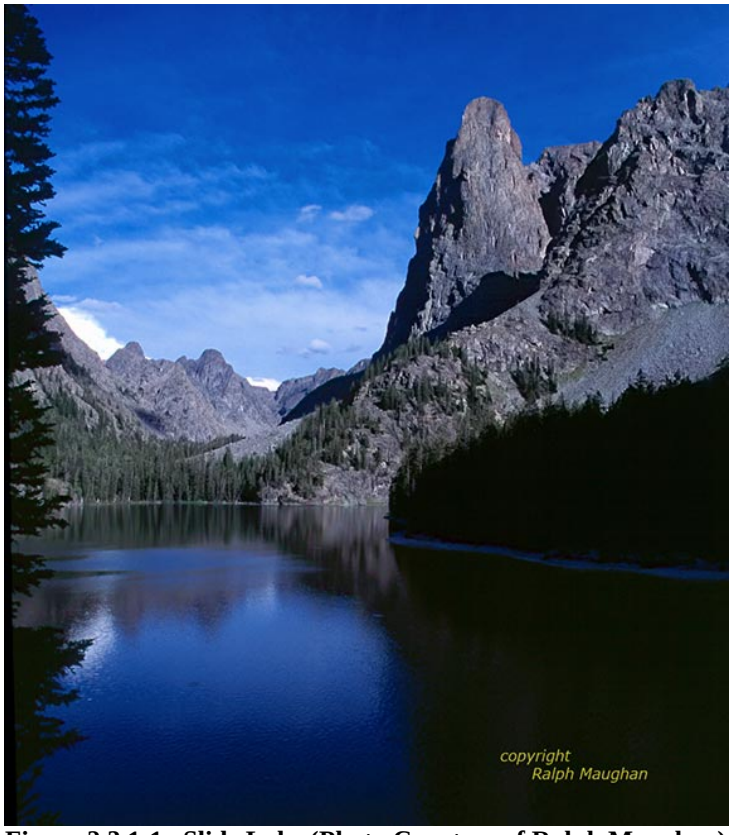


Figure 2.3.1-1. Slide Lake (Photo Courtesy of Ralph Maughan)
(http://www.forwolves.org/ralph/wpages/bridger.htm)

The Bridger Wilderness, consisting of 428,169 acres, is situated on the west slope of the Wind River Range in Wyoming and extends approximately 80 miles along the western slope of the Continental Divide. The wilderness lies south of the other six Class I areas and is on the west border of the Fitzpatrick Wilderness (Figure 2.1-1). The Bridger Wilderness is a combination of jagged granite rock, alpine forest and open alpine meadows and is the headwaters for the Green River. This wilderness forms a triple divide for three major watersheds: the Columbia River, the Colorado River, and the Missouri River. The Wind River Range contains numerous peaks, some exceeding 13,000 feet, the highest of which is Gannett Peak (13,804 feet) located on the boundary between the Bridger Wilderness and the adjacent Fitzpatrick Wilderness to the east. This wilderness contains seven of the ten largest glaciers in the U.S. (lower 48). Some of the more common species found in the Bridger Wilderness are mule deer, moose, elk, bighorn sheep, gray wolf, and both grizzly and black bear.

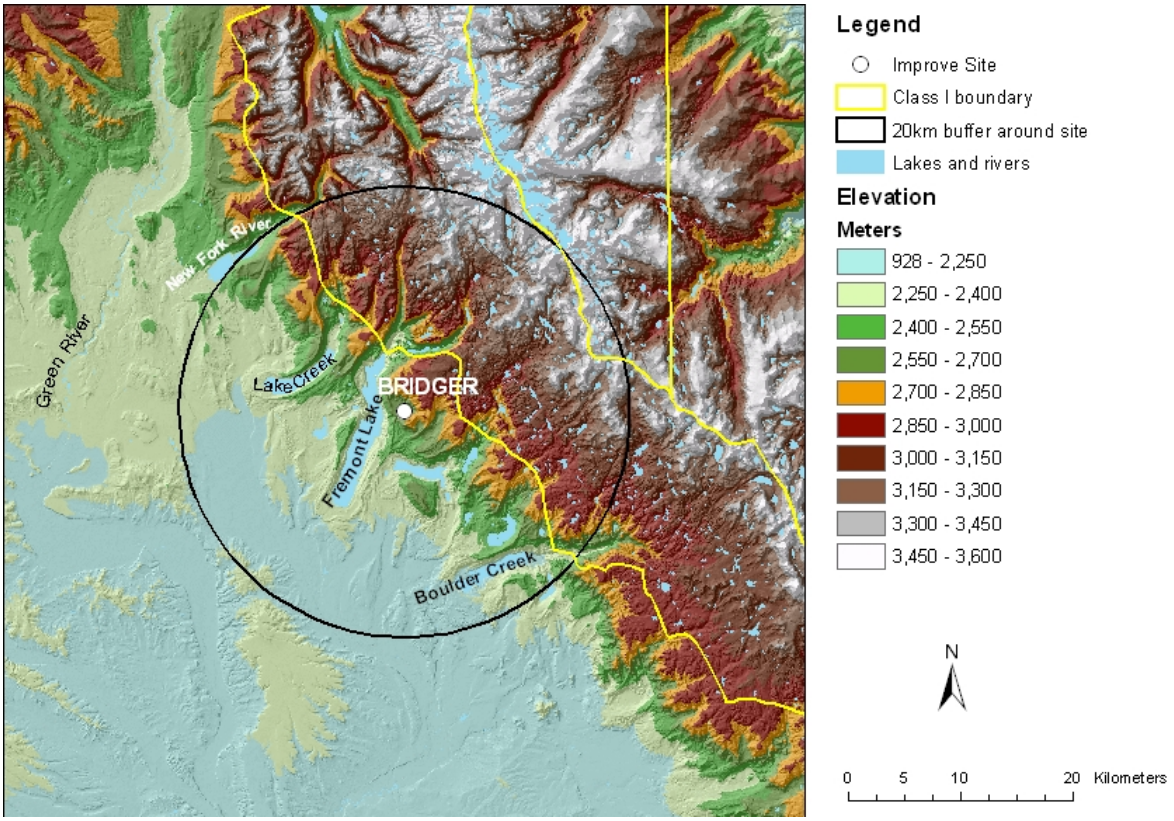


Figure 2.3.1-2. Bridger Wilderness Monitoring Site and Partial Boundary
http://www.coha.dri.edu/images/clipart/wy_20km_terrain_bridger.jpg

Figure 2.3.1-3. Bridger Wilderness Boundary
http://www.publiclands.org/explore/quadrant_map.php?id=1742&site_name=Bridger%20Wilderness&quad=WY_Q8

2.3.2 Fitzpatrick Wilderness

Figure 2.3.2-1. The Wind Rivers From the Wind River Indian Reservation (Courtesy of Ralph Maughan)
http://www.forwolves.org/ralph/wpages/graphics/fitzpatrick1.jpg

The Fitzpatrick Wilderness Area (191,103 acres) is located on the east slope of the northern Wind River Range in Wyoming along the Continental Divide, which makes up its western border. It shares its western border with the Bridger Wilderness Area, while its eastern border is shared with the Wind River Indian Reservation. Elevations range from approximately 5,575 feet at the western side of the upper Wind River Basin at river level to east slope elevations of 8,200 feet. Gannett Peak claims the highest elevation (13,804 feet) and is on the Divide boundary between the Fitzpatrick Wilderness and the adjacent Bridger Wilderness to the east. Precipitous canyons formed by glaciers from granite and limestone rock are found throughout the area. Alpine meadows, stands of timber and rocky plateaus are also common sights. There are more than 60 lakes and at least 75 miles of streams which tout excellent trout fishing. Abundant wildlife includes elk, mule deer, moose, bighorn sheep, black bear, bobcats and coyotes.

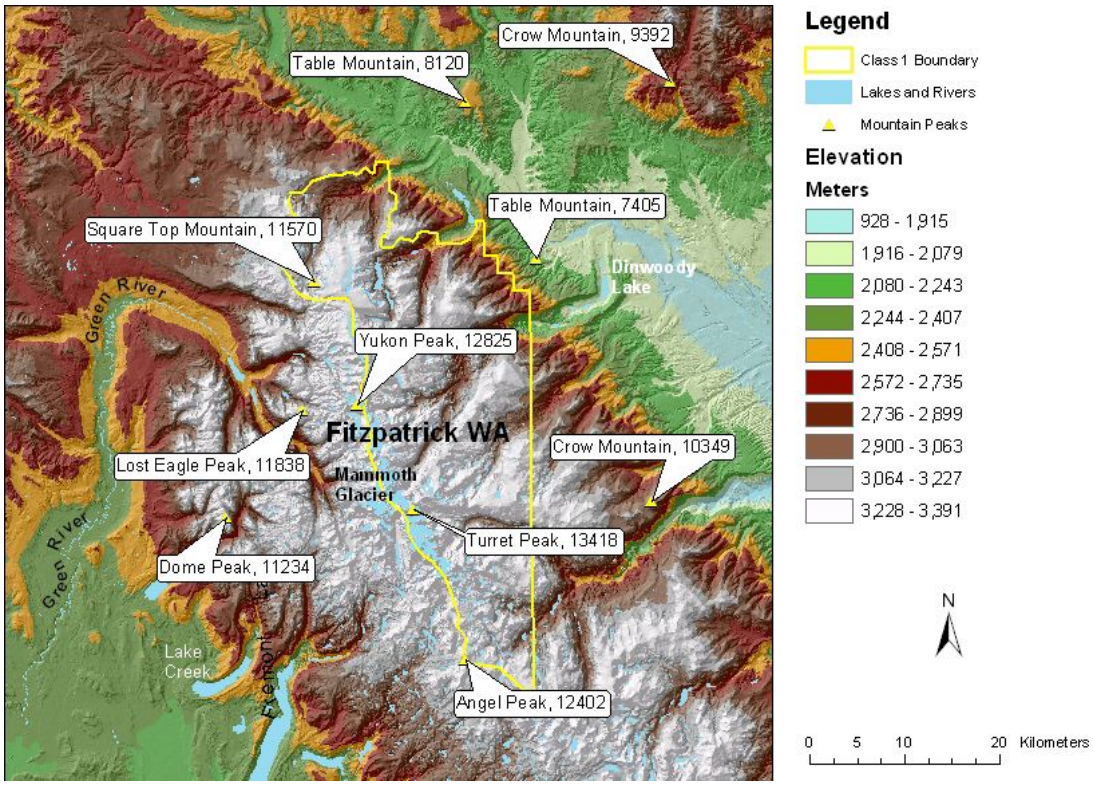


Figure 2.3.2-2. Fitzpatrick Wilderness Class I Boundary
http://www.coha.dri.edu/images/clipart/wy_20km_terrain_fitzpatrick.jpg

2.3.3 Monitoring Strategy and Location - BRID1 Monitoring Site

The IMPROVE site designated as the monitor representing the Bridger and Fitzpatrick Wilderness Areas is BRID1. The Division considers the BRID1 site as adequate for assessing reasonable progress goals of the two above-mentioned Class I areas and no additional monitoring sites or equipment are necessary at this time.

The Air Quality Division routinely participates in the IMPROVE monitoring program by attending Western States Air Resources Council (WESTAR) and Western Regional Air Partnership (WRAP) meetings and maintaining memberships in both organizations.

BRID1 is located at the White Pine Ski Area, 10 miles northeast of Pinedale, Wyoming and approximately 2 miles outside of the southwestern Bridger Wilderness boundary. The monitoring site sits on a small hilltop in a high basin on the west slope of the Wind River Range at an elevation of 8,553 feet. The site is approximately 1,148 feet above Fremont Lake which lies slightly over 1 mile to the west, and about the same distance below the elevation of the nearest Bridger Wilderness boundary to the northeast. BRID1 is approximately 1,378 feet higher than the upper Green River Basin town of Pinedale.

The nearest metropolitan area to the BRID1 monitor, Salt Lake City, Utah (over 1,099,000), is located approximately 187 miles to the southwest. The metropolitan area of Billings, Montana (over 149,650 population), lies approximately 203 miles to the northeast of the monitor and the

metropolitan area of Boise, Idaho (over 635,450 population), is situated approximately 329 miles southwest of the monitor.

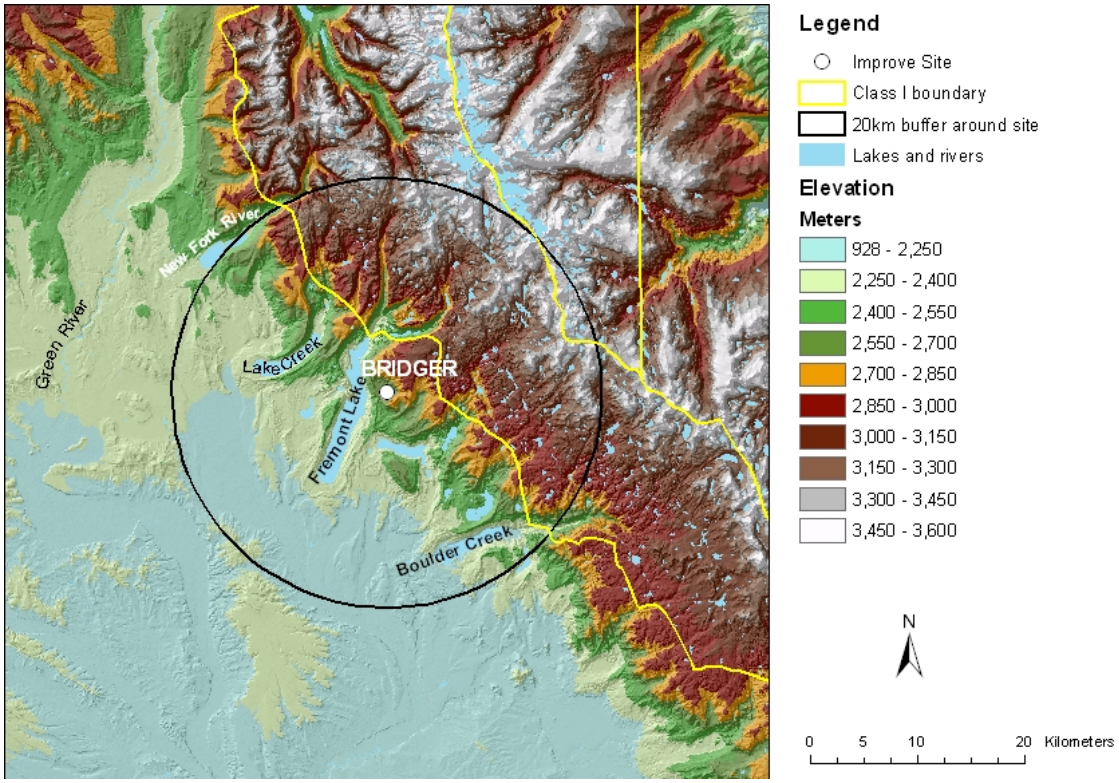


Figure 2.3.3-1. BRID1 Monitoring Site
http://www.coha.dri.edu/images/clipart/wy_20km_terrain_bridger.jpg

Figure 2.3.3-2. Looking North Toward BRID1 Monitor
http://vista.cira.colostate.edu/Images/Photos/IMPROVE/BRID1/BRID1_2005_N_IN.JPG

2.3.4 Assessment of Baseline, Natural and Current Conditions - BRID1 Class I Areas

Natural visibility represents the visibility condition that would be experienced in the absence of human-caused impairment. Based on EPA guidance, the Bridger and Fitzpatrick Wilderness Class I areas have an established natural visibility of 0.28 deciviews for the 20 percent best days and 6.45 deciviews for the 20 percent worst days. This is based on on-site data at the BRID1 IMPROVE monitoring site.

Baseline visibility is determined from the BRID1 monitoring site (located at the White Pine Ski Area, 10 miles northeast of Pinedale, Wyoming) for the 20 percent best and 20 percent worst days for the years 2000 through 2004 as specified in the Regional Haze regulations under 40 CFR 51.308(d)(2)(i). The baseline visibility for the Bridger and Fitzpatrick Wilderness Class I areas is 2.1 deciviews for the 20 percent best days and 11.12 deciviews for the 20 percent worst days, which, for this first SIP submittal, is also the same as the current visibility. These best and worst 20 percent conditions are also calculated based on EPA guidance. This technical information was obtained from the "Haze Planning" section of the Western Regional Air Partnership (WRAP) Technical Support System (TSS) by choosing the "Monitoring" section followed by the "Deciview Glide Slope" information at http://vista.cira.colostate.edu/tss/. Further description of this technical information can be found in Chapter 13.

Photographs representing similar visibility conditions on best and worst days for baseline and natural conditions are included in Figures 2.3.4-1 through 2.3.4-4.

Baseline Best Days

Vista Reference: Mt. Bonneville (Bridger Wilderness)

Photo Taken at 9:00 AM

Haze Index (HI) = 2 Deciviews

B_{ext} = 12 Mm^{-1}

Visual Range = 330 km/205 mi

Figure 2.3.4-1. BRID1 Monitor - Baseline Best Days
http://vista.cira.colostate.edu/Datawarehouse/IMPROVE/Data/Photos/BRID/start.htm

Baseline Worst Days

Vista Reference: Mt. Bonneville (Bridger Wilderness)

Photo Taken at 9:00 AM

Haze Index (HI) = 11 Deciviews

B_{ext} = 30 Mm^{-1}

Visual Range = 130 km/81 mi

Figure 2.3.4-2. BRID1 Monitor - Baseline Worst Days
http://vista.cira.colostate.edu/Datawarehouse/IMPROVE/Data/Photos/BRID/start.htm

Natural Best Days

Vista Reference: Mt. Bonneville (Bridger Wilderness)

Photo Taken at 9:00 AM

Haze Index (HI) = 1 Deciview

B_{ext} = 11 Mm^{-1}

Visual Range = 350 km/217 mi

Figure 2.3.4-3. BRID1 Monitor - Natural Best Days
http://vista.cira.colostate.edu/Datawarehouse/IMPROVE/Data/Photos/BRID/start.htm

Natural Worst Days

Vista Reference: Mt. Bonneville (Bridger Wilderness)

Photo Taken at 3:00 PM

Haze Index (HI) = 6 Deciviews

B_{ext} = 18 Mm^{-1}

Visual Range = 220 km/137 mi

Figure 2.3.4-4. BRID1 Monitor - Natural Worst Days
http://vista.cira.colostate.edu/Datawarehouse/IMPROVE/Data/Photos/BRID/start.htm

CHAPTER 3
POLLUTANTS CAUSING VISIBILITY IMPAIRMENT IN WYOMING CLASS I AREAS

This chapter provides a summary of regional haze monitoring data from the IMPROVE monitoring sites in Wyoming, and the pollutants that affect visibility impairment in each of Wyoming's Class I areas. A summary of the visibility improvement needed from baseline (2000-2004) to the 2018 uniform rate of progress (URP) milestone, and to the 2064 natural condition goal is also provided. Depictions of Wyoming IMPROVE monitoring sites are provided in Chapter 2.

The haze index (*HI*) in deciview (dv) units, as discussed in EPA's 2003 Guidance for Tracking Progress Under the Regional Haze Rule, is a visibility metric based on the light-extinction coefficient that expresses incremental changes in perceived visibility. A change in the *HI* of one dv is approximately equal to a 10% change in extinction coefficient. The haze index is defined by:

$$HI = 10\ln(b_{ext}/10)$$

The value of the haze index is approximately zero dv for a pristine atmosphere. This value increases as visibility degrades.

EPA's 2003 guidance for calculating light extinction is based on the original protocol defined by the IMPROVE program in 1988. In December 2005, the IMPROVE Steering Committee voted to adopt a revised algorithm for use by IMPROVE as an alternative to the original approach.

The revised algorithm for estimating light extinction is calculated as recommended for use by the IMPROVE steering committee using the following equations:

$$\begin{aligned} b_{ext} \approx\ & 2.2 \times f_s(RH) \times [\text{Small Amm. Sulfate}] + 4.8 \times f_L(RH) \times [\text{Large Amm. Sulfate}] \\ & + 2.4 \times f_s(RH) \times [\text{Small Amm. Nitrate}] + 5.1 \times f_L(RH) \times [\text{Large Amm. Nitrate}] \\ & + 2.8 \times [\text{Small POM}] + 6.1 \times [\text{Large POM}] \\ & + 10 \times [\text{EC}] \\ & + 1 \times [\text{Soil}] \\ & + 1.7 \times f_{ss}(RH) \times [\text{Sea Salt}] \\ & + 0.6 \times [\text{CM}] \\ & + 0.33 \times [NO_2(\text{ppb})] \\ & + \text{Rayleigh Scattering (Site Specific)} \end{aligned}$$

The revised algorithm splits ammonium sulfate, ammonium nitrate, and POM concentrations into small and large size fractions as follows:

$$\text{For } [\text{Total}] < 20\mu g/m^3 \begin{cases} [\text{Large}] = \dfrac{[\text{Total}]}{20} \times [\text{Total}] \\ [\text{Small}] = [\text{Total}] - [\text{Large}] \end{cases}$$

$$\text{For } [\text{Total}] \geq 20\mu g/m^3, [\text{Large}] = [\text{Total}]$$

Chapter 13 provides additional information on light extinction.

The following table identifies the different pollutant species that contribute to haze, and their abbreviations, as they appear in the figures in this section. References to sulfate and nitrate in this section are intended to reflect ammonium sulfate and ammonium nitrate, respectively.

Table 3-1. IMPROVE Monitor Aerosol Composition

Pollutant		IMPROVE Abbreviation
	Ammonium Nitrate	ammno3f_bext
	Ammonium Sulfate	ammso4f_bext
	EC (Elemental Carbon)	ecf_bext
	OMC (Organic Mass Carbon)	omcf_bext
	CM (Coarse Mass)	cm_bext
	Soil (Fine Soil)	soilf_bext
	Sea Salt	seasalt_bext

The figures which follow in this chapter provide information for each Class I area (based on representative IMPROVE monitoring site) for the 20% best and 20% worst days during the baseline period, monthly averages of all monitored days, and the improvement needed by 2018 and 2064.

Figures 3-1 and 3-2 summarize the distribution of pollutant species in Wyoming's Class I areas, for the current (2000-2004 baseline) 20% best and 20% worst days.

Figure 3-1. Light Extinction by Pollutant Species for Wyoming Class I Areas 20% Best Days (2000-2004)

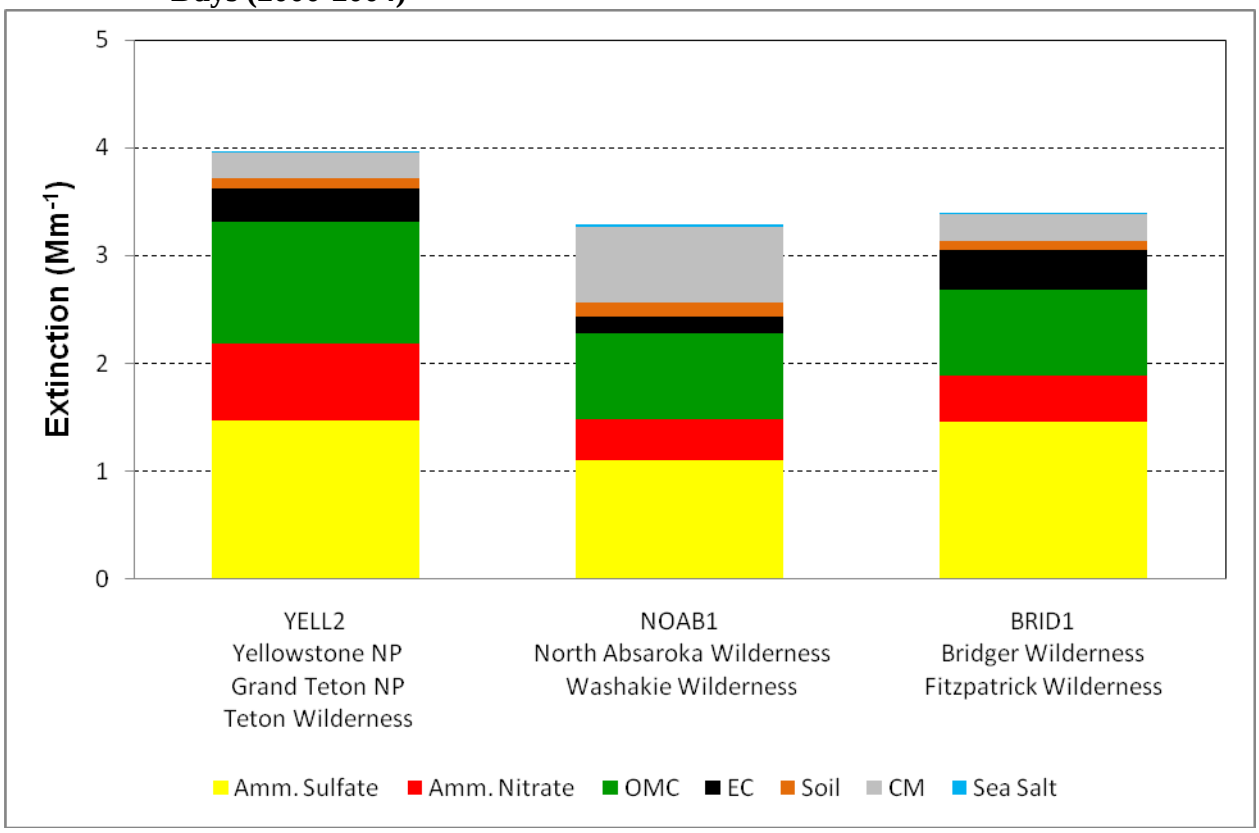
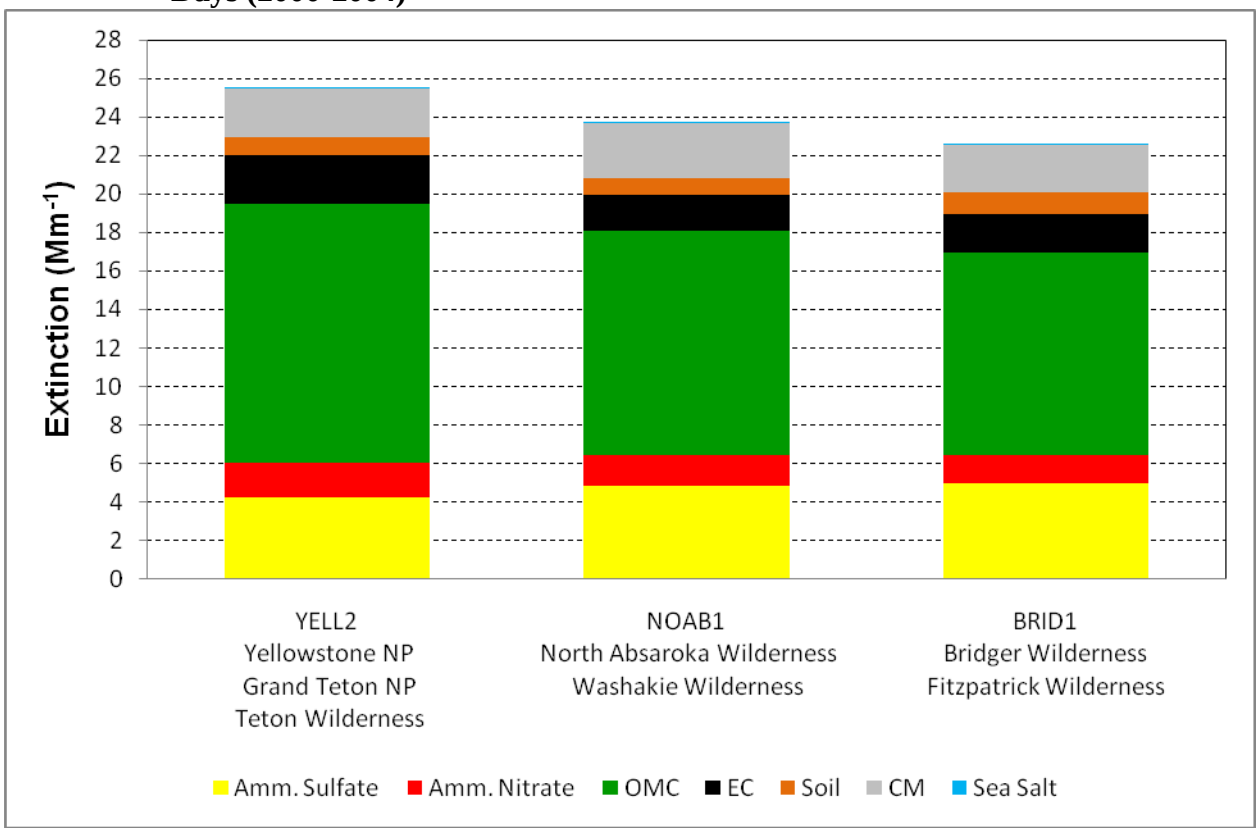


Figure 3-2. Light Extinction by Pollutant Species for Wyoming Class I Areas 20% Worst Days (2000-2004)



As the above figures indicate, Wyoming's Class I areas are dominated by sulfate and organic carbon on the 20% best days, and organic carbon and sulfate on the 20% worst days. On the 20% best days, sulfate is significant in all of the Class I areas. The majority of this can be attributed to point sources. On the 20% worst days, organic carbon is the most significant species in all of the Class I areas, with natural fire having the largest contribution.

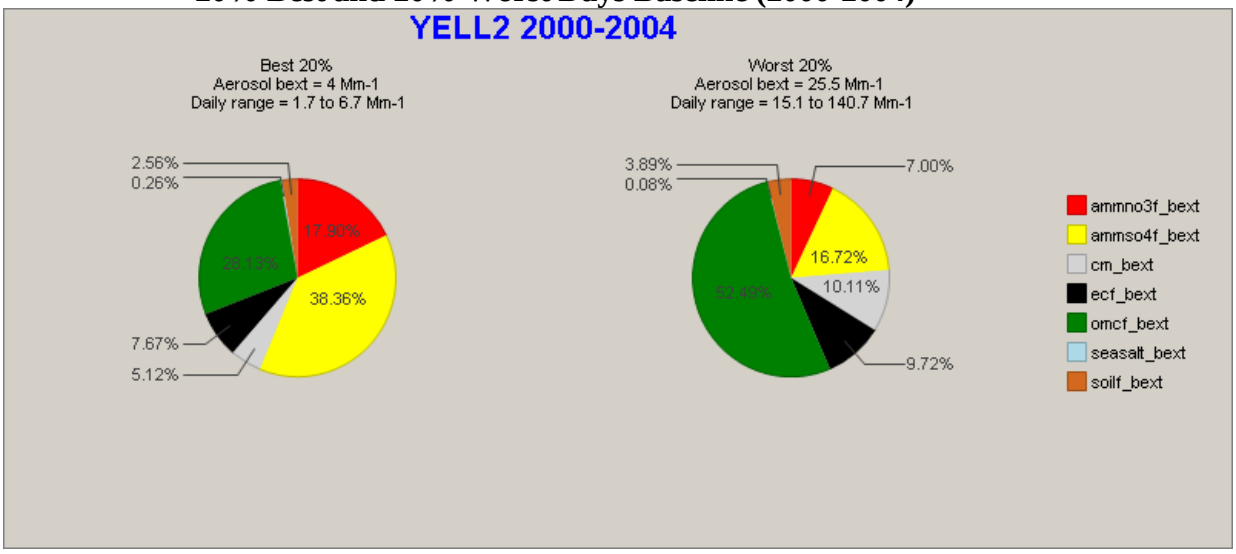
The following sections provide an additional breakdown of the pollutant species that contribute to each Class I area. The first figure in each section shows a simple pie chart of the 20% best and 20% worst days, similar to the bar chart figures above. The second figure in each section shows the pollutant species based on monthly averages for all days (including best or worst) during the baseline period, as an example of the seasonal variation in Class I areas. The third figure in each section presents a closer look at the daily variation during a given year--in this case 2004. The fourth figure in each section shows the improvement needed (shown in reduction in deciview) for each Class I area, from the baseline year to the 2018 milestone, and to 2064 natural conditions.

3.1 Yellowstone National Park, Grand Teton National Park and Teton Wilderness

As depicted in the following figures, on the best 20% days sulfate is the dominant species, but organic carbon is the largest contributor on the worst 20% days. Both sulfate and nitrate

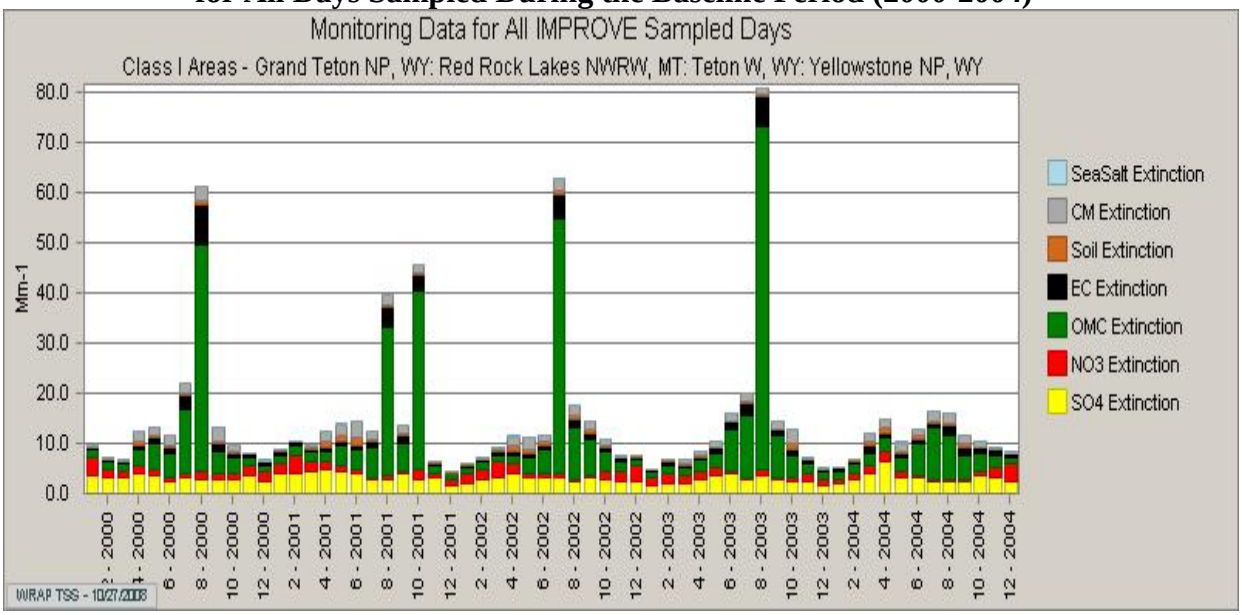
pollutant species fluctuate during the year. Significant spikes of organic carbon, however, are evident especially in the warmer months, most likely due to wildfire activity. Figure 3.1-4, indicates a 1.3 deciview reduction would be needed to meet a 2018 URP, and a 5.4 deciview reduction would be needed to meet a 2064 URP. While 51.308(d)(1)(i)(B) requires that the State disclose the incremental change required to meet a URP goal, there is no requirement to meet a URP goal. This is discussed in more detail in Chapter 7.

Figure 3.1-1. Yellowstone IMPROVE Site - Average Pollutant Species Contribution to 20% Best and 20% Worst Days Baseline (2000-2004)



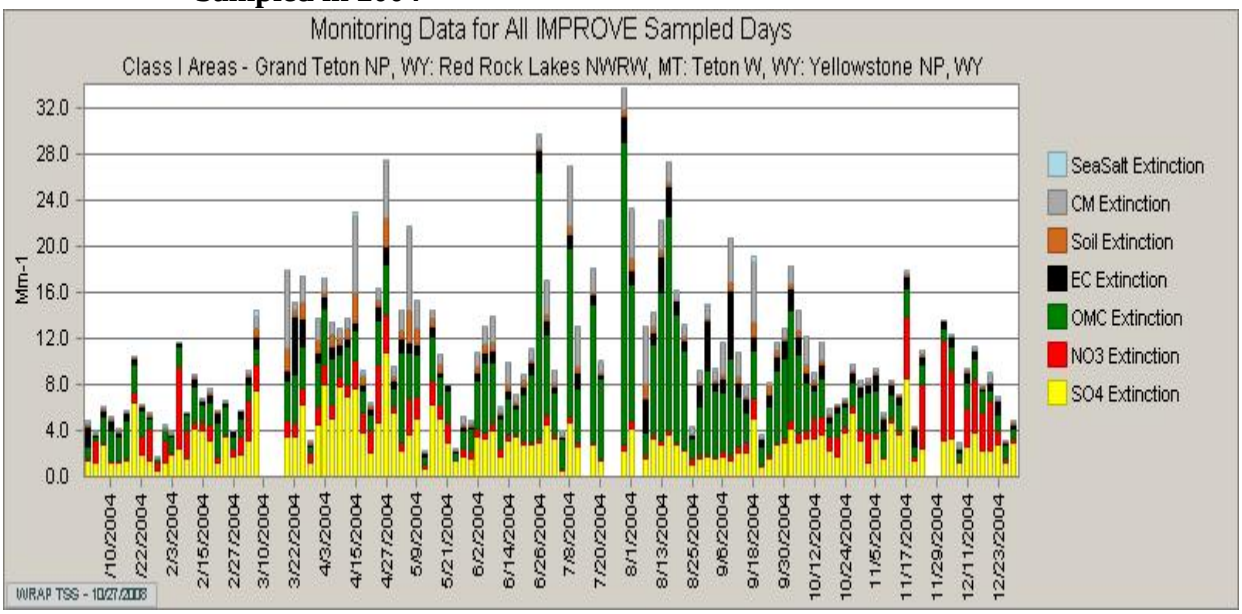
(http://vista.cira.colostate.edu/dev/web/AnnualSummaryDev/Composition.aspx)

Figure 3.1-2. Yellowstone IMPROVE Site - Monthly Average Pollutant Species Variation for All Days Sampled During the Baseline Period (2000-2004)



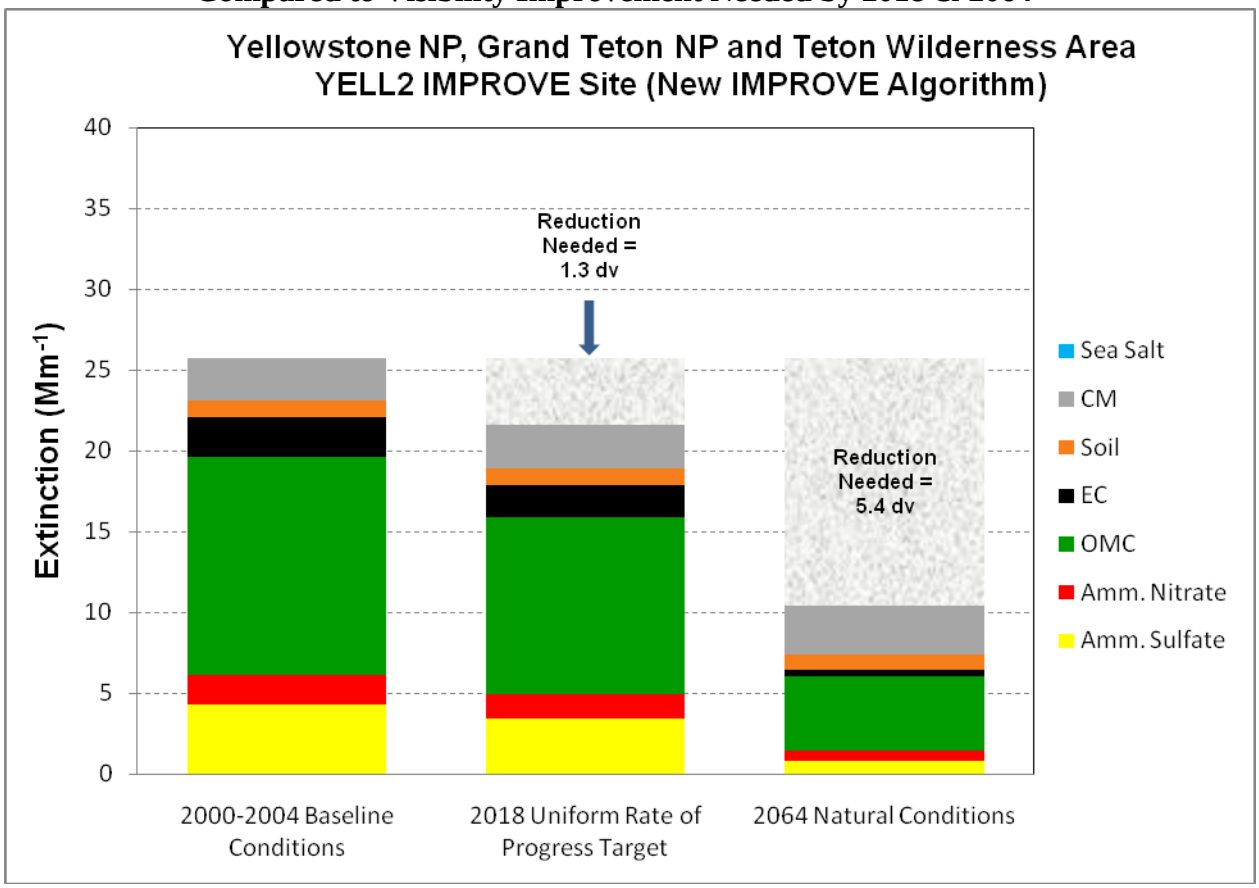
(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Figure 3.1-3. Yellowstone IMPROVE Site - Pollutant Species Variation for All Days Sampled in 2004



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

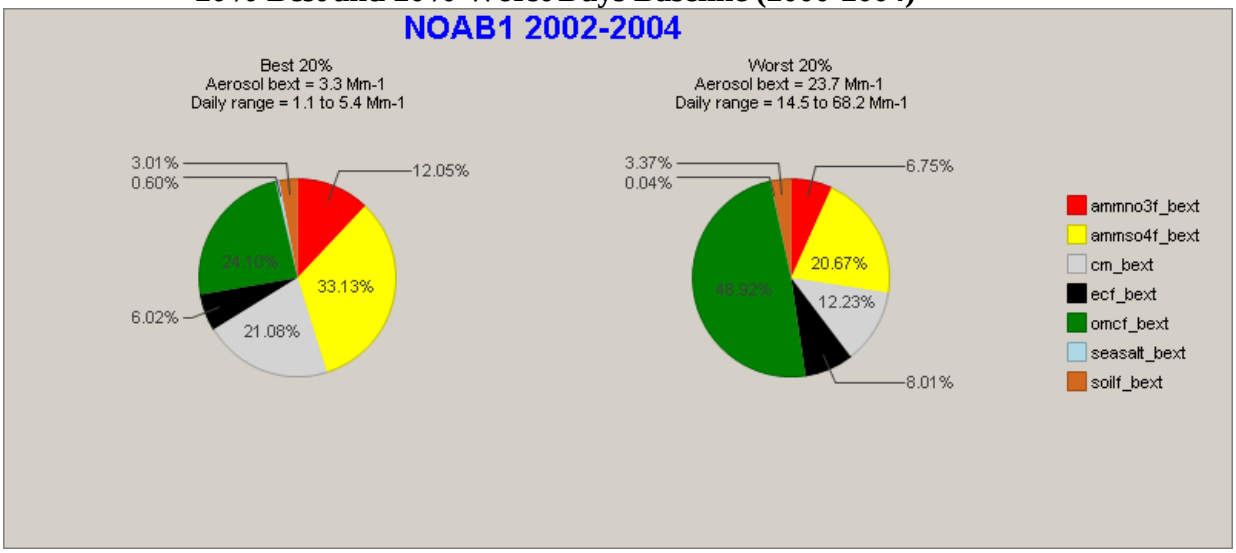
Figure 3.1-4. Yellowstone IMPROVE Site - Baseline Worst Day Aerosol Composition Compared to Visibility Improvement Needed by 2018 & 2064



3.2 North Absaroka and Washakie Wilderness Areas

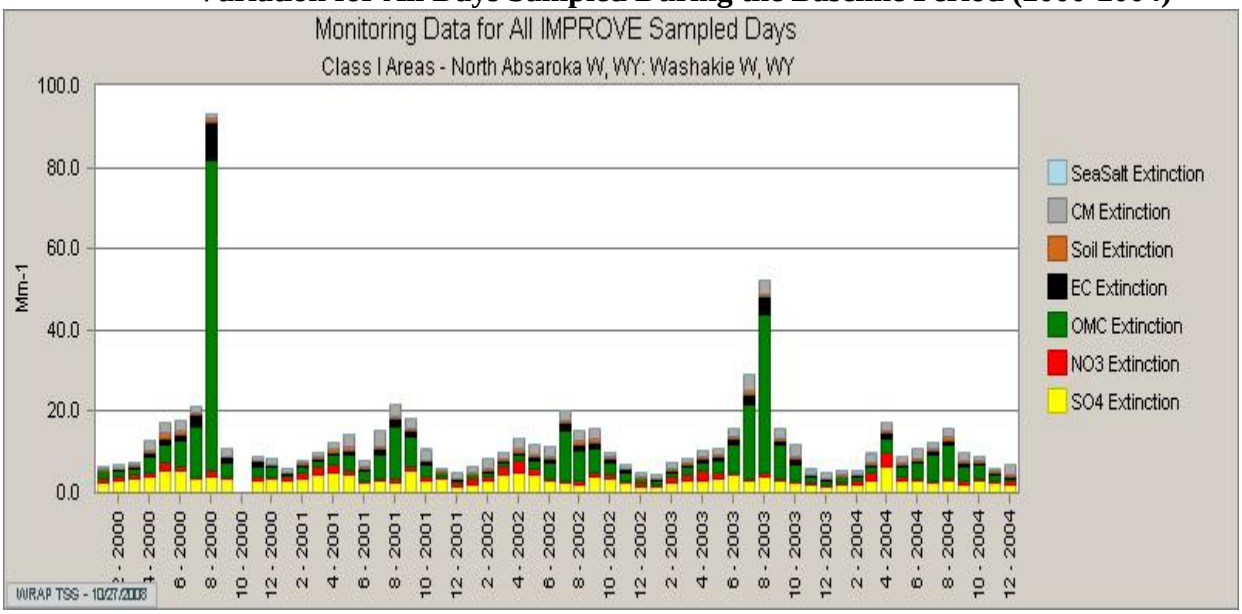
As depicted in the following figures, on the best 20% days sulfate is the dominant species, but organic carbon is the largest contributor on the worst 20% days. Both sulfate and nitrate pollutant species fluctuate during the year. Like the Yellowstone IMPROVE site, the North Absaroka IMPROVE site shows significant spikes of organic carbon, especially in the warmer months most likely due to wildfire activity. Figure 3.2-4, indicates a 1.1 deciview reduction would be needed to meet a 2018 URP, and a 4.7 deciview reduction would be needed to meet a 2064 URP. While 51.308(d)(1)(i)(B) requires that the State disclose the incremental change required to meet a URP goal, there is no requirement to meet a URP goal. This is discussed in more detail in Chapter 7.

Figure 3.2-1. North Absaroka IMPROVE Site - Average Pollutant Species Contribution to 20% Best and 20% Worst Days Baseline (2000-2004)



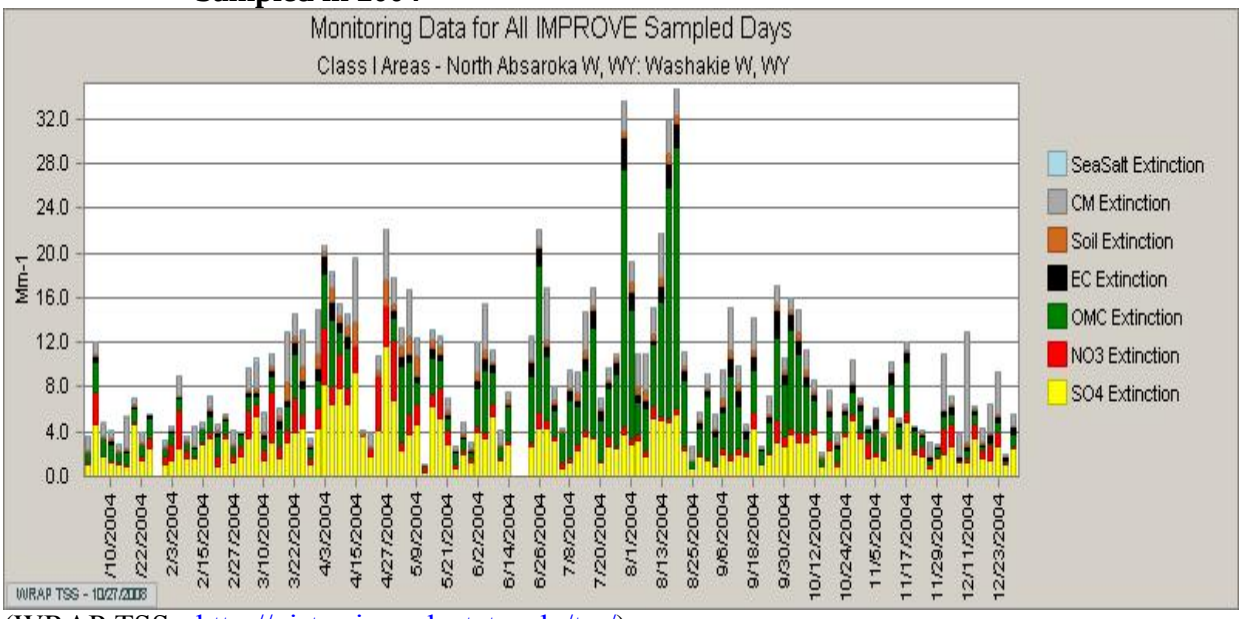
(http://vista.cira.colostate.edu/dev/web/AnnualSummaryDev/Composition.aspx)

Figure 3.2-2. North Absaroka IMPROVE Site - Monthly Average Pollutant Species Variation for All Days Sampled During the Baseline Period (2000-2004)



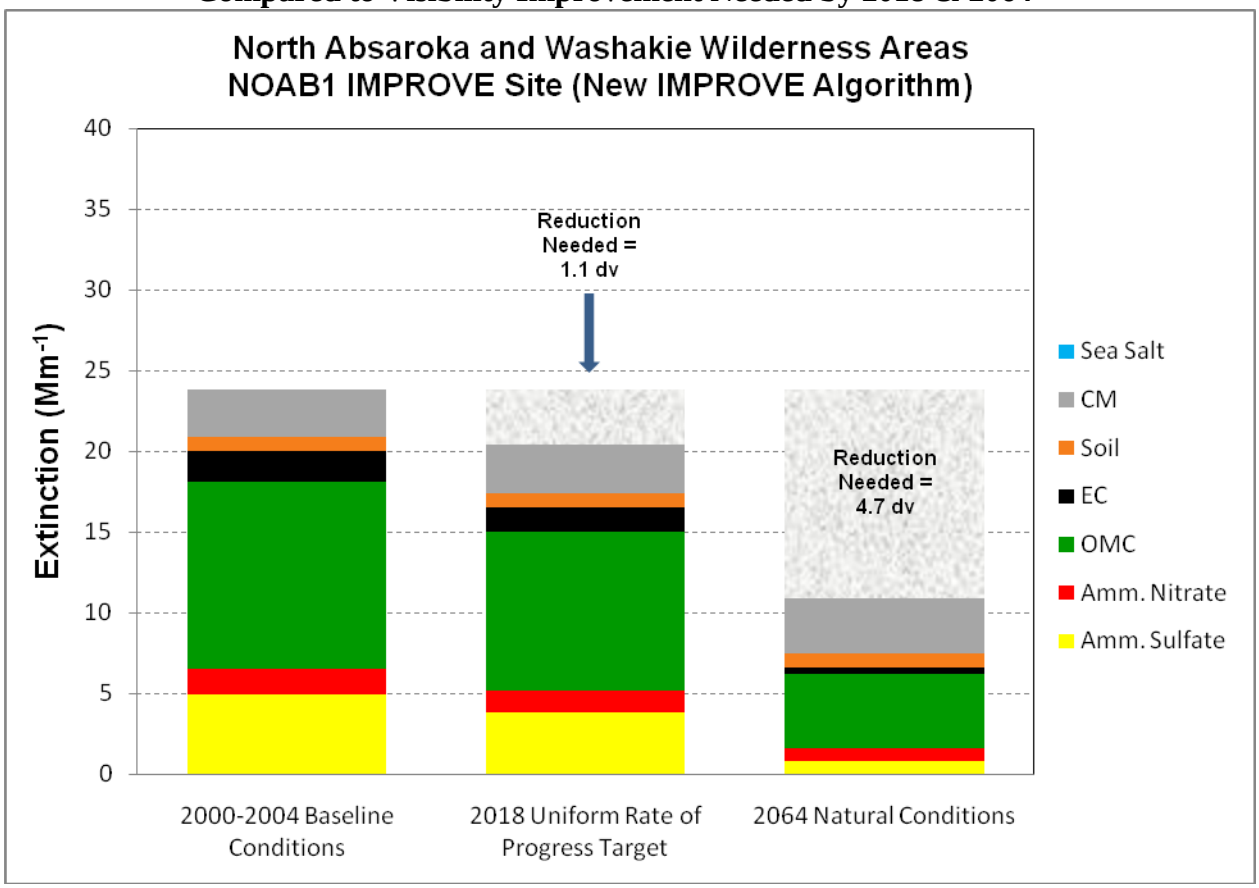
(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Figure 3.2-3. North Absaroka IMPROVE Site - Pollutant Species Variation for All Days Sampled in 2004



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

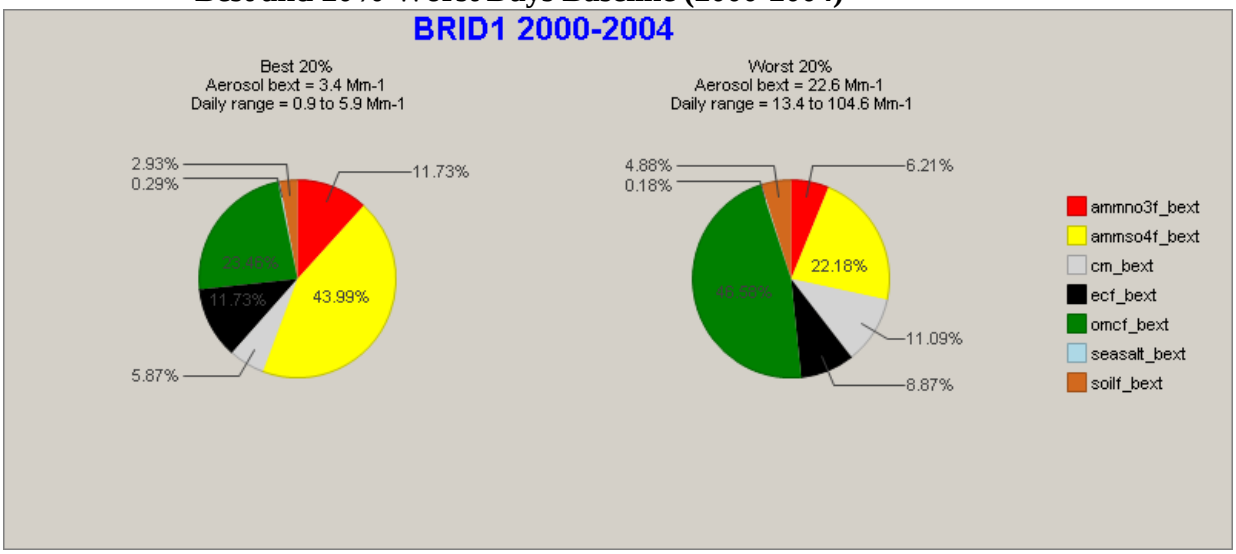
Figure 3.2-4. North Absaroka IMPROVE Site - Baseline Worst Day Aerosol Composition Compared to Visibility Improvement Needed by 2018 & 2064



3.3 Bridger and Fitzpatrick Wilderness Areas

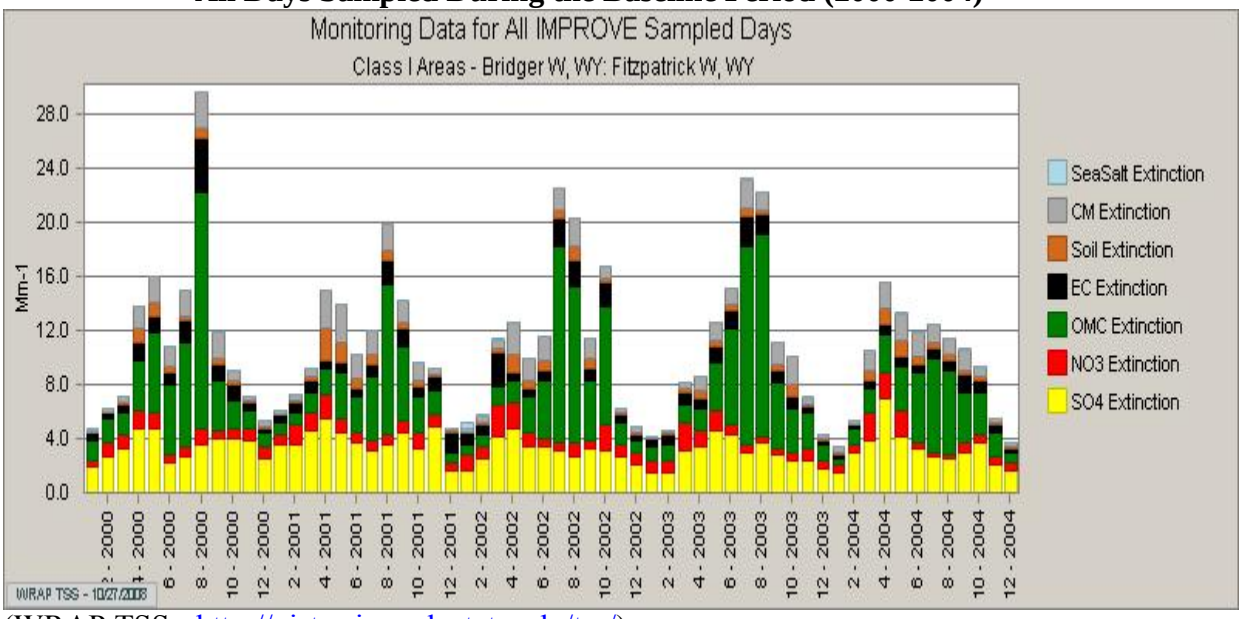
As with all other Wyoming Class I areas, on the best 20% days sulfate is the dominant species, but organic carbon is the largest contributor on the worst 20% days. Both sulfate and nitrate pollutant species fluctuate during the year. Like the other Class I sites, the Bridger IMPROVE site shows significant spikes of organic carbon, especially in the warmer months most likely due to wildfire activity. Figure 3.3-4, indicates a 1.1 deciview reduction would be needed to meet a 2018 URP, and a 4.6 deciview reduction would be needed to meet a 2064 URP. While 51.308(d)(1)(i)(B) requires that the State disclose the incremental change required to meet a URP goal, there is no requirement to meet a URP goal. This is discussed in more detail in Chapter 7.

Figure 3.3-1. Bridger IMPROVE Site - Average Pollutant Species Contribution to 20% Best and 20% Worst Days Baseline (2000-2004)



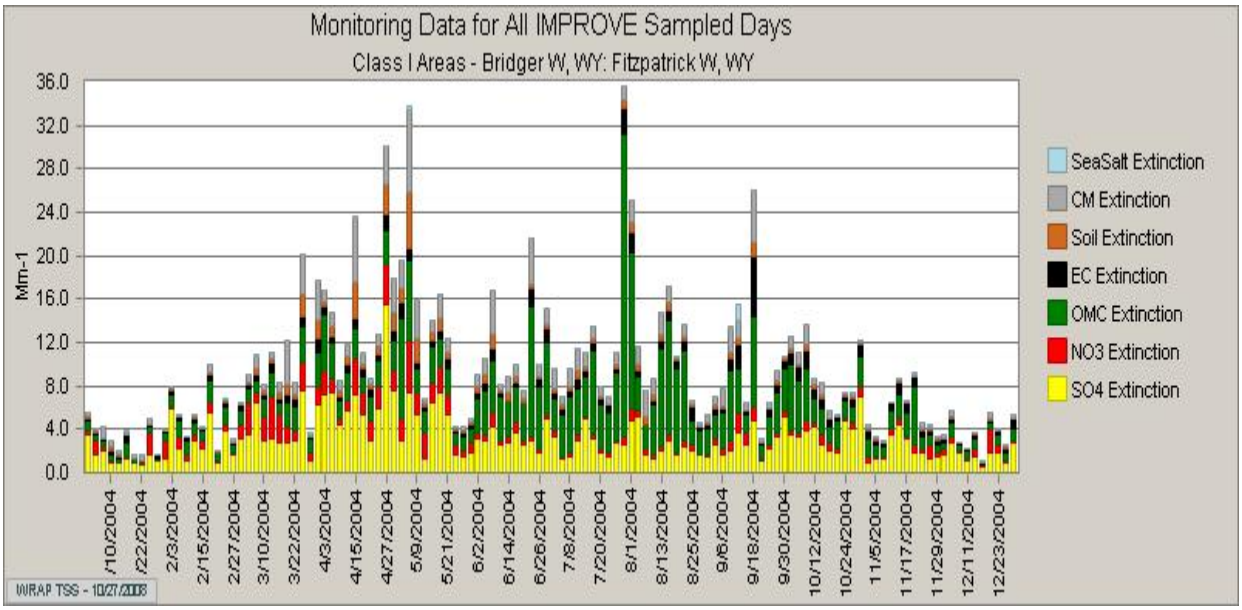
(http://vista.cira.colostate.edu/dev/web/AnnualSummaryDev/Composition.aspx)

Figure 3.3-2. Bridger IMPROVE Site - Monthly Average Pollutant Species Variation for All Days Sampled During the Baseline Period (2000-2004)



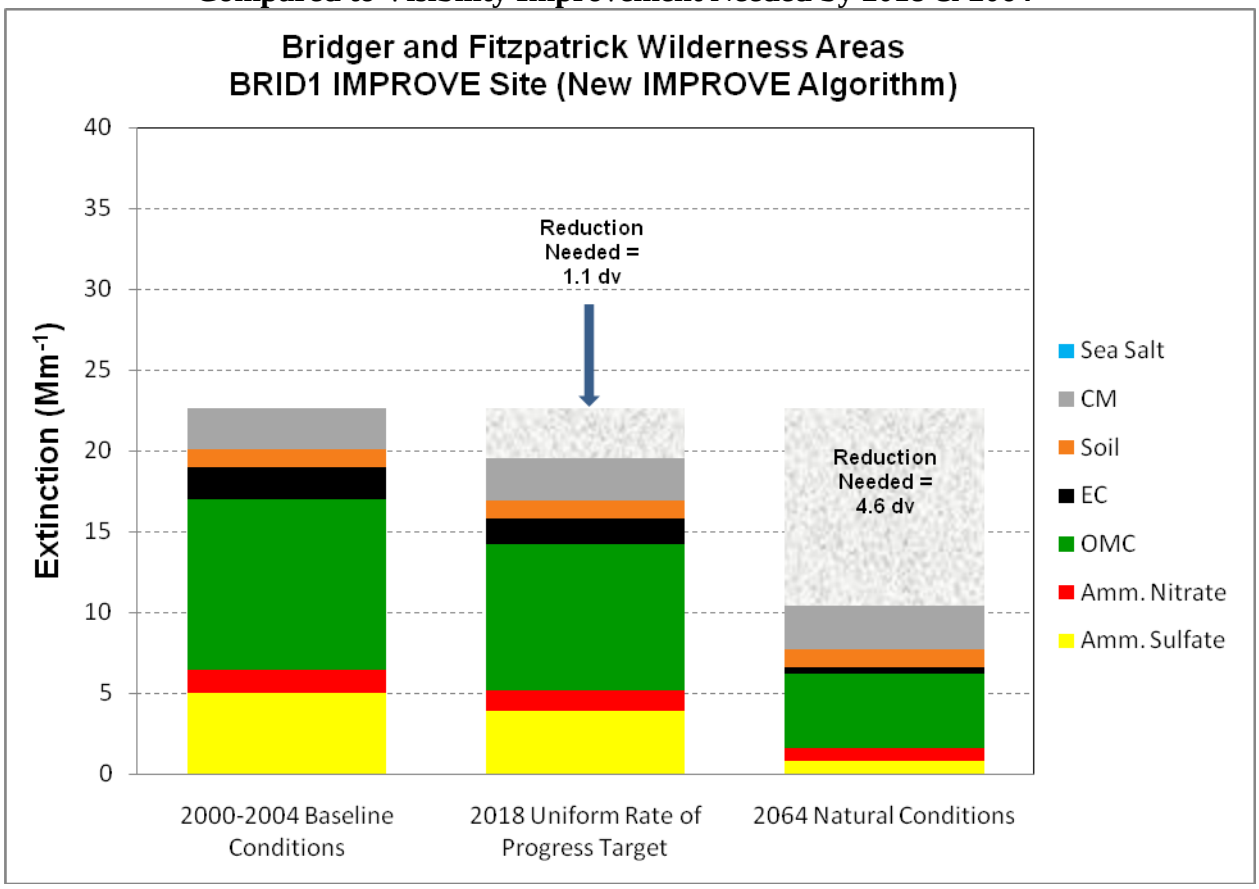
(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Figure 3.3-3. Bridger IMPROVE Site - Pollutant Species Variation for All Days Sampled in 2004



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Figure 3.3-4. Bridger IMPROVE Site - Baseline Worst Day Aerosol Composition Compared to Visibility Improvement Needed by 2018 & 2064



CHAPTER 4
STATEWIDE EMISSION INVENTORY

4.1 Introduction

The process for inventorying sources is similar for all species of interest. The number and types of sources is identified by various methods. For example, major stationary sources report actual annual emission rates to the EPA national emissions database. Wyoming collects annual emission data from both major and minor sources and this information is used as input into the emissions inventory. In other cases, such as mobile sources, an EPA mobile source emissions model is used to develop emission projections. Population, employment and household data are used in other parts of the emissions modeling to characterize emissions from area sources such as home heating. Thus, for each source type, emissions are calculated based on an emission rate and the amount of time the source is operating. Emission rates can be based on actual measurements from the source, or EPA emission factors based on data from tests of similar types of emission sources. In essence all sources go through the same process. The number of sources is identified, emission rates are determined by measurements of those types of sources and the time of operation is determined. By multiplying the emission rate times the hours of operation in a day, a daily emission rate can be calculated. A second inventory is created to predict emissions in 2018 based on expected controls, growth, or other factors. Additional inventories are created for future years to simulate the impact of different control strategies. While the Division attempts to make sound estimates of all sources of emissions in the State, they are only estimates at one point in time. Oil and gas emission estimates are some of the more complicated emission inventories that the Division collects, and the Division is working hard to improve those estimates.

The following presents the Wyoming emissions from the WRAP TSS.

4.2 SO_x Emission Inventory

Table 4.2-1. Wyoming SO_x Emission Inventory - 2002 and 2018

Wyoming Planning and Preliminary Reasonable Progress Emission Inventories			
	Statewide SO_x		
Source Category	Plan 02d (tpy)	PRP18b (tpy)	Net Change From Plan 02d to PRP18b (Percent)
Point	119,717	96,809	-19
Area	16,689	23,093	38
On-Road Mobile	959	81	-92
Off-Road Mobile	5,866	65	-99
Oil & Gas	150	3	-98
Road Dust	0	0	0
Fugitive Dust	0	0	0
Windblown Dust	0	0	0
Anthro Fire	173	109	-37
Natural Fire	2,286	2,286	0
Biogenic	0	0	0
Total	145,840	122,446	-16

Sulfur oxides (SO_x) are compounds of sulfur and oxygen molecules. Sulfur dioxide (SO_2) is the predominant form found in the lower atmosphere. Sulfur dioxide emissions produce sulfate particles in the atmosphere. Ammonium sulfate particles have a significantly greater impact on visibility than other pollutants like dust from unpaved roads due to the physical characteristics causing greater light scattering from the particles. Sulfur dioxide emissions come primarily from coal combustion at electrical generation facilities, but smaller amounts come from natural gas combustion, mobile sources and even wood combustion. There are natural sources of sulfur dioxide such as volcanoes. A 16% statewide reduction in SO_x emissions is expected by 2018 due to planned controls on existing sources, even with a growth consideration in generating capacity for the State. Similar reductions are expected from other states as BART or other planned controls take effect by 2018.

4.3 NO_x Emission Inventory

Table 4.3-1. Wyoming NO_x Emission Inventory - 2002 and 2018

Wyoming Planning and Preliminary Reasonable Progress Emission Inventories			
	Statewide NO_x		
Source Category	Plan02d (tpy)	PRP18b (tpy)	Net Change From Plan02d to PRP18b (Percent)
Point	117,806	110,109	-7
Area	15,192	19,663	29
On-Road Mobile	38,535	9,728	-75
Off-Road Mobile	76,637	49,677	-35
Oil & Gas	14,725	34,142	132
Road Dust	0	0	0
Fugitive Dust	0	0	0
Windblown Dust	0	0	0
Anthro Fire	782	484	-38
Natural Fire	8,372	8,372	0
Biogenic	15,925	15,925	0
Total	287,974	248,100	-14

Nitrogen oxides (NO_x) are generated during any combustion process where nitrogen and oxygen from the atmosphere combine together under high temperature to form nitric oxide, and to a lesser degree nitrogen dioxide, and in much smaller amounts other odd oxides of nitrogen. Nitrogen oxides react in the atmosphere to form nitrate particles. Nitrogen oxide emissions in Wyoming are expected to decrease by 2018, primarily due to significant improvements in mobile sources. It is projected that off-road and on-road vehicles emissions will decline by more than 55,760 tons per year from the Plan02d emissions total of 115,172 tons per year. Point sources are also projected to decrease statewide emissions by about 7,700 tons per year. A power plant would be a typical example of a point source. Oil and gas development is expected to increase statewide emissions from 2002 to 2018 by about 19,400 tons per year. With population increases and more construction, fugitive dust emissions will also increase.

4.4 OC Emission Inventory

Table 4.4-1. Wyoming OC Emission Inventory - 2002 and 2018

Wyoming Planning and Preliminary Reasonable Progress Emission Inventories			
	Statewide OC		
Source Category	Plan02d (tpy)	PRP18b (tpy)	Net Change From Plan02d to PRP18b (Percent)
Point	646	990	53
Area	2,000	1,975	-1
On-Road Mobile	304	249	-18
Off-Road Mobile	625	411	-34
Oil & Gas	0	0	0
Road Dust	20	26	30
Fugitive Dust	96	133	39
Windblown Dust	0	0	0
Anthro Fire	1,709	886	-48
Natural Fire	23,793	23,793	0
Biogenic	0	0	0
Total	29,193	28,463	-3

Organic carbon particles emitted directly from the combustion of organic materials are called primary organic aerosols. A wide variety of sources contribute to this classification including byproducts from wood and agricultural burning with emissions from natural fires as the largest contributor to organic carbon emissions. Since it is impossible to predict future emissions from natural fires, this category was held constant and organic carbon emissions from all sources are expected to show a 3% decline.

4.5 EC Emission Inventory

Table 4.5-1. Wyoming EC Emission Inventory - 2002 and 2018

Wyoming Planning and Preliminary Reasonable Progress Emission Inventories			
	Statewide EC		
Source Category	Plan02d (tpy)	PRP18b (tpy)	Net Change From Plan02d to PRP18b (Percent)
Point	104	180	73
Area	304	335	10
On-Road Mobile	443	86	-81
Off-Road Mobile	1,986	1,161	-42
Oil & Gas	0	0	0
Road Dust	2	2	0
Fugitive Dust	7	9	29
Windblown Dust	0	0	0
Anthro Fire	298	153	-49
Natural Fire	4,922	4,922	0
Biogenic	0	0	0
Total	8,066	6,848	-15

Elemental carbon is the carbon black, or soot, a byproduct of incomplete combustion. It is the partner to primary organic aerosols and represents the more complete combustion of fuel producing carbon particulate matter as the end product. A carbon particle has a sixteen times greater impact on visibility than that of a coarse particle of granite. Reductions in manmade emissions in elemental carbon are largely due to mobile sources and expected new Federal emission standards for mobile sources, especially for diesel engines. Fleet replacement will also play a part in the reduction. Elemental carbon emissions are predicted to decrease approximately 15% by 2018. As with organic carbon, however, the overwhelming source for elemental carbon is from wildfires which the Division cannot control or predict future emissions.

4.6 Fine PM Emission Inventory

Table 4.6-1. Wyoming Fine PM Emission Inventory - 2002 and 2018

Wyoming Planning and Preliminary Reasonable Progress Emission Inventories			
	Statewide Fine PM		
Source Category	Plan02d (tpy)	PRP18b (tpy)	Net Change From Plan02d to PRP18b (Percent)
Point	11,375	15,709	38
Area	1,601	1,756	10
On-Road Mobile	0	0	0
Off-Road Mobile	0	0	0
Oil & Gas	0	0	0
Road Dust	160	206	29
Fugitive Dust	2,082	2,882	38
Windblown Dust	5,838	5,838	0
Anthro Fire	242	129	-47
Natural Fire	1,535	1,535	0
Biogenic	0	0	0
Total	22,833	28,055	23

Fine soil emissions are largely related to agricultural and mining activities, windblown dust from construction areas and emissions from unpaved and paved roads. A particle of fine dust has a relative impact on visibility one tenth as great as a particle of elemental carbon. On any given visibility event where poor visual air quality is present in a scene, the impact of dust can vary widely. Agricultural activities, dust from unpaved roads and construction are prevalent in this source category and changes in emissions are tied to population and vehicle miles traveled. Since soil emissions are not directly from the tailpipe of the vehicle, the category of mobile sources does not show any emissions and all vehicle related emissions from paved and unpaved roads show up in the fugitive dust and road dust categories.

4.7 Coarse PM Emission Inventory

Table 4.7-1. Wyoming Coarse PM Emission Inventory - 2002 and 2018

Wyoming Planning and Preliminary Reasonable Progress Emission Inventories			
	Statewide Coarse PM		
Source Category	Plan02d (tpy)	PRP18b (tpy)	Net Change From Plan02d to PRP18b (Percent)
Point	24,751	30,619	24
Area	409	653	60
On-Road Mobile	171	165	-4
Off-Road Mobile	0	0	0
Oil & Gas	0	0	0
Road Dust	1,125	1,449	29
Fugitive Dust	18,030	25,144	39
Windblown Dust	52,546	52,546	0
Anthro Fire	259	109	-58
Natural Fire	5,369	5,369	0
Biogenic	0	0	0
Total	102,660	116,054	13

Coarse mass particles emissions are closely related to the same sources as fine soil emissions but other activities like rock crushing and processing, material transfer, open pit mining and unpaved road emissions can be prominent sources. Coarse mass particles travel shorter distances in the atmosphere than some other smaller particles but can remain in the atmosphere sufficiently long enough to play a role in regional haze. Coarse mass particulate matter has the smallest direct impact on regional haze on a particle-by-particle basis where one particle of coarse mass has a relative visibility weight of 0.6 compared to a carbon particle having a weight of 10. Increases in coarse mass are seen in the fugitive and road dust categories, as well as point and area source categories. These increases are largely attributable to population growth, vehicle miles traveled and employment data.

4.8 Ammonia Emission Inventory

Table 4.8-1. Wyoming Ammonia Emission Inventory - 2002 and 2018

Wyoming Planning and Preliminary Reasonable Progress Emission Inventories			
	Statewide Ammonia		
Source Category	Plan02d (tpy)	PRP18b (tpy)	Net Change From Plan02d to PRP18b (Percent)
Point	685	1,398	104
Area	29,776	29,901	0
On-Road Mobile	538	724	35
Off-Road Mobile	41	57	39
Oil & Gas	0	0	0
Road Dust	0	0	0
Fugitive Dust	0	0	0
Windblown Dust	0	0	0
Anthro Fire	218	119	-45
Natural Fire	1,775	1,775	0
Biogenic	0	0	0
Total	33,033	33,974	3

Ammonia emissions come from a variety of sources including wastewater treatment facilities, livestock operations, and fertilizer application and to a small extent, mobile and point sources. Increases in ammonia emissions are correlated to population statistics and increased vehicular traffic. Ammonia is directly linked to the production of ammonium nitrate and ammonium sulfate particles in the atmosphere when sulfur dioxide and nitrogen oxides eventually convert over to these forms of particles. Mobile source emissions are expected to rise due to increases in vehicle miles traveled. Future point source emissions are also expected to increase by 2018, however, little to no overall increases in ammonia are predicted for 2018.

4.9 Inventories Utilized For Emissions Projections

The WRAP Regional Modeling Center (RMC) developed multiple annual emissions inventories for a 2002 actual emissions base case, a planning case to represent the 2000-04 regional haze baseline period using averages for key emissions categories, and a 2018 base case of projected emissions determined using factors known at the end of 2005. All emission inventories were developed using the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system. These inventories have undergone a number of revisions throughout the development process to arrive at the final versions used in CMAQ and CAMx air quality modeling.

- The 2002 base case emissions scenario, referred to as “2002 Base Case” or “Base02”, represents the actual conditions in calendar year 2002 with respect to ambient air quality and the associated sources of criteria and particulate matter air pollutants. The Base02 emissions inventories are used to validate the air quality model and associated databases

and to demonstrate acceptable model performance with respect to replicating observed particulate matter air quality.

- The 2000-04 baseline period planning case emissions scenario is referred to as "Plan02", and represents baseline emission patterns based on average, or "typical", conditions. This inventory provides a basis for comparison with the future year 2018 projected emissions, as well as to gauge reasonable progress with respect to future year visibility. Plan 02d, used by the State of Wyoming in these inventories, was last revised in October, 2008.
- The 2018 future-year base case emissions scenario, referred to as "2018 Base Case" or "Base18", represents conditions in future year 2018 with respect to sources of criteria and particulate matter air pollutants, taking into consideration growth and controls. Modeling results based on this emission inventory are used to define the future year ambient air quality and visibility metrics.
- 2018 Preliminary Reasonable Progress refers to a WRAP emissions or modeling scenario based on the preliminary reasonable progress emissions inventories, generated in early 2007. This scenario includes corrections, refinements and additions to the 2018 Base Case, as well as estimates of controlling SO_2 and some NO_x from BART sources. The PRP18b analysis series, used by the State of Wyoming in these inventories, was last revised in August, 2009.

The CMAQ and CAMx air quality models are explained in more detail in Chapter 5.

4.10 PRP18b

A "base case" emissions projection inventory was compiled by the WRAP in January of 2006. In June 2007, a revision to this inventory named 2018 Preliminary Reasonable Progress version "a" (PRP18a) updated the first set (base case) of projections. The most recent projections, 2018 Preliminary Reasonable Progress version "b" (PRP18b), provides a more current assessment of the reasonable progress toward visibility goals by the WRAP. Table 4.9-1 below depicts the net change from the PRP18a NO_x emission inventories to the PRP18b emission inventories.

Table 4.9-1. Net Change From PRP18a to PRP18b Emission Inventories

Source Category	PRP18a NO_x Emission Inventory (tpy)	PRP18b NO_x Emission Inventory (tpy)	Net Change From PRP18a to PRP18b (tpy)	Net Change From PRP18a to PRP18b (%)
Point	133,216	110,109	-23,107	-17%
Area (includes Oil & Gas)	53,806	53,805	No Change	No Change
On-Road Mobile	9,728	9,728	No Change	No Change
Off-Road Mobile	59,378	49,676	-9,702	-16%

The off-road mobile category showed a 16% decrease in NO_x emissions, 89% of which was attributable to locomotives. The remaining 11% was attributable to off-road equipment. A

decrease of 17% in point source NO_x emissions was achieved, with 89% of the decrease due to BART. Area and on-road source categories remained virtually unchanged.

Three ERG Technical Memorandums, documenting PRP18a and PRP18b emission inventories, can be found in Chapter 4 of the Wyoming TSD.

CHAPTER 5
SOURCE APPORTIONMENT AND REGIONAL HAZE MODELING

5.1 Overview

Visibility impairment occurs when pollutants emitted into the atmosphere scatter and absorb light, thereby creating haze. These pollutants can remain suspended in the atmosphere for long periods and be transported long distances, thereby contributing to regional-scale impacts on visibility in Class I areas. Air quality models offer the opportunity to better understand how these impacts occur, by identifying the sources that contribute to haze, and helping to select the most effective emissions reduction strategies to improve visibility.

Wyoming Class I area visibility is affected by a combination of local and regional transport of air pollutants. Chapter 4 provided information on emission inventories, as the first step in identifying significant source categories causing visibility impairment. This chapter describes the results of (1) source apportionment analysis showing the in-state and regional contribution of haze sources, for the 20% worst and best visibility days, and (2) regional modeling projections of visibility conditions by the 2018 benchmark or milestone, based on application of the regional haze strategies outlined in this Plan, including BART. The source apportionment information and regional modeling results are the basis for the demonstration of reasonable progress for the 20% worst and best days, described in Chapter 7.

Additional explanation of the source apportionment and modeling methodology can be found in the WRAP Air Quality Modeling methods document in Chapter 5 of the Wyoming TSD.

5.1.1 Source Apportionment Analysis - PSAT and WEP

In order to determine the significant sources contributing to haze in Wyoming's Class I areas, the Division has relied upon source apportionment analysis techniques provided by the WRAP for this Regional Haze Plan. This information can be found on the WRAP TSS website at http://vista.cira.colostate.edu/TSS/Results/HazePlanning.aspx. There were two techniques used for source apportionment of regional haze. One was the Particulate Matter Source Apportionment Technology (PSAT) tool, used for the attribution of sulfate and nitrate sources only. The second was the Weighted Emissions Potential (WEP) tool, used for attribution of sources of sulfate, nitrate, organic carbon, elemental carbon, fine PM, and coarse PM.

PSAT uses the CAMx air quality model to show nitrate-sulfate-ammonia chemistry and applies this chemistry to a system of tracers or "tags" to track the chemical transformations, transport and removal of NO_x and SO_2. Emission scenarios used for the PSAT analyses were the Plan02c and Base18b. PSAT results were not regenerated for use in this document using the more recently updated Plan02d and PRP18b emissions scenarios because of the time and resources that would have been required. No significant changes were anticipated with additional modeling runs. These two pollutants are important because they tend to originate from anthropogenic (human-caused) sources. Therefore, the results from this analysis can be useful in determining contributing sources that may be controllable, both in-state and in neighboring states.

WEP is a screening tool that helps to identify source regions that have the potential to contribute to haze formation at specific Class I areas. Unlike PSAT, this method does not account for chemistry or deposition. The WEP combines emissions inventories, wind patterns, and residence time of air mass over each area where emissions occur, to estimate the percent contribution of different pollutants. Like PSAT, the WEP tool compares baseline (2000-2004) to 2018, to show the improvement expected by the 2018 URP, for sulfate, nitrate, organic carbon, elemental carbon, fine PM, and coarse PM.

As described in Section 5.2 below, the Division believes PSAT is a better tool than WEP for identifying the contribution of sulfates and nitrates to Wyoming Class I areas, because PSAT does account for chemistry and deposition, and is better at identifying regional contribution of sources from outside the WRAP region (see discussion in 5.2 below). For these reasons, the Division has relied upon the PSAT results as the primary source apportionment tool for sulfates and nitrates, and thus the better tool for identifying anthropogenic sources. The results from the WEP analysis were used by the Division primarily to identify the pollutants more commonly associated with non-anthropogenic (natural) sources. Even though these sources are mostly uncontrollable, it is still important to consider their relative contribution to haze.

The review of PSAT results in this chapter (discussed in 5.2 below) focus on the contribution on sulfates and nitrates, while the WEP results focus on the contribution of organic carbon, elemental carbon, fine PM, and coarse PM.

5.1.2 Regional Haze Modeling - CMAQ

The primary tool utilized by the Division for modeling regional haze improvements by 2018, and for determining Wyoming's Reasonable Progress Goals (see Chapter 7), was the Community Multi-Scale Air Quality (CMAQ) model. The CMAQ model was used to estimate 2018 visibility conditions in Wyoming and all Western Class I areas, based on application of the regional haze strategies presented in this Plan, including assumed controls on BART sources. A more in depth description of the CMAQ model used to project 2018 visibility conditions can be found in the WRAP Air Quality Modeling document referenced in Chapter 5 of the Wyoming TSD.

The modeling was conducted by the Regional Modeling Center (RMC) at the University of California Riverside, under the oversight of the WRAP Modeling Forum. Results can be found on the WRAP TSS website at http://vista.cira.colostate.edu/tss/Results/HazePlanning.aspx.

The CMAQ model was designed as a "one atmosphere" modeling system to encompass modeling of multiple pollutants and issues, including ozone, PM, visibility, and air toxics. This is in contrast to many earlier air quality models that focused on single pollutants. CMAQ takes into account emissions, advection and dispersion, photochemical transformation, aerosol thermodynamics and phase transfer, aqueous chemistry, and wet and dry deposition of trace species. The model requires inputs of three-dimensional gridded wind, temperature, humidity, cloud/precipitation, and boundary layer parameters. The current version of CMAQ can only utilize output fields from the MM5 meteorological model. MM5 is a state-of-the-science

atmosphere model that has proven useful for air quality applications and has been used extensively in past local, state, regional, and national modeling efforts. MM5 has undergone extensive peer review, with all of its components continually undergoing development and scrutiny by the modeling community.

The RMC developed air quality modeling inputs including annual meteorology and emissions inventories for a 2002 actual emissions base case, a planning case to represent the 2000-2004 regional haze baseline period using averages for key emissions categories, and a 2018 base case of projected emissions determined using factors known at the end of 2005. All emission inventories were prepared for CMAQ using the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system. Each of these inventories underwent a number of revisions throughout the development process to arrive at the final versions used in CMAQ modeling. The development of each of these emission scenarios is documented under the emissions inventory sections of the TSS.

The 2018 visibility projections were made using the Plan02d and PRP18b CMAQ 36-km modeling results. Projections were made using relative response factors (RRFs) for each species:

1) RRF = [2018 Modeled Species/Baseline Modeled Species]
2) Projected Species Mass = Baseline IMPROVE Species x RRF
3) Projected Species Extinction = Conversion via IMPROVE Algorithm of Projected Species Mass

There are three RRF calculation methods. These methods differ in how the days for the calculation are selected. The Specific Days (EPA) method is the EPA default method, and single species' RRFs are calculated across observed (IMPROVE) worst or best days in the base model year. The Specific Days (EPA) method was the method utilized by the State of Wyoming. The second method is the Quarterly Weighted method, whereby four quarterly species' RRFs are calculated from the 20% worst or best days in each quarter, in spite of how those days compare to the overall annual worst and best days. The third method is the Monthly Weighted method, whereby twelve monthly species' RRF are calculated from the 20% best or worst days in each month, regardless of how those days compare to the overall annual worst and best days.

More information on how to use the visibility tool in connection with RRF factors can be found at http://vista.cira.colostate.edu/tss/help/GettingStarted.aspx#MP, and specific information regarding how RRF factors are calculated can be found in Section 6.4 of the 2007 EPA document "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze" at http://www.epa.gov/scram001/guidance/guide/final-03-pm-rh-guidance.pdf. This EPA guidance was followed for setting up the "EPA Specific Days" option and other inputs on the WRAP TSS Visibility Projections Tool, so all Class I areas in the WRAP region used their IMPROVE site-specific monitoring and modeling data to derive the RRFs.

Generally, emissions inputs were prepared by individual states and tribes for point, area, and most dust emissions categories. The following WRAP Forums were relied upon to summarize this data and provide it to the RMC:

- Point Source emissions were obtained from projects commissioned by the Stationary Sources Joint Forum and the Emissions Forum.
- Area Source emissions were obtained from projects commissioned by the Stationary Sources Joint Forum and the Emissions Forum.
- Mobile Source emissions were from projects commissioned by the Emissions Forum.
- Fire (natural and anthropogenic) emissions were from projects commissioned by the Fire Emissions Joint Forum.
- Ammonia, Dust, and Biogenic emissions were from projects commissioned by the Dust Emissions Joint Forum and the Modeling Forum.
- Emissions from Pacific offshore shipping were from a project conducted by the RMC.[1]
- Other emissions from North America were from projects commissioned by the Emissions Forum and the Modeling Forum. The Mexico emissions are from 1999, and were held constant for 2018. Canada emissions are from 2000 and were held constant for 2018.
- Boundary conditions reaching North America from the rest of the world were from a project commissioned by the VISTAS Regional Planning Organization, on behalf of the five regional planning organizations working on regional haze.

The results from the CMAQ regional modeling analysis are discussed later in this section.

Because some WRAP states are still going through the difficult case-by-case BART determinations for each EGU, the WRAP was not able to model all of the emission reductions from BART and State long-term strategies in the most recent modeling effort. Therefore, the modeling results and all graphics associated with the modeling results do not include BART and long-term strategy reductions proposed in this SIP or any other WRAP SIPs that were not available at the time WRAP modeled. The WRAP was only able to include enforceable reductions that were on the books at the time of the last model run.

5.2 Major Source Categories Contributing to Haze in Wyoming

Figures in this section show profiles of the relative contribution of in-state vs. out-of-state sources contributing to emissions in Wyoming's Class I areas, for the 20% worst and best days, for the baseline (2000-2004) and future year (2018) scenarios, using the PSAT and WEP techniques. The Wyoming Class I areas are grouped by general location (based on representative IMPROVE monitoring sites).

As previously described, there are several differences between the PSAT and WEP techniques. PSAT focuses on sulfate and nitrate contribution only, taking into account chemistry and deposition. PSAT also estimates the contribution from all regions--the WRAP states, CENRAP states[2], Canada, Mexico, Pacific offshore (shipping), and "outside the domain" (global transport). The WEP does not address sulfate and nitrate chemistry and deposition, and while it

[1] See WRAP TSS website under "Resources", "Emissions", and "Offshore Emissions" for summary, or go to http://vista.cira.colostate.edu/docs/wrap/emissions/OffshoreEmissions.doc.

[2] CENRAP is a regional planning organization similar to the WRAP that is comprised of Nebraska, Kansas, Oklahoma, Texas, Minnesota, Iowa, Missouri, Arkansas, and Louisiana.

does estimate the contribution from Canada and Pacific offshore regions, it does not include other regional contributions.

Based on these differences, the figures provided below focus on PSAT results for identifying the contribution of sulfates and nitrates (the primary anthropogenic source pollutants) and WEP results for identifying the contribution of organic carbon, elemental carbon, fine PM, and coarse PM (commonly associated with non-anthropogenic sources).

Sections 5.2.1 through 5.2.4 below show 20% worst- and best-day PSAT profiles on the contribution of sulfate and nitrate at each IMPROVE monitoring site representing the Class I areas in Wyoming. The pie charts display relative regional contributions to total annual modeled sulfate and nitrate mass at the respective sites. The WRAP contribution is separated from the rest of the pie for easy identification. The remaining pie slices are outside the Western United States, for the regions described above.

The PSAT bar charts below the pie charts display source region and source category contributions of sulfate and nitrate mass. There are five source categories listed--point, area, mobile, anthropogenic fires (controlled burning), and natural and biogenic sources (mostly wildfire and windblown dust). Estimated contributions outside the modeling domain (Outside Domain) are also shown, and include Mexico, Canada, and Pacific offshore emissions.

Sections 5.2.5 through 5.2.12 present WEP profiles for organic carbon, elemental carbon, fine PM, and coarse PM, at Class I areas in Wyoming.

Unlike the PSAT figures, the WEP figures are bar charts only and summarize weighted emissions by state and region for 12 source categories. These categories are windblown dust, fugitive dust, road dust, off-road mobile, on-road mobile, off-shore, WRAP area oil and gas, area, biogenic, natural fire, anthropogenic fire, and point. This analysis used more source categories than the PSAT analysis to account for the additional pollutant types, and the more natural origins contributing to these pollutants, including dust and fire sources.

5.2.1 PSAT Regional Contribution to Sulfate on 20% Worst Days

Figures 5.2.1-1 through 5.2.1-3 in this section illustrate the state and regional contribution of sulfate to the 20% worst days in Wyoming Class I areas for 2002 and 2018, based on PSAT profiles for each IMPROVE monitoring site representing the nearest Class I areas. The figures below consist of a pie chart that shows the estimated contribution of the major regions (WRAP states, Pacific Offshore, CENRAP, Eastern U.S., Canada, Mexico, and Outside Domain (global)). The bar chart is the WRAP source region portion, depicting Wyoming and other western states.

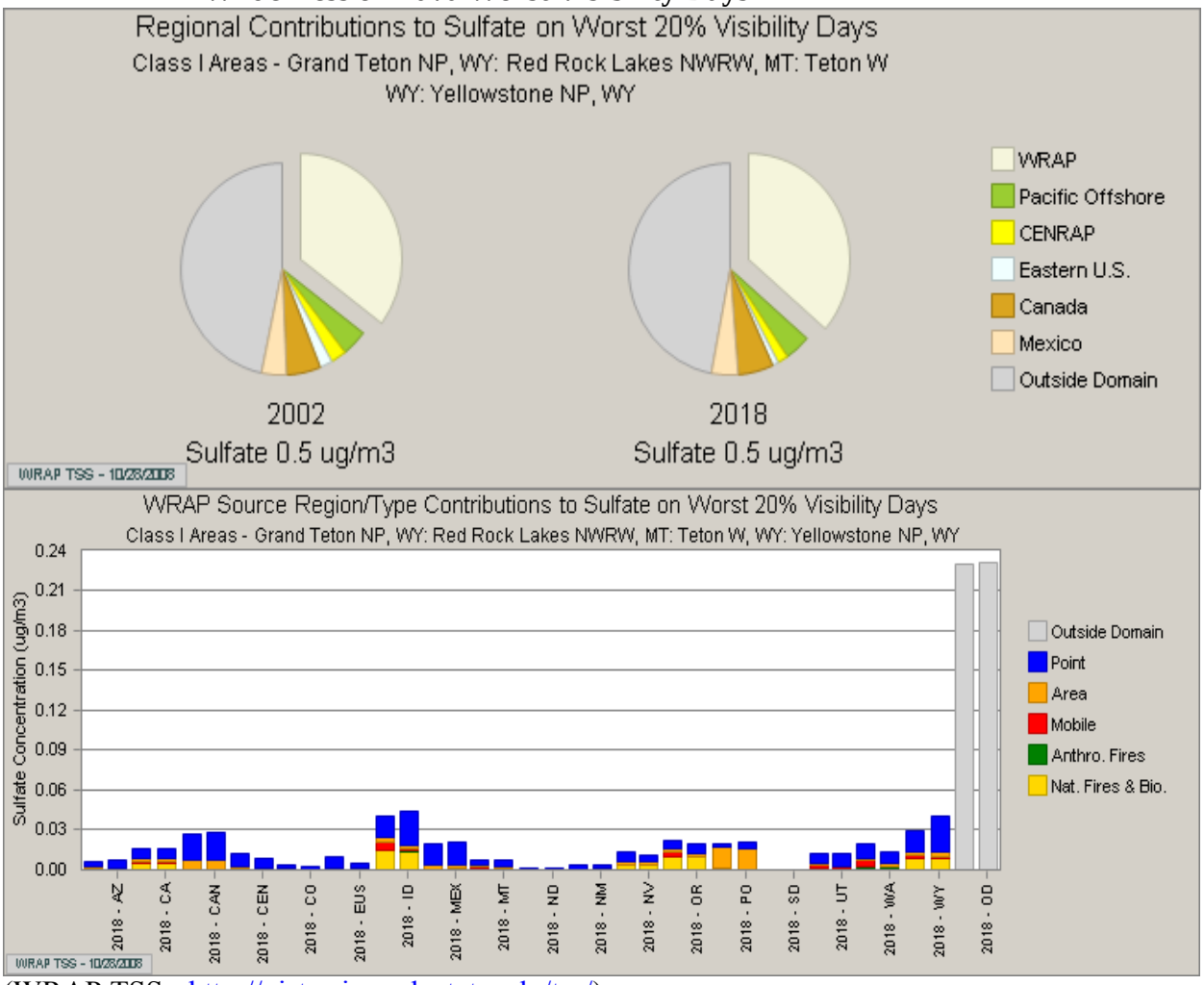
Note that in all the figures in this section, the majority of sulfate emissions originate outside the WRAP region. However, the nitrate contribution, discussed in Sections 5.2.3 and 5.2.4, is much higher within the WRAP region. The WRAP contribution is about one-third of the total, with the exception of the Bridger site, where the contribution is more than one-half. The largest contributor is outside the domain, or “global”. Among the other regions (not including the

WRAP region), Canada, followed by Pacific Offshore and Mexico are the next sizable contributors.

Also indicated in these figures, the largest contributor of sulfate is generally from point sources. The variation in sulfate contribution is based on the location of the Class I area monitoring site in the State. For example, the contribution of sulfate from Canada and Montana are the highest in the northernmost Class I area monitoring site, the North Absaroka Wilderness area. Similarly, the sulfate contribution from Mexico is highest in the southernmost Class I area monitoring site, the Bridger Wilderness area.

In terms of comparison of 2002 and 2018, it can be seen that the WRAP portion of the pie chart remains nearly unchanged, with only slight increases in 2018. The source category that accounts for this slight increase is primarily point.

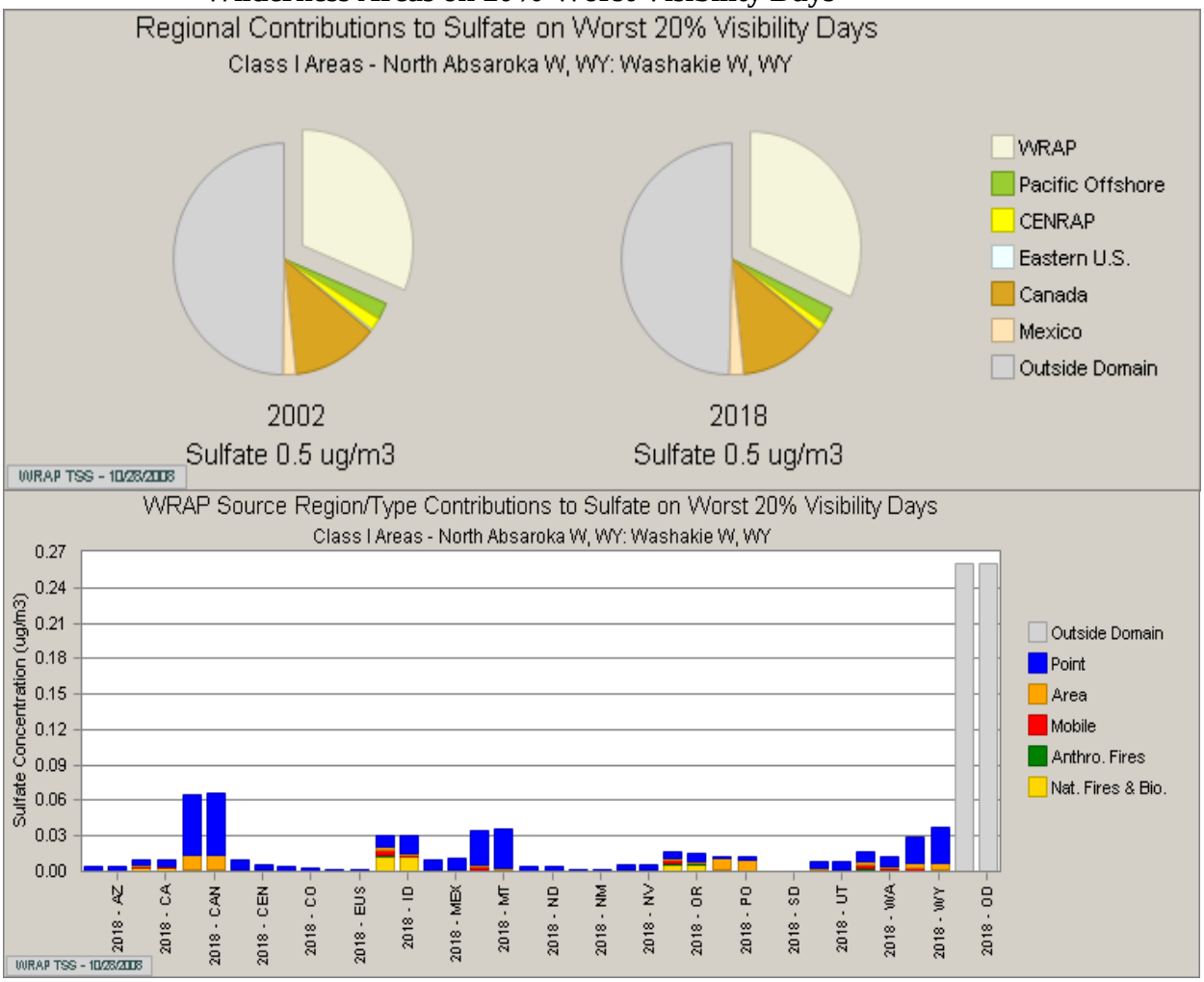
Figure 5.2.1-1. PSAT Sulfate Contribution at Yellowstone NP, Grand Teton NP, and Teton Wilderness on 20% Worst Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

It is interesting to note that for the 20% worst days at Yellowstone, the point source sulfate contribution is approximately the same from Idaho as from Wyoming, most likely due to the proximity of industrial sources and wind direction. There is also a noticeable contribution from point sources in Canada, and a sizeable contribution from Mexico. Area and mobile sources from Wyoming and Idaho are much less. Close to half of the sulfate comes from the area outside the domain.

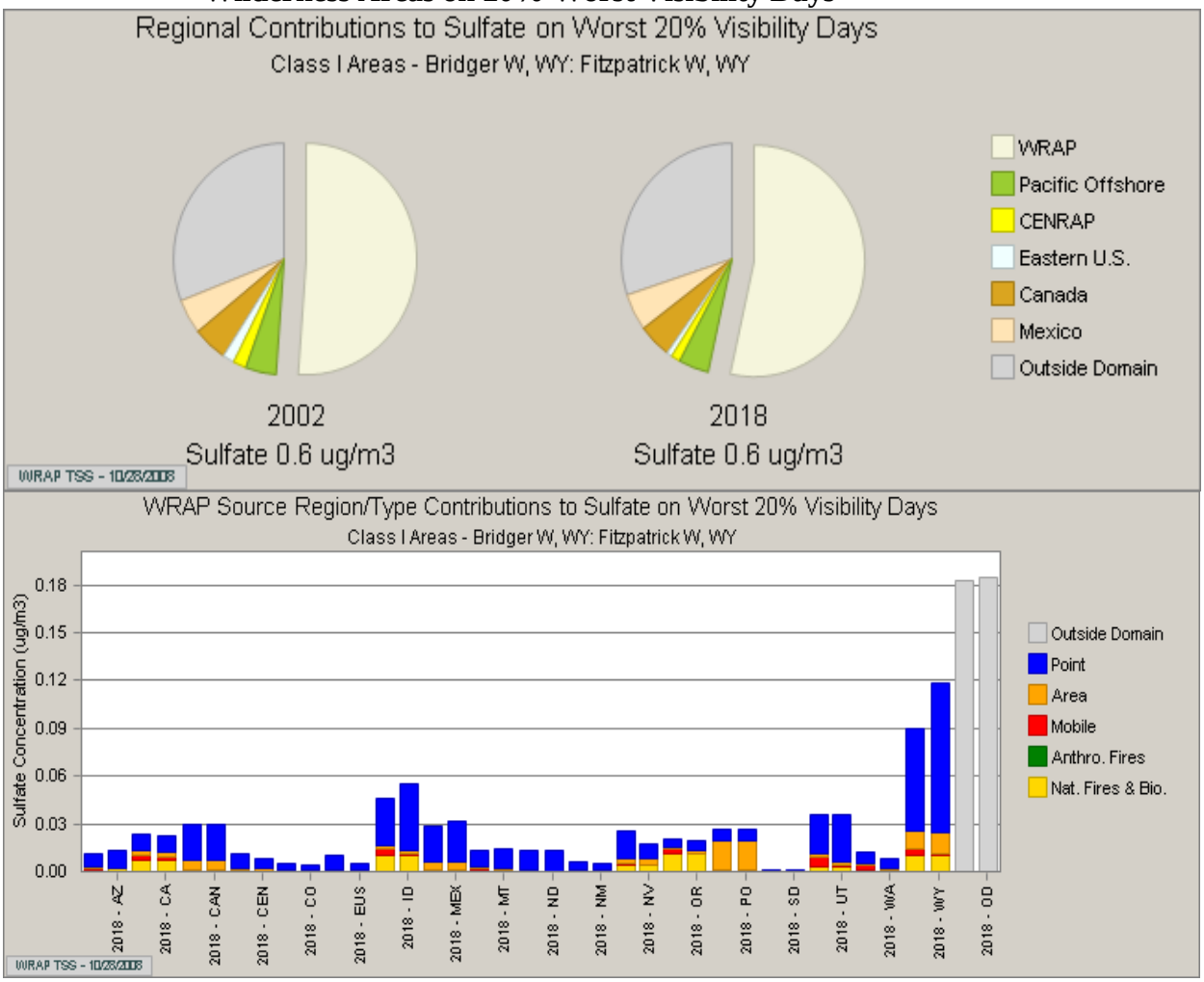
Figure 5.2.1-2. PSAT Sulfate Contribution at North Absaroka Wilderness and Washakie Wilderness Areas on 20% Worst Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

It should be noted that for the 20% worst days at North Absaroka, point source sulfate contribution is higher from Canada and Montana than from Wyoming, most likely due to the proximity of industrial sources and wind direction. There is a much larger sulfate contribution from Canada at the North Absaroka monitoring site than the other two monitoring sites (Yellowstone and Bridger). Area and mobile sources are very minimal contributors to sulfate in Wyoming. Approximately one half of the sulfate source is generated from the area outside the domain.

Figure 5.2.1-3. PSAT Sulfate Contribution at Bridger Wilderness and Fitzpatrick Wilderness Areas on 20% Worst Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% worst days at the Bridger monitoring site, overall sulfate levels are slightly higher compared to the Yellowstone and North Absaroka monitoring sites. The majority of the sulfate originates from point sources in Wyoming, Idaho, and Utah. There are also considerable contributions from Canada and Mexico. Area and mobile sources, again, contribute a small amount of sulfate in Wyoming. Approximately one-third of the sulfate is generated from the area outside the domain.

5.2.2 PSAT Regional Contribution to Sulfate on 20% Best Days

Figures 5.2.2-1 through 5.2.2-3 in this section illustrate the state and regional contribution of sulfate to the 20% best days in Wyoming Class I areas for 2002 and 2018, based on PSAT profiles for each IMPROVE monitoring site representing the nearest Class I areas. The figures below consist of a pie chart that shows the estimated contribution of the major regions (WRAP states, Pacific Offshore, CENRAP, Eastern U.S., Canada, Mexico, and Outside Domain

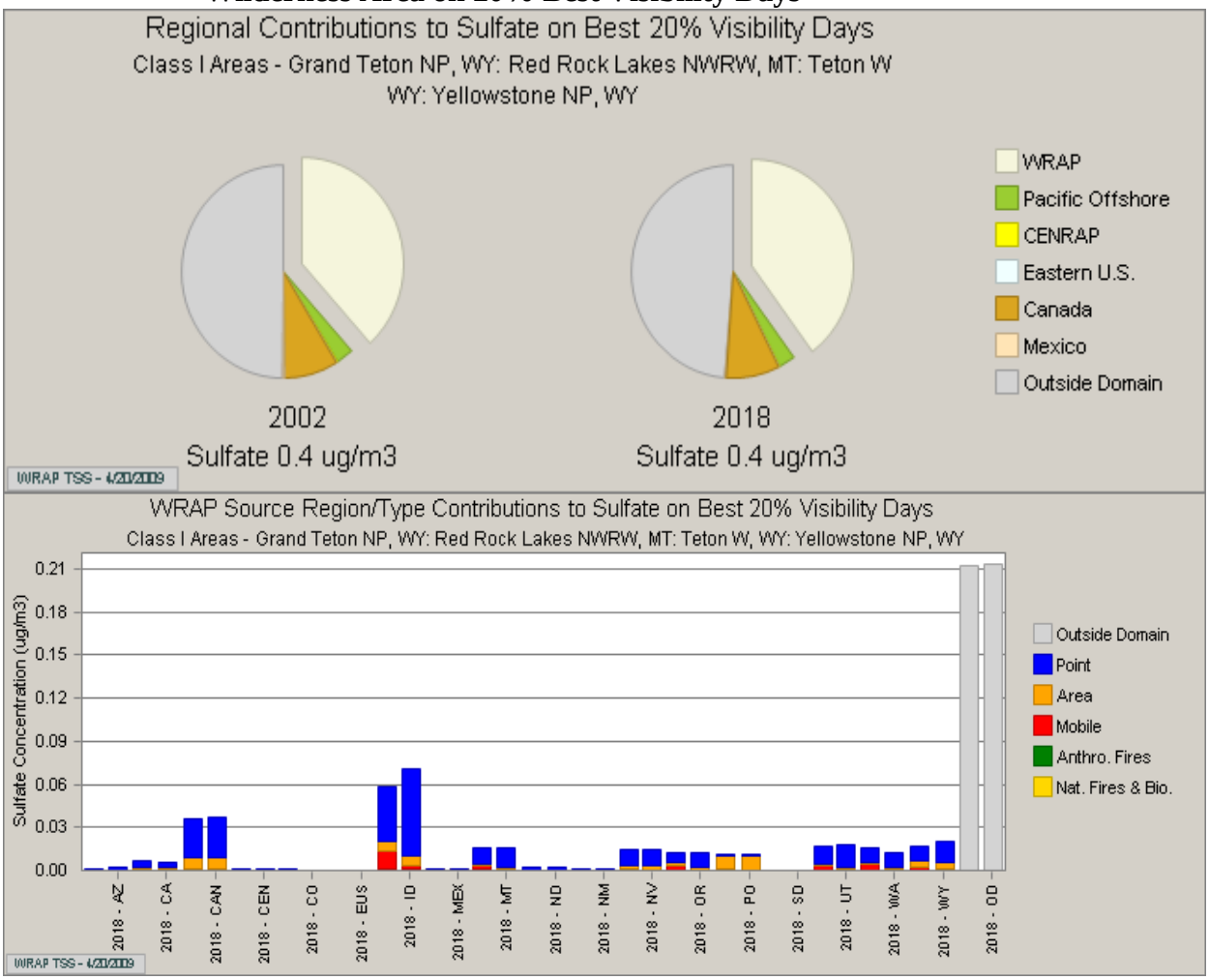
(global)). The bar chart is the WRAP source region portion, depicting Wyoming and other western states.

Note that in all the figures in this section, the majority of sulfate emissions originate outside the WRAP region. However, the nitrate contribution, discussed in Sections 5.2.3 and 5.2.4, is much higher within the WRAP region. The WRAP contribution is about one-third to just less than one-half of the total. The largest contributor is outside the domain, or "global". Among the other regions (not including the WRAP region), Canada, followed by Pacific Offshore are the next sizable contributors.

Also indicated in these figures, the largest contributor of sulfate is generally from point sources. The variation in sulfate contribution is based on the location of the Class I area monitoring site in the State. For example, the contribution of sulfate from Canada is the highest in the northernmost Class I area monitoring site, the North Absaroka Wilderness area. Similarly, the sulfate contribution from Idaho is highest in the southernmost Class I area monitoring site, the Bridger Wilderness area.

In terms of comparison of 2002 and 2018, it can be seen that the WRAP portion of the pie chart increases only slightly in 2018. The source category that accounts for this slight increase is primarily point.

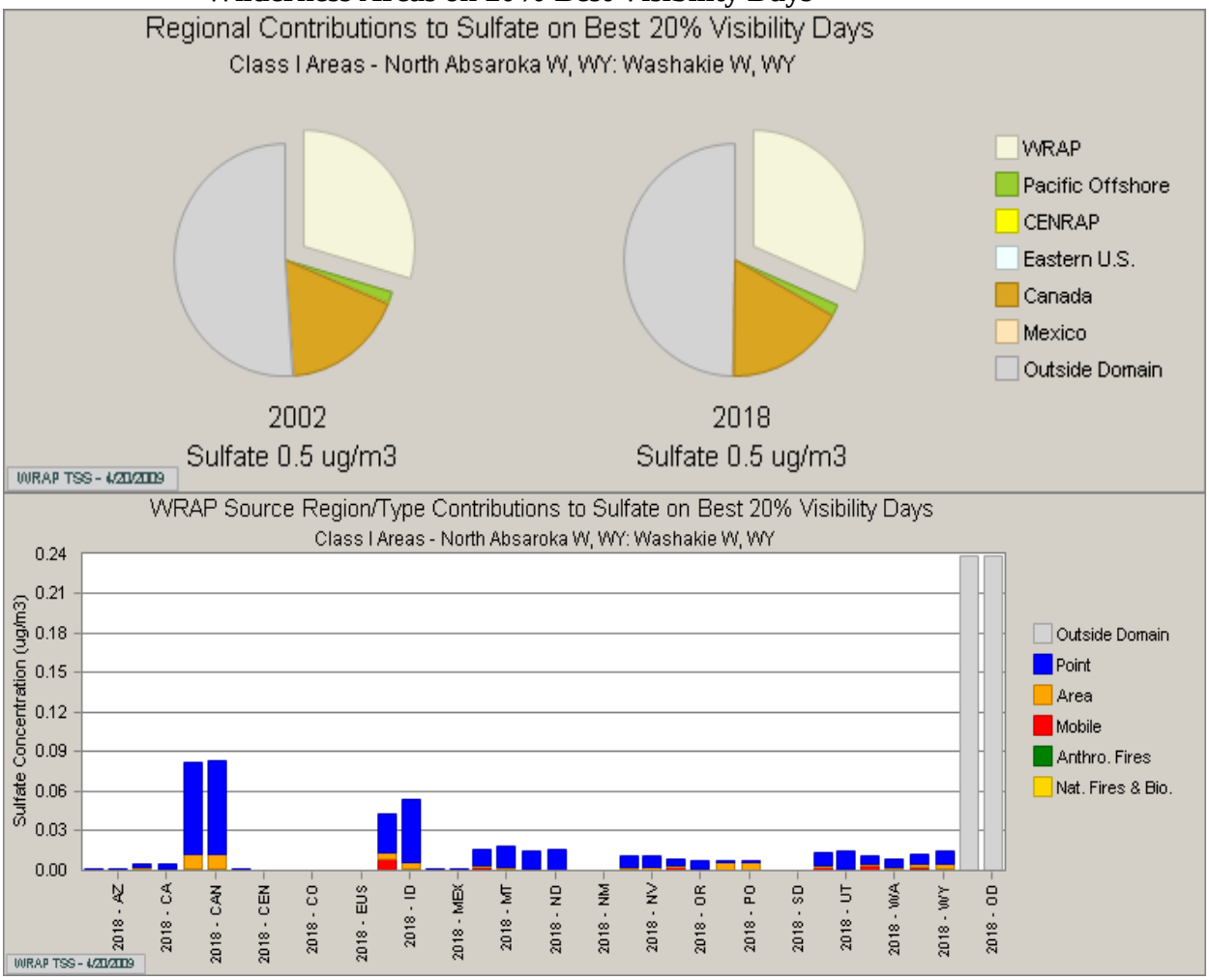
Figure 5.2.2-1. PSAT Sulfate Contribution at Yellowstone NP, Grand Teton NP, and Teton Wilderness Area on 20% Best Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

It is interesting to note that for the 20% best days at Yellowstone, the point source sulfate contribution is approximately four times greater from Idaho and more than twice as much from Canada as from Wyoming, most likely due to the proximity of industrial sources and wind direction. There are also noticeable contributions from point sources in Utah, Montana, Nevada, Washington and Oregon. The largest area and mobile source contribution comes from Idaho, followed by Pacific Offshore and Canada. About half of the sulfate comes from the area outside the domain.

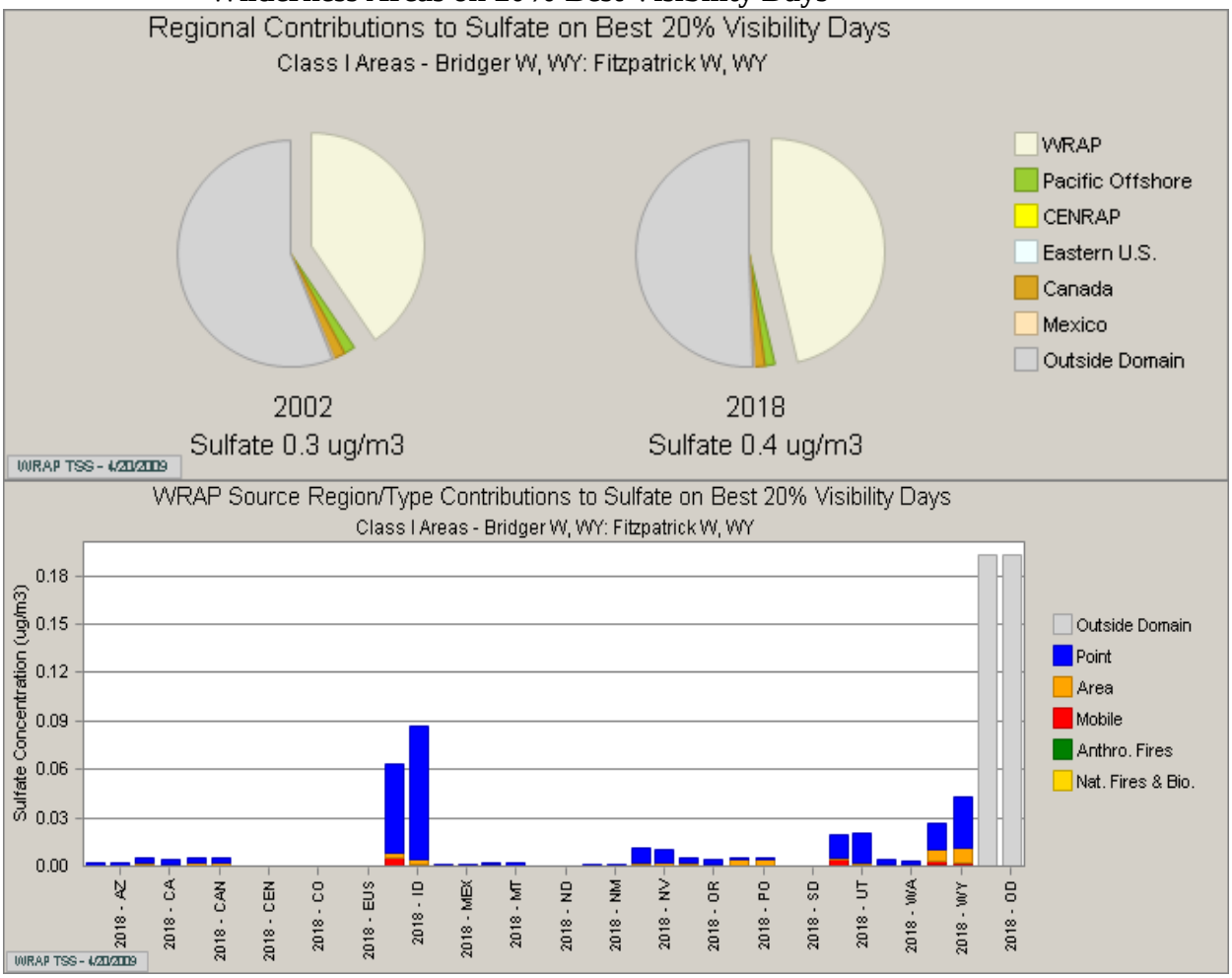
Figure 5.2.2-2. PSAT Sulfate Contribution at North Absaroka Wilderness and Washakie Wilderness Areas on 20% Best Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

It should be noted that for the 20% best days at North Absaroka, point source sulfate contribution is several times higher from Canada and Idaho than from Wyoming, most likely due to the proximity of industrial sources and wind direction. There is a much larger sulfate contribution from Canada at the North Absaroka monitoring site than the other two monitoring sites (Yellowstone and Bridger). Area and mobile sources are very minimal contributors to sulfate in Wyoming. Approximately one half of the sulfate source is generated from the area outside the domain.

Figure 5.2.2-3. PSAT Sulfate Contribution at Bridger Wilderness and Fitzpatrick Wilderness Areas on 20% Best Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% best days at the Bridger monitoring site, overall sulfate levels are approximately the same as Yellowstone and slightly lower than the North Absaroka monitoring site. The majority of the sulfate originates from point sources in Idaho, with much smaller amounts from Wyoming, Utah, and Nevada, respectively. Area and mobile sources, again, contribute a small amount of sulfate in Wyoming. Well over one-half of the sulfate is generated from the area outside the domain.

5.2.3 PSAT Regional Contribution to Nitrate on 20% Worst Days

Figures 5.2.3-1 through 5.2.3-3 in this section illustrate the state and regional contribution of nitrate to the 20% worst days in Wyoming Class I areas for 2002 and 2018, based on PSAT profiles for each IMPROVE monitoring site representing the nearest Class I areas.

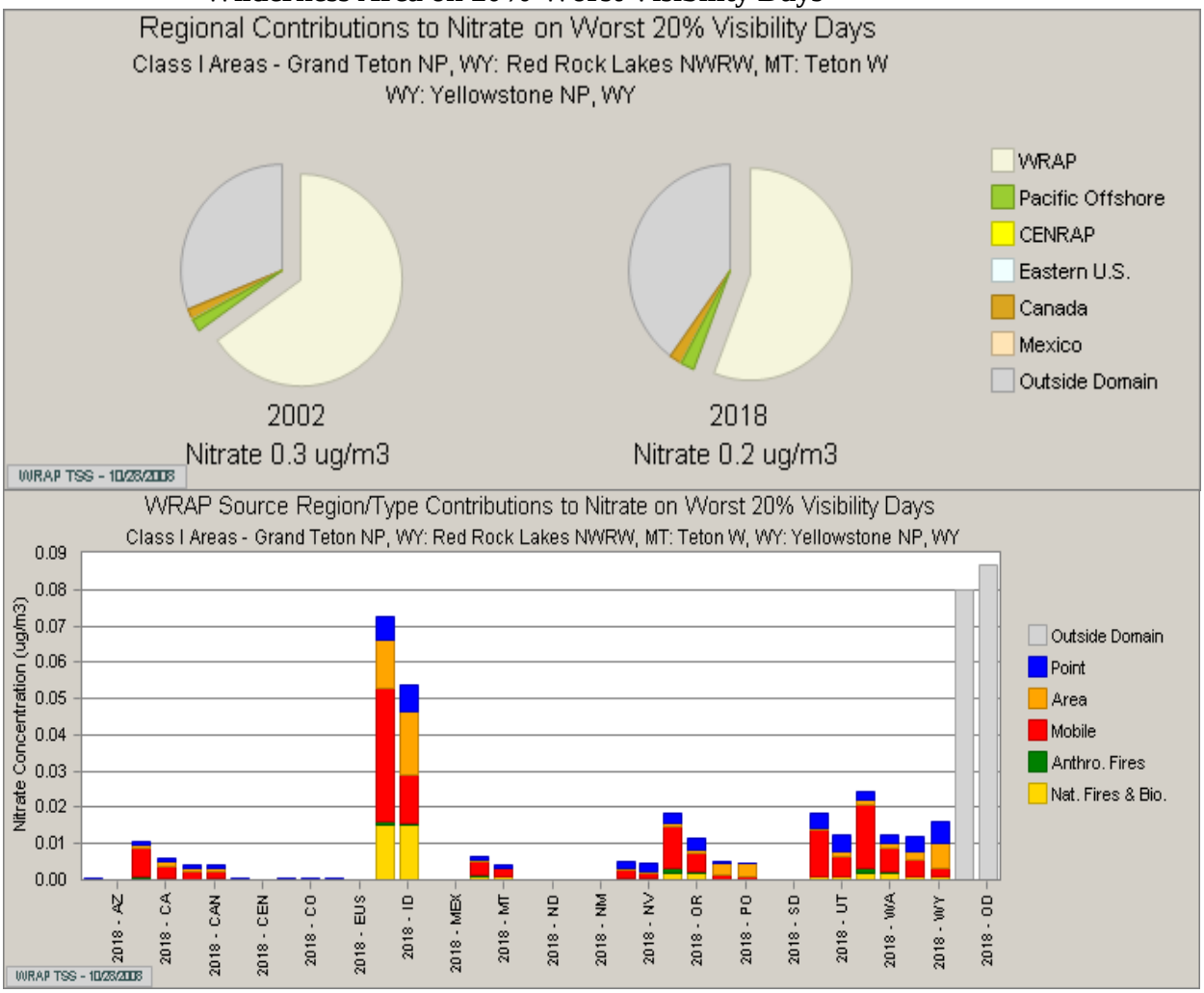
In all the figures in this section, most of the nitrate originates from within the WRAP region, as opposed to the sulfate contribution, which is mostly derived from outside the WRAP. The WRAP contribution ranges from approximately one-half to nearly three-quarters of the total.

Other sizeable contributions of nitrate are generated from outside the domain, and to a much lesser extent, Canada and Pacific offshore. Contributions from other regions are negligible.

These figures indicate that overall, the majority of nitrate stems from mobile sources. In all but one of the Class I area monitors (Bridger), contributions from other states and Canada are much larger than contributions from inside Wyoming.

In terms of comparison of 2002 and 2018, these figures indicate that the WRAP portion of the pie chart has a significant decrease in nitrate by 2018. Most of this decrease can be attributed to the numerous Federal and state "on-the-books" requirements for mobile sources (see Chapter 8, Long-Term Strategy).

Figure 5.2.3-1. PSAT Nitrate Contribution at Yellowstone NP, Grand Teton NP, and Teton Wilderness Area on 20% Worst Visibility Days

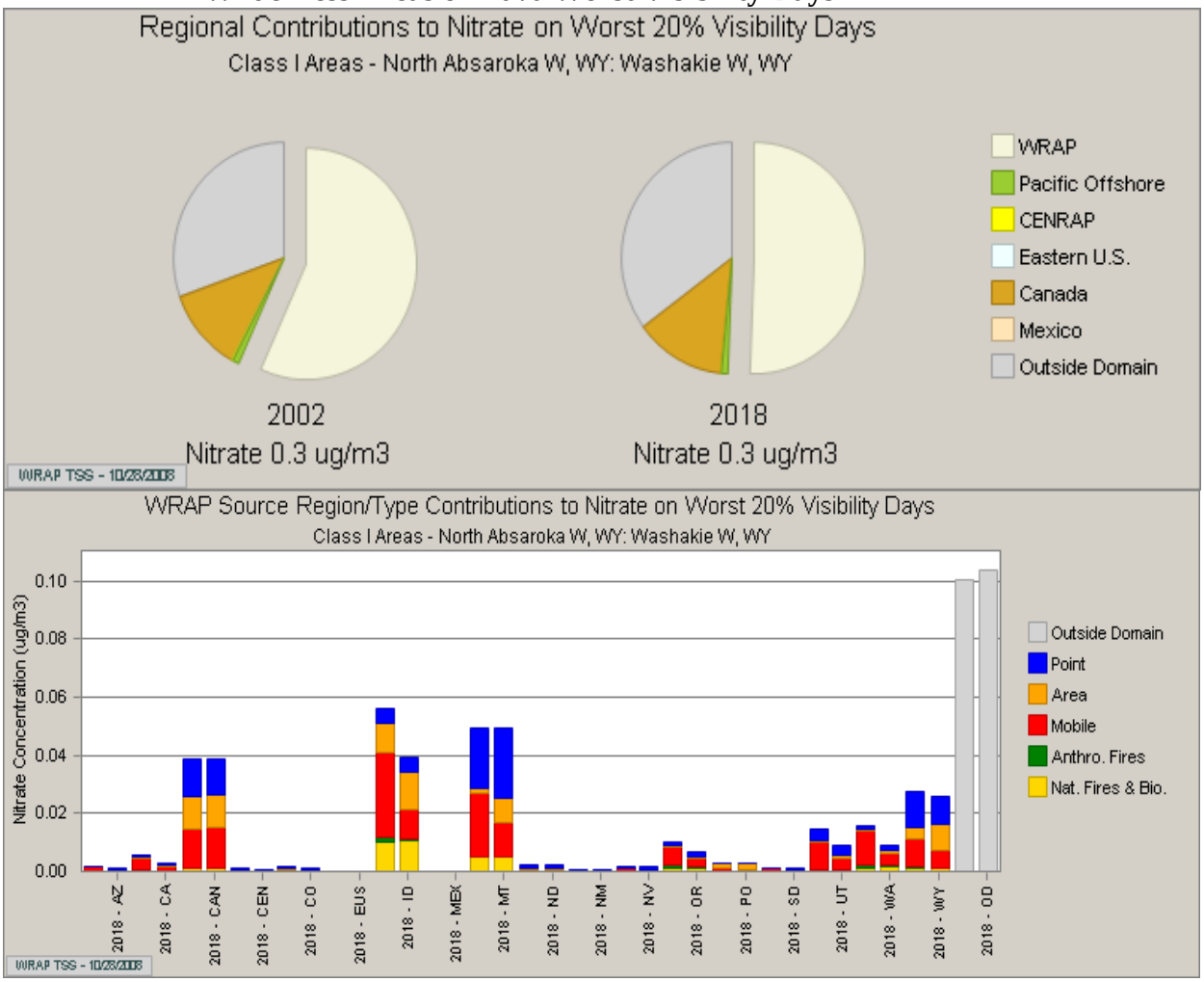


(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% worst days at Yellowstone, significant nitrate contributions can be seen from Idaho, Washington, and to a lesser extent, Oregon, Utah and Wyoming. Mobile sources make up the majority of the overall contributions. However, the projected 2018 area source contributions for

Idaho and Wyoming exceed the mobile source contribution. In most cases, nitrate contributions are projected to decline significantly by 2018, with the exception of a small increase within Wyoming.

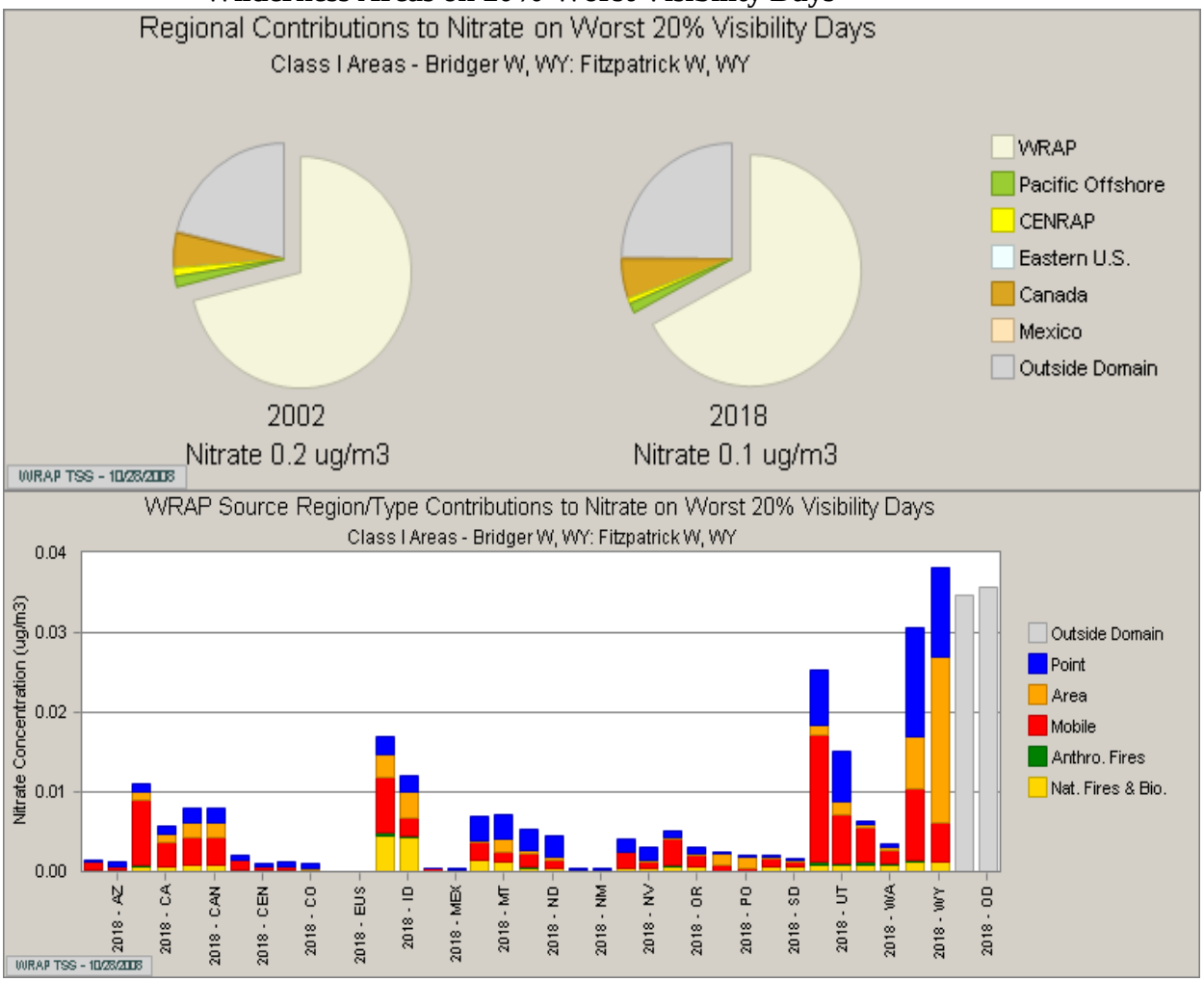
Figure 5.2.3-2. PSAT Nitrate Contribution at North Absaroka Wilderness and Washakie Wilderness Areas on 20% Worst Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% worst days, significant nitrate contributions for North Absaroka can be seen from Idaho, Montana, and Canada. The extent of contribution from Montana and Canada is greater at this monitoring site due to their close proximity. The extent of Idaho's contribution is less at this site compared to the Yellowstone site, also due to proximity. Smaller contributions of nitrate originate from Wyoming, Washington, Utah, and Oregon. Mobile sources appear to be the dominant contributor overall; however, point sources in Montana are a large factor.

Figure 5.2.3-3. PSAT Nitrate Contribution at Bridger Wilderness and Fitzpatrick Wilderness Areas on 20% Worst Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Unlike Yellowstone and North Absaroka, for the 20% worst days the largest nitrate contribution for Bridger originates within Wyoming. Point sources in 2002 and projected area and point sources in 2018 appear to be the largest contributors within Wyoming. The next highest contribution comes from Utah, followed by Idaho. It is interesting to note that contributions from California (mostly mobile source) in 2002 were greater than contributions from Canada or Montana.

5.2.4 PSAT Regional Contribution to Nitrate on 20% Best Days

Figures 5.2.4-1 through 5.2.4-3 in this section illustrate the state and regional contribution of nitrate to the 20% best days in Wyoming Class I areas for 2002 and 2018, based on PSAT profiles for each IMPROVE monitoring site representing the nearest Class I areas.

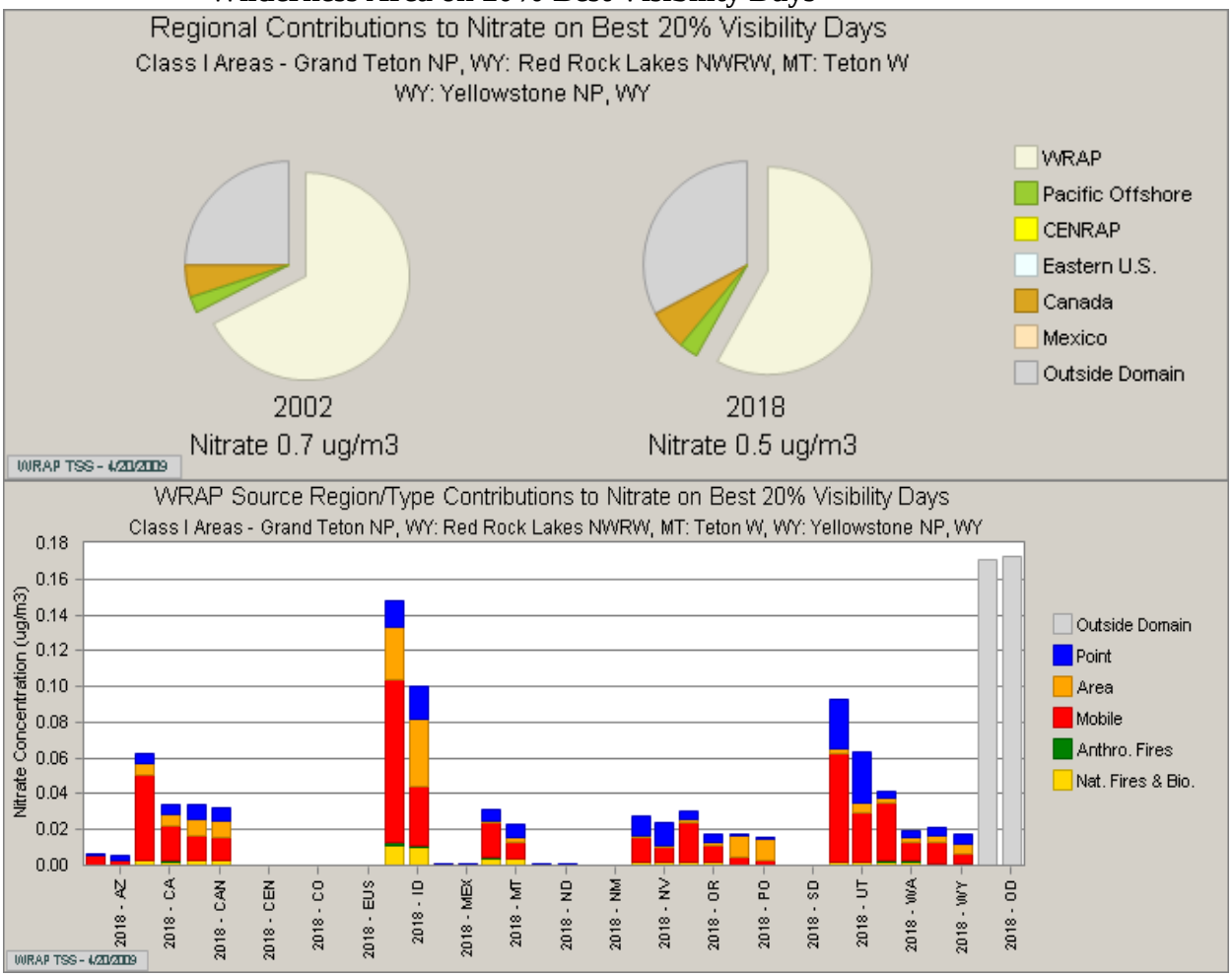
In all the figures in this section, most of the nitrate originates from within the WRAP region, as opposed to the sulfate contribution, which is mostly derived from outside the WRAP. The

WRAP contribution ranges from approximately one-half to nearly three-quarters of the total. Other sizeable contributions of nitrate are generated from outside the domain, and to a much lesser extent, Canada and Pacific offshore. Contributions from other regions are negligible.

These figures indicate that overall, the majority of nitrate stems from mobile sources. Point and area sources are the next largest categories of nitrate contribution, especially at the Bridger monitoring site, where Wyoming's area and point source contribution is the most sizeable. In all but one of the Class I area monitors (Bridger), contributions from other states and Canada are much larger than contributions from inside Wyoming.

In terms of comparison of 2002 and 2018, these figures indicate that the WRAP portion of the pie chart has a significant decrease in nitrate by 2018. Most of this decrease can be attributed to the numerous Federal and state "on-the-books" requirements for mobile sources (see Chapter 8, Long-Term Strategy).

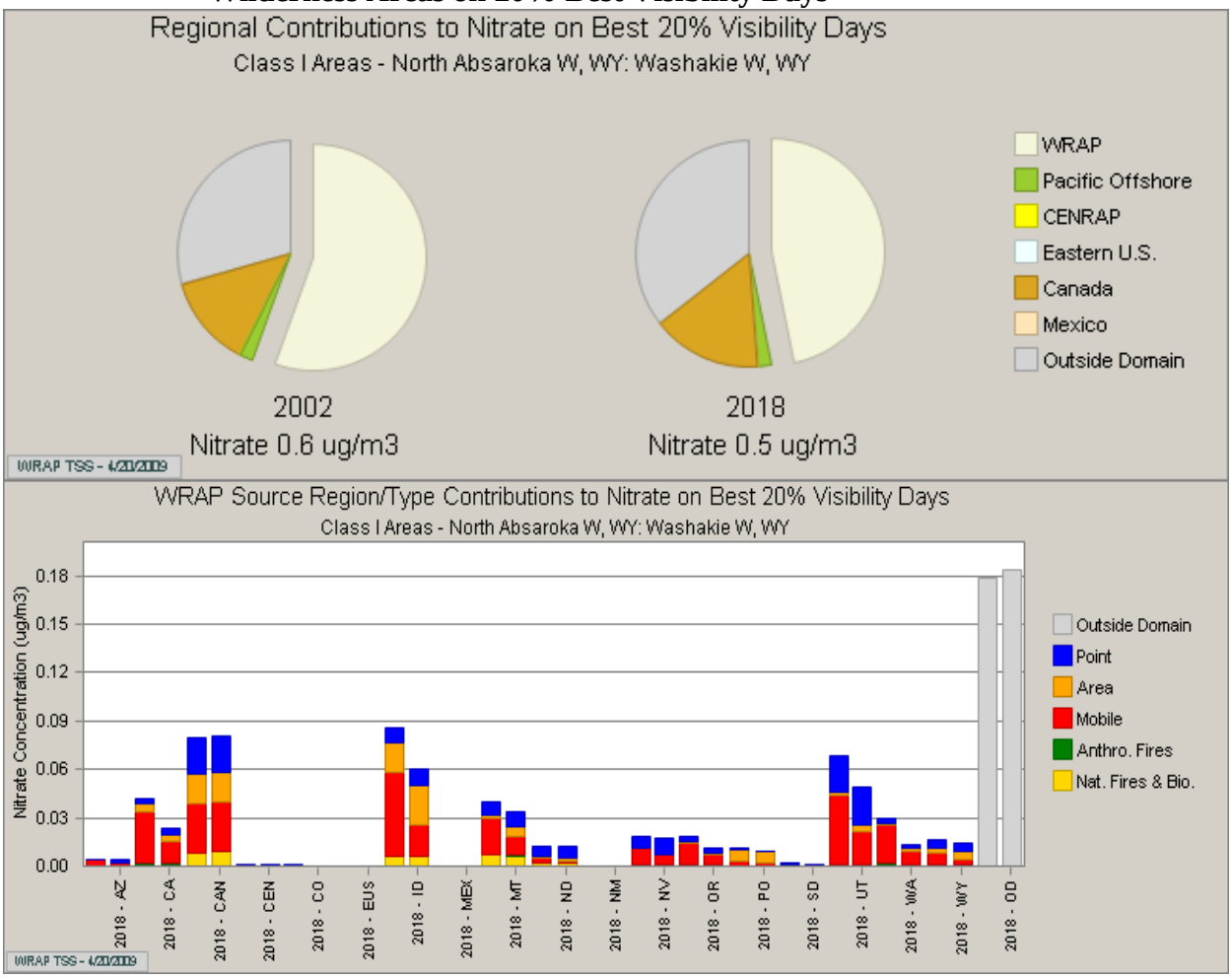
Figure 5.2.4-1. PSAT Nitrate Contribution at Yellowstone NP, Grand Teton NP, and Teton Wilderness Area on 20% Best Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% best days at Yellowstone, significant nitrate contributions can be seen from Idaho, Utah, California and Washington, and to a lesser extent, Canada, Montana, Oregon and Wyoming. Mobile sources make up the majority of the overall contributions. Nitrate contributions are projected to decline significantly by 2018.

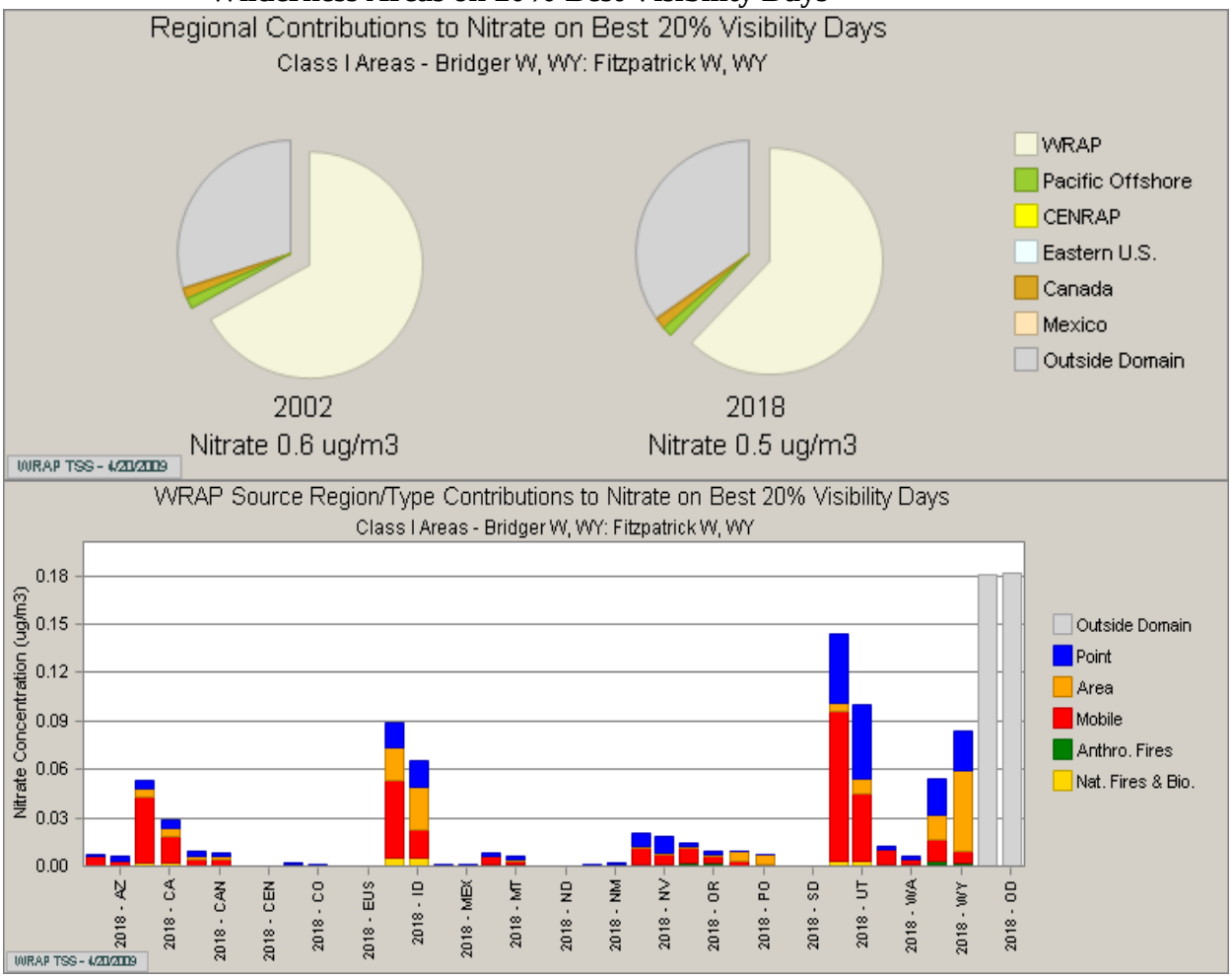
Figure 5.2.4-2. PSAT Nitrate Contribution at North Absaroka Wilderness and Washakie Wilderness Areas on 20% Best Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% best days, significant nitrate contributions for North Absaroka can be seen from Idaho, Canada, Utah, California and Montana. The extent of contribution from these states and Canada is due in part to wind direction and proximity. The extent of Idaho's contribution is less at this site compared to the Yellowstone site, due mostly to proximity. Smaller contributions of nitrate originate from Washington, Nevada, Oregon, Wyoming and North Dakota. Mobile sources appear to be the dominant contributor overall; however, point sources in Utah and California and area sources in Idaho and Canada are a large factor.

Figure 5.2.4-3. PSAT Nitrate Contribution at Bridger Wilderness and Fitzpatrick Wilderness Areas on 20% Best Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% best days the largest nitrate contribution for Bridger originates within Utah. Mobile and point sources appear to be the largest contributors within Utah. The next highest contribution comes from Idaho, followed by Wyoming and California. It is interesting to note that contributions from California (mostly mobile source) were greater than contributions from Canada or Montana.

5.2.5 WEP Potential Contribution to OC on 20% Worst Days

Figures 5.2.5-1 through 5.2.5-3 in this section represent the contribution of organic carbon to the 20% worst days in Wyoming Class I areas for 2002 and 2018, based on the WEP profile for each IMPROVE monitoring site representing the nearest Class I areas.

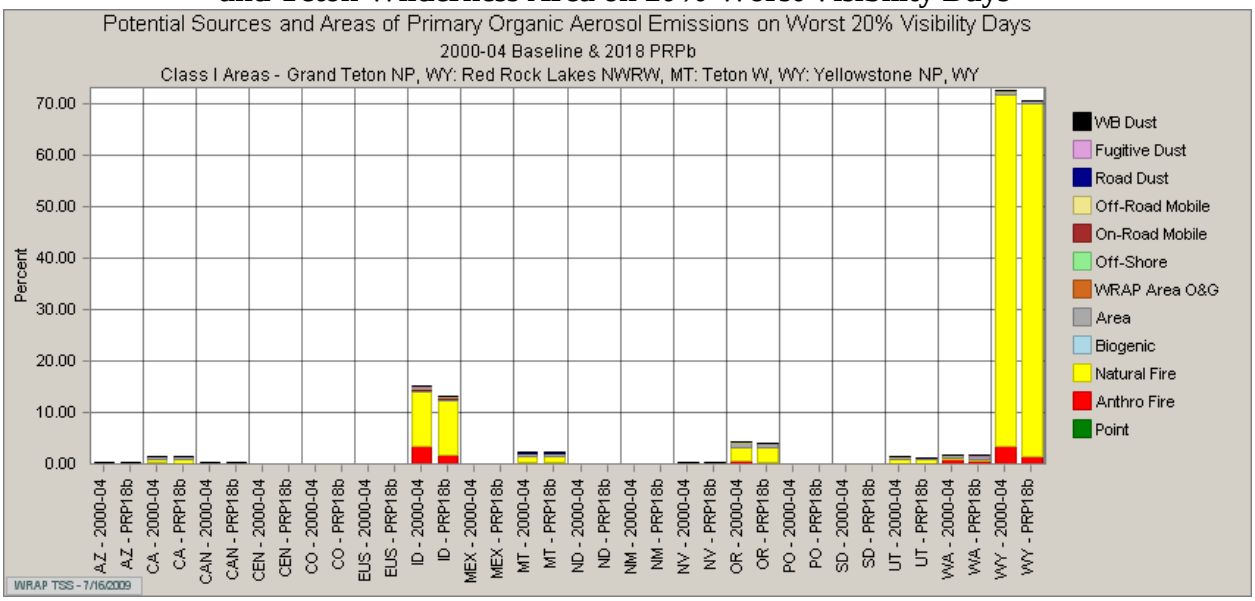
In general, the figures below primarily reflect the contribution of fire sources - mostly natural fire (wildfire) and to a lesser degree, anthropogenic or controlled burning (forestry, agricultural, and residential burning). Area source organic carbon is from woodstoves and other urban related

sources. Area source contributions of organic carbon are the lowest at the Yellowstone Class I area monitoring site due to its location, which is not near any urban areas.

When comparing 2002 and 2018, the figures show a slight reduction in future years, mainly due to a projected drop in anthropogenic fires. Most other sources remain fairly constant.

The WRAP TSS website states that the Primary Organic Aerosol parameter represents organic carbon compounds emitted directly as particulates, but not secondary organics which condense from a gaseous state after being emitted.

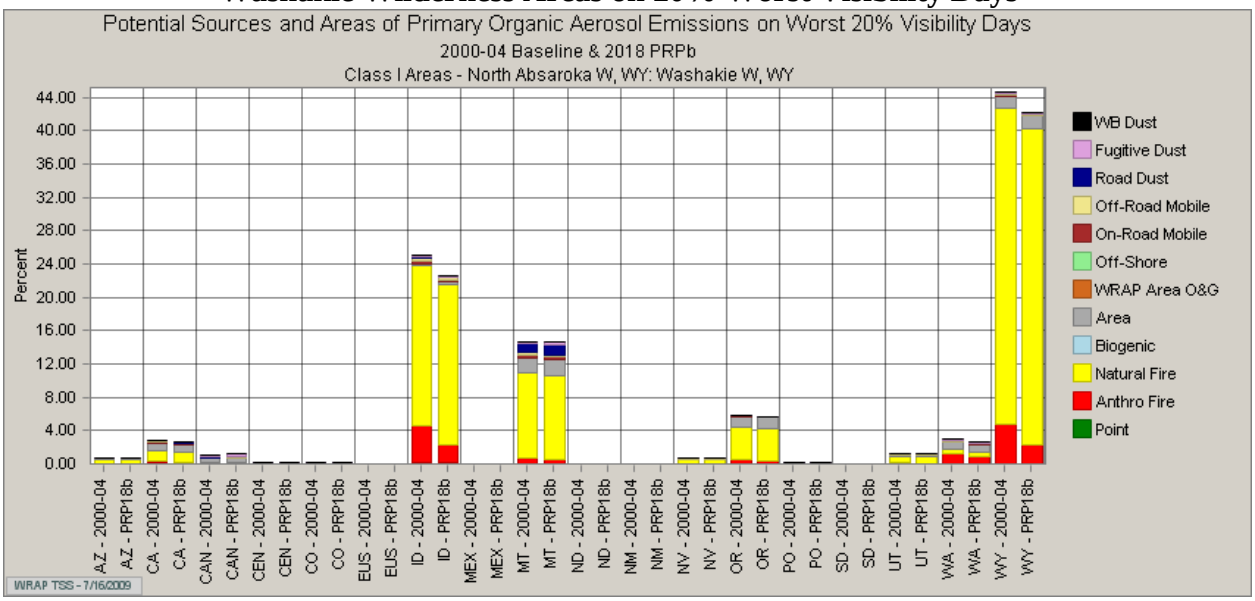
Figure 5.2.5-1. WEP Potential Contribution to OC at Yellowstone NP, Grand Teton NP, and Teton Wilderness Area on 20% Worst Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% worst visibility days at Yellowstone, the most sizeable organic carbon contribution is from Wyoming natural fire sources, and to a minimal extent, anthropogenic fire followed by area sources. A much smaller contribution from these sources in Idaho can be seen.

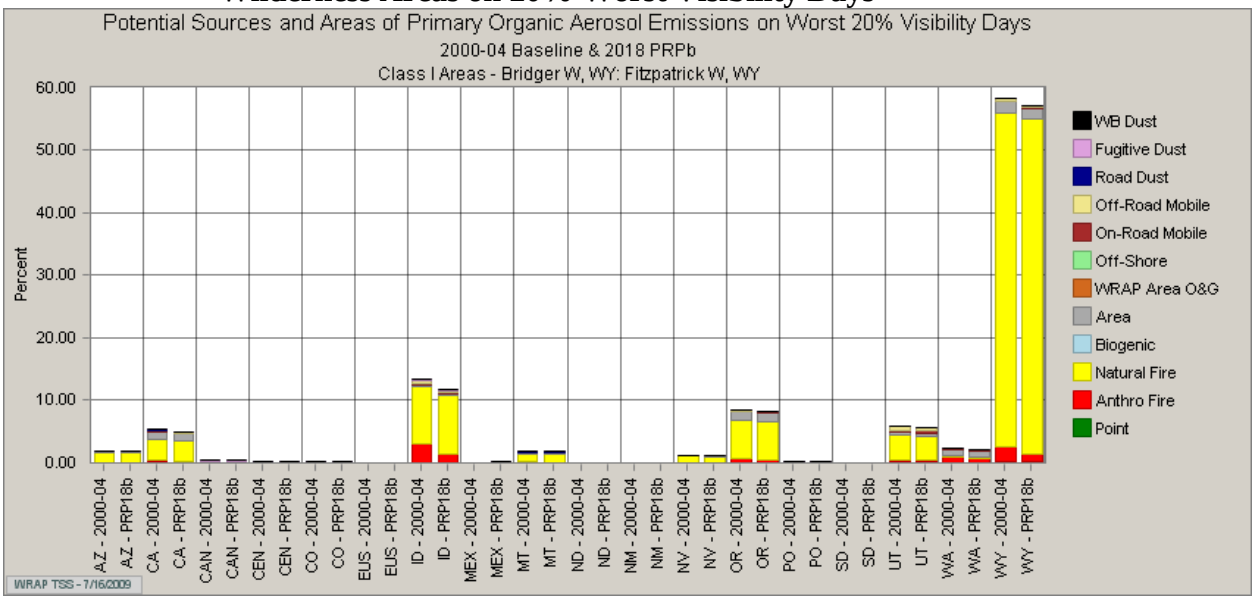
Figure 5.2.5-2. WEP Potential Contribution to OC at North Absaroka Wilderness and Washakie Wilderness Areas on 20% Worst Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% worst visibility days at North Absaroka, the most sizeable organic carbon contribution is from Wyoming natural fire sources, and to a minimal extent, anthropogenic fire followed by area sources. However, a large contribution from these sources also comes from Idaho, followed by Montana, and to a lesser extent, Oregon.

Figure 5.2.5-3. WEP Potential Contribution to OC at Bridger Wilderness and Fitzpatrick Wilderness Areas on 20% Worst Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% worst visibility days at Bridger, the most sizeable organic carbon contribution is from Wyoming natural fire sources, and to a minimal extent, area sources, followed by

anthropogenic fire. Idaho, Oregon, Utah and California are the next largest contributors, respectively.

5.2.6 WEP Potential Contribution to OC on 20% Best Days

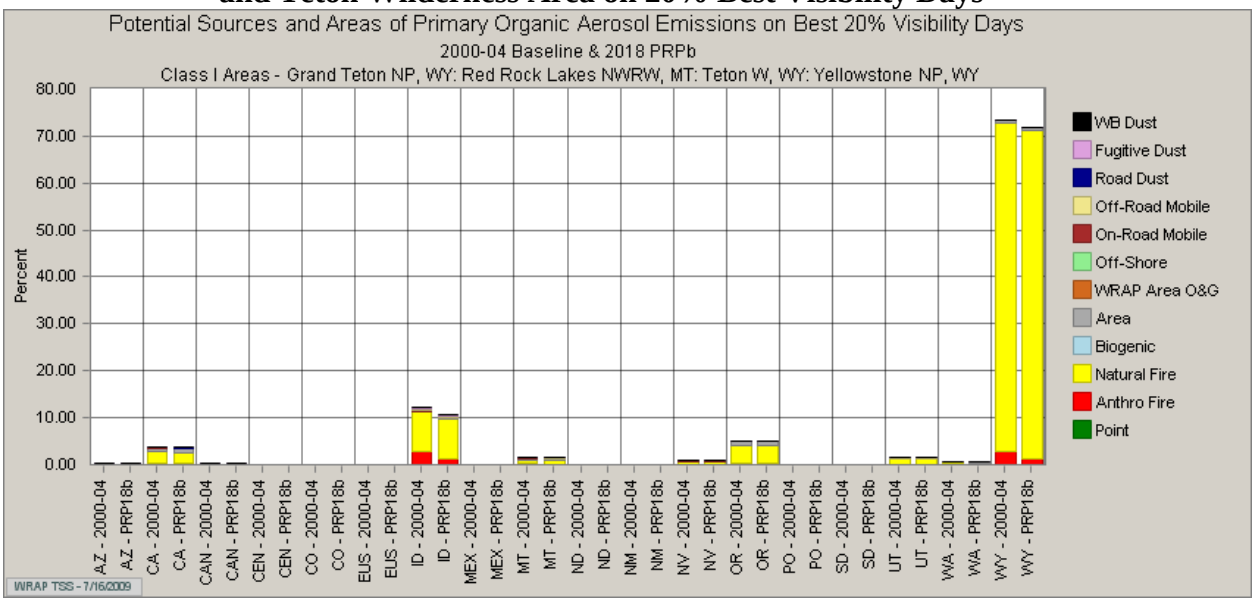
Figures 5.2.6-1 through 5.2.6-3 in this section represent the contribution of organic carbon to the 20% best days in Wyoming Class I areas for 2002 and 2018, based on the WEP profile for each IMPROVE monitoring site representing the nearest Class I areas.

In general, the figures below primarily reflect the contribution of fire sources - mostly natural fire (wildfire) and to a lesser degree, anthropogenic or controlled burning (forestry, agricultural, and residential burning). Area source organic carbon is from woodstoves and other urban related sources. Area source contributions of organic carbon are the lowest at the Yellowstone Class I area monitoring site due to its location, which is not near any urban areas.

When comparing 2002 and 2018, the figures show a slight reduction in future years, mainly due to a projected drop in anthropogenic fires. Most other sources remain fairly constant.

The WRAP TSS website states that the Primary Organic Aerosol parameter represents organic carbon compounds emitted directly as particulates, but not secondary organics which condense from a gaseous state after being emitted.

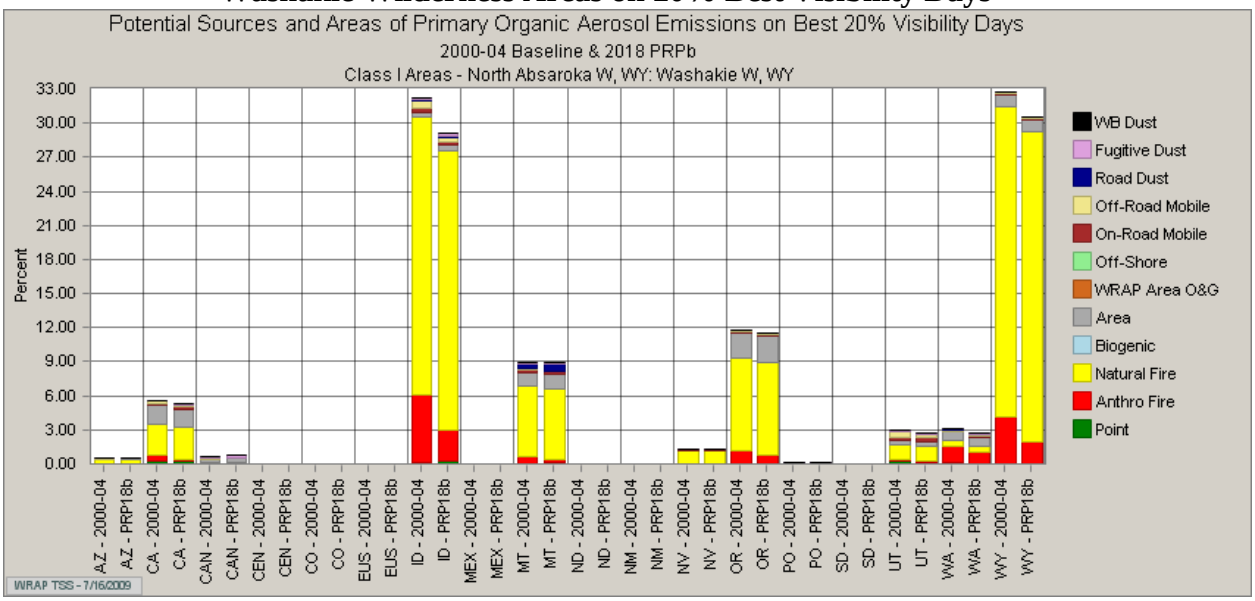
Figure 5.2.6-1. WEP Potential Contribution to OC at Yellowstone NP, Grand Teton NP, and Teton Wilderness Area on 20% Best Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% best visibility days at Yellowstone, the most sizeable organic carbon contribution is from Wyoming natural fire sources, and to a minimal extent, anthropogenic fire followed by area sources. A much smaller contribution from these sources in Idaho can be seen.

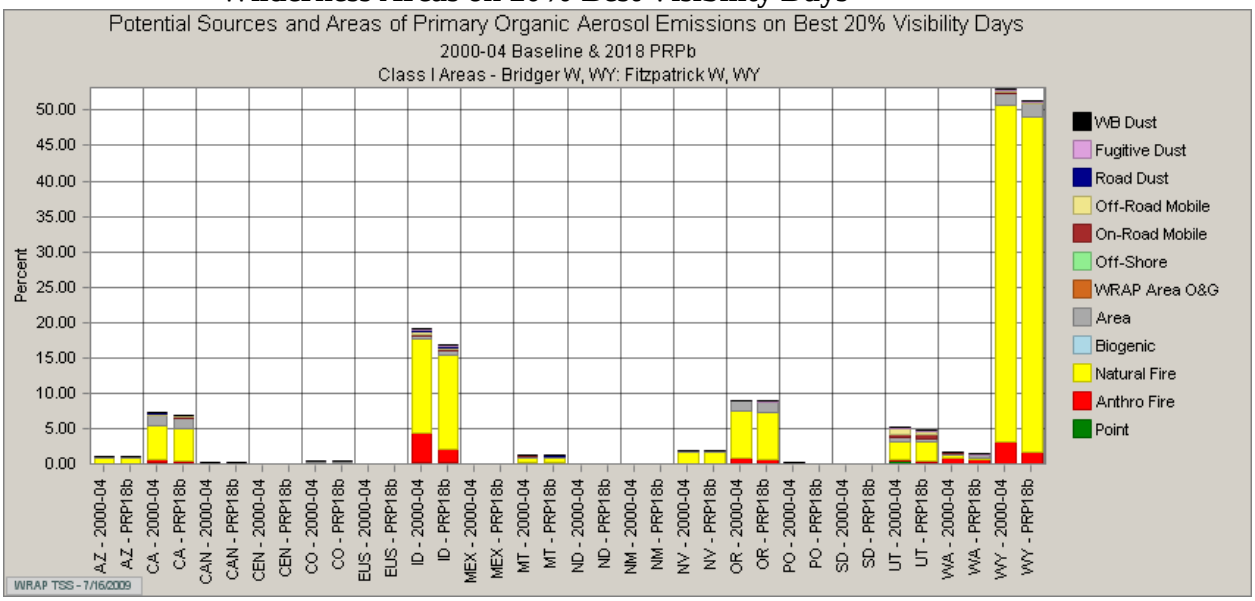
Figure 5.2.6-2. WEP Potential Contribution to OC at North Absaroka Wilderness and Washakie Wilderness Areas on 20% Best Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% best visibility days at North Absaroka, the most sizeable organic carbon contribution is from Wyoming natural fire sources, and to a minimal extent, anthropogenic fire followed by area sources. However, a contribution from these sources nearly equal in size comes from Idaho. Oregon, Montana and California, respectively, are the next largest contributors.

Figure 5.2.6-3. WEP Potential Contribution to OC at Bridger Wilderness and Fitzpatrick Wilderness Areas on 20% Best Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% best visibility days at Bridger, the most sizeable organic carbon contribution is from Wyoming natural fire sources, and to a minimal extent, area and anthropogenic fire sources. Idaho, Oregon, California and Utah are the next largest contributors, respectively.

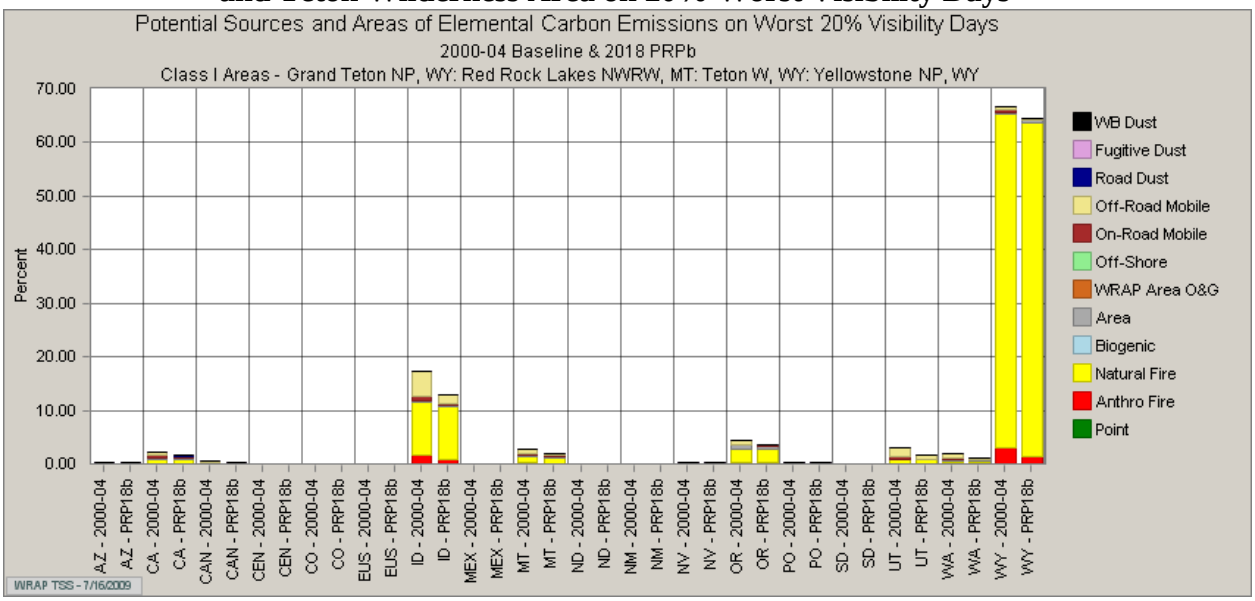
5.2.7 WEP Potential Contribution to EC on 20% Worst Days

Figures 5.2.7-1 through 5.2.7-3 in this section represent the contribution of elemental carbon to the 20% worst days in Wyoming Class I areas for 2002 and 2018, based on the WEP profile for each IMPROVE monitoring site representing the nearest Class I areas.

In general, the figures below primarily reflect the contribution of fire sources - mostly natural fire (wildfire) and to a much lesser degree, off-road mobile and anthropogenic or controlled burning (forestry, agricultural, and residential burning). Off-road mobile elemental carbon contributions are minimal to none at Yellowstone compared to North Absaroka and Bridger.

When comparing 2002 and 2018, the figures show a reduction in future years, mainly due to a projected drop in off-road mobile and anthropogenic fire emissions. Most other sources remain fairly constant.

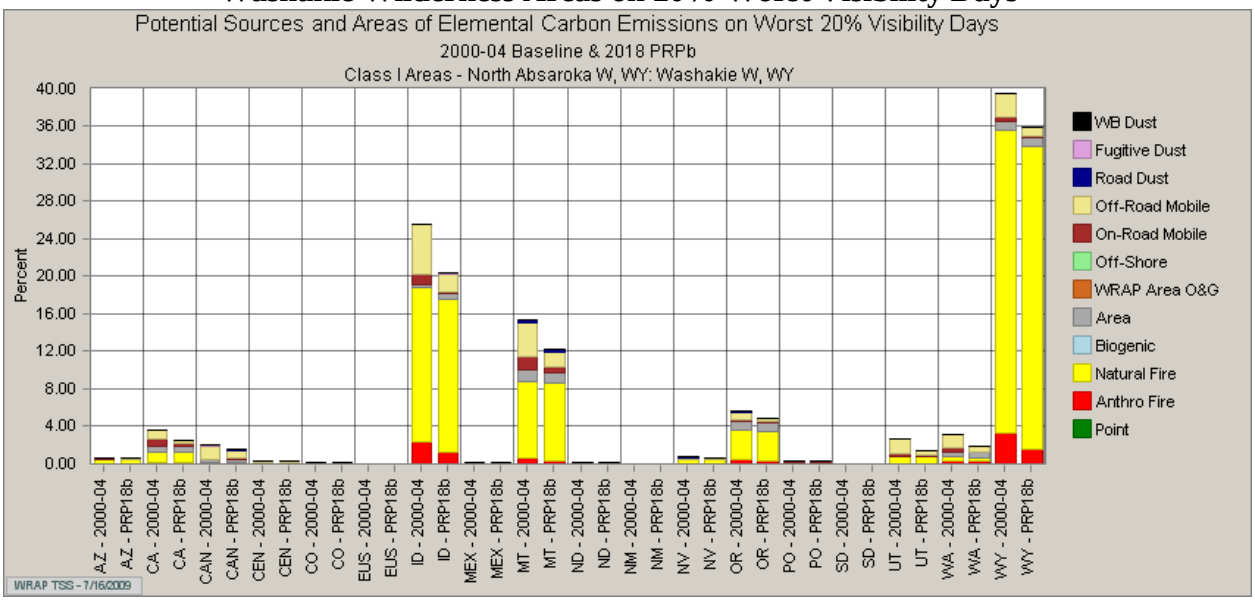
Figure 5.2.7-1. WEP Potential Contribution to EC at Yellowstone NP, Grand Teton NP, and Teton Wilderness Area on 20% Worst Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% worst visibility days at Yellowstone, the most sizeable elemental carbon contribution is from Wyoming natural fire sources, and to a minimal extent, anthropogenic fire. A much smaller contribution from these sources, except for off-road mobile, can be seen in Idaho.

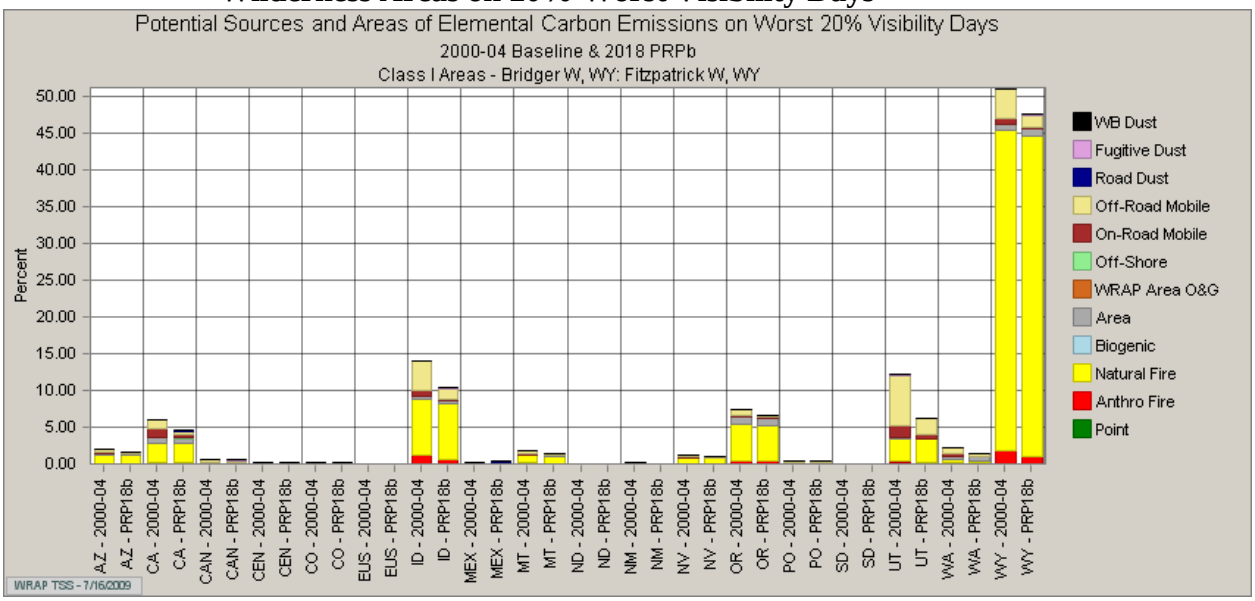
Figure 5.2.7-2. WEP Potential Contribution to EC at North Absaroka Wilderness and Washakie Wilderness Areas on 20% Worst Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

At North Absaroka for the 20% worst visibility days, natural fire sources from Wyoming is the largest contributor to elemental carbon, followed by anthropogenic fire and off-road mobile, and to a much lesser extent, area sources and on-road mobile. Idaho contributes a significant amount of these sources, followed by Montana and to a lesser extent, Oregon. California, Washington and Utah, respectively, also show some measurable contributions from these sources.

Figure 5.2.7-3. WEP Potential Contribution to EC at Bridger Wilderness and Fitzpatrick Wilderness Areas on 20% Worst Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% worst visibility days at Bridger, Wyoming is the largest contributor. Natural fire is the largest component of contribution followed by off-road mobile, anthropogenic fire, area and on-road mobile, respectively. Idaho, Utah, Oregon and California, respectively, have the next sizeable contributions from these sources at this site.

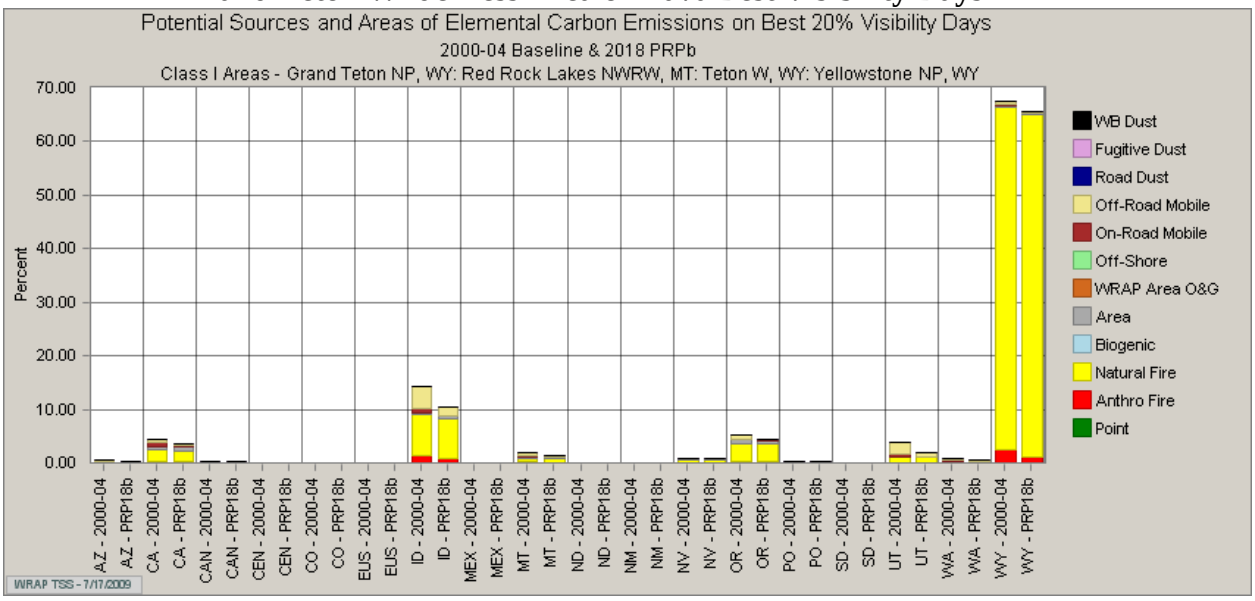
5.2.8 WEP Potential Contribution to EC on 20% Best Days

Figures 5.2.8-1 through 5.2.8-3 in this section represent the contribution of elemental carbon to the 20% best days in Wyoming Class I areas for 2002 and 2018, based on the WEP profile for each IMPROVE monitoring site representing the nearest Class I areas.

In general, the figures below primarily reflect the contribution of fire sources - mostly natural fire (wildfire) and to a much lesser degree, off-road mobile and anthropogenic or controlled burning (forestry, agricultural, and residential burning). Off-road mobile elemental carbon contributions are smaller at Yellowstone compared to North Absaroka and Bridger.

When comparing 2002 and 2018, the figures show a reduction in future years, mainly due to a projected drop in off-road mobile and anthropogenic fire emissions. Most other sources remain fairly constant.

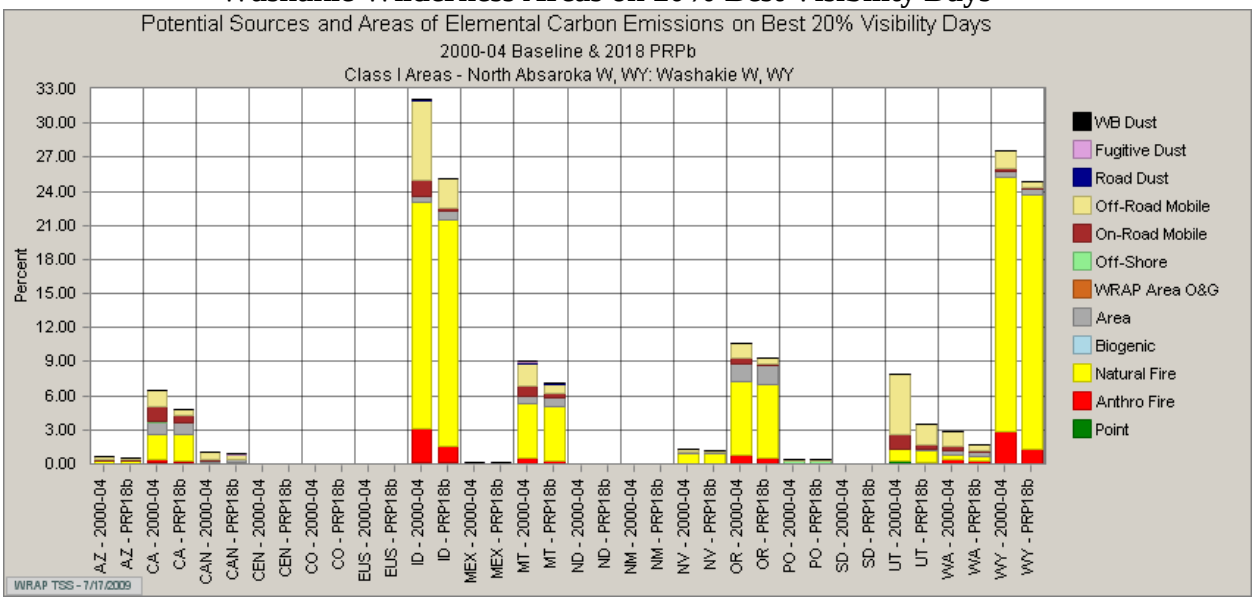
Figure 5.2.8-1. WEP Potential Contribution to EC at Yellowstone NP, Grand Teton NP, and Teton Wilderness Area on 20% Best Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% best visibility days at Yellowstone, the most sizeable elemental carbon contribution is from Wyoming natural fire sources, and to a minimal extent, anthropogenic fire followed by off-road mobile. A smaller contribution from these sources, except for off-road mobile, can be seen in Idaho.

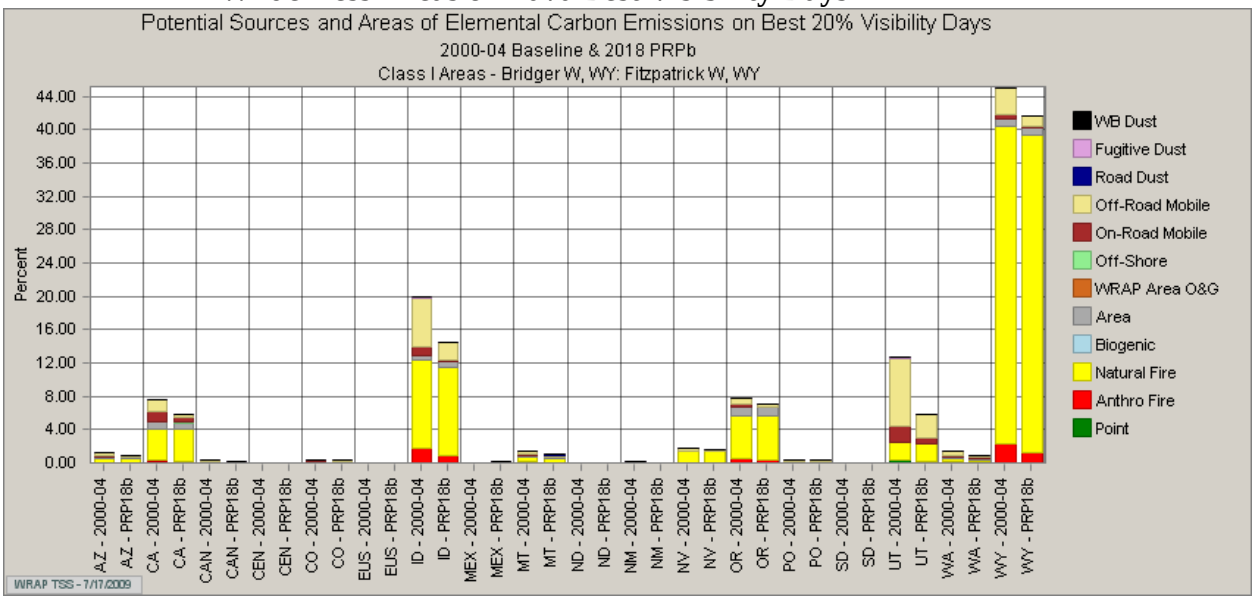
Figure 5.2.8-2. WEP Potential Contribution to EC at North Absaroka Wilderness and Washakie Wilderness Areas on 20% Best Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

At North Absaroka for the 20% best visibility days, natural fire sources from Wyoming, Idaho, Oregon and Montana are the largest contributors to elemental carbon. The next largest source is off-road mobile, mainly originating in Idaho and Utah. Anthropogenic fire, area sources and on-road mobile contribute to a much smaller degree in comparison to natural fire and off-road mobile. Idaho contributes the most significant amount of elemental carbon overall, followed by Wyoming, Oregon, Montana, Utah and California, respectively.

Figure 5.2.8-3. WEP Potential Contribution to EC at Bridger Wilderness and Fitzpatrick Wilderness Areas on 20% Best Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% best visibility days at Bridger, Wyoming is the largest contributor. Natural fire is the largest component of contribution followed by off-road mobile, anthropogenic fire, area and on-road mobile, respectively. Idaho, Utah, Oregon and California, respectively, have the next sizeable contributions from these sources at this site.

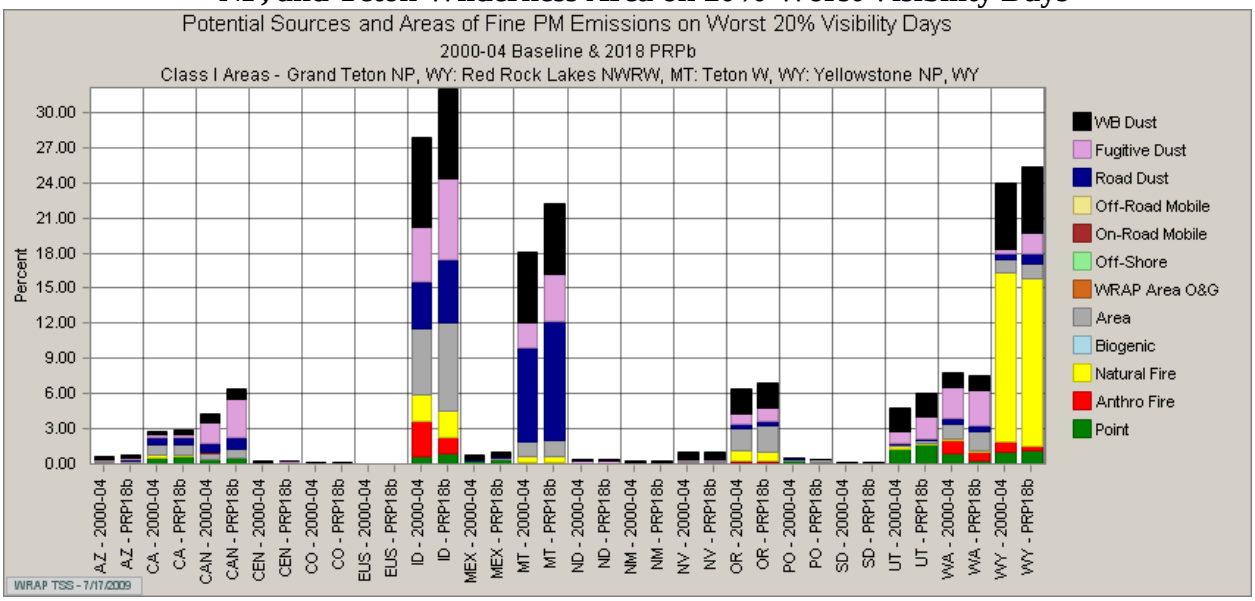
5.2.9 WEP Potential Contribution to Fine PM on 20% Worst Days

Figures 5.2.9-1 through 5.2.9-3 in this section illustrate the contribution of fine PM to the 20% worst days in Wyoming Class I areas for 2002 and 2018, based on the WEP profile for each IMPROVE monitoring site representing the nearest Class I areas.

In general, the figures below represent contributions which consist predominantly of dust sources (mining, construction, unpaved roads and agriculture), with smaller contributions from area sources (woodstoves, etc.) and point sources, followed by natural fire and anthropogenic fire. Note that the largest contribution from natural fire in all three figures originates in Wyoming, with the most sizeable contribution affecting the Yellowstone monitoring site.

When comparing 2002 and 2018, these figures indicate a consistent increase in most cases in fine PM emissions, primarily from dust sources. However, at the Bridger site, a small increase in point source contribution is noted.

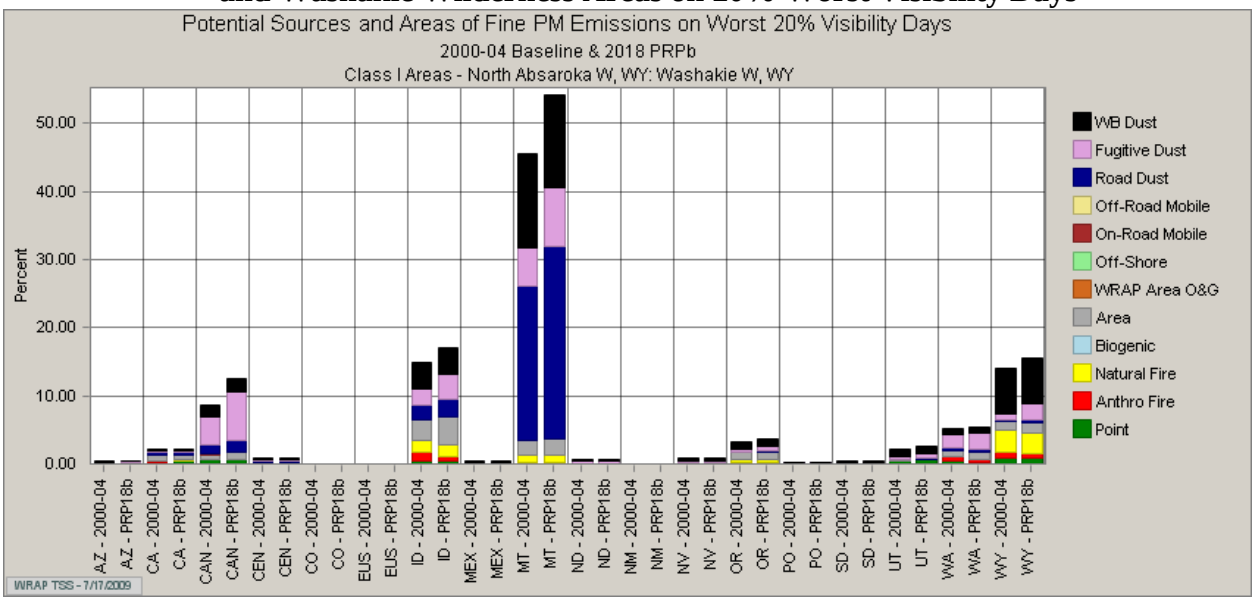
Figure 5.2.9-1. WEP Potential Contribution to Fine PM at Yellowstone NP, Grand Teton NP, and Teton Wilderness Area on 20% Worst Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

The 20% worst visibility days at Yellowstone are dominated by fine PM contributions from dust sources in Idaho and Montana. Idaho also contributes a sizeable amount of fine PM area source emissions. Wyoming's fine PM contributions are slightly higher than Montana's, but originate mainly from natural fire sources, followed by dust sources. Less significant PM contributions from dust sources are noted in Washington, Oregon, Canada, and Utah, respectively.

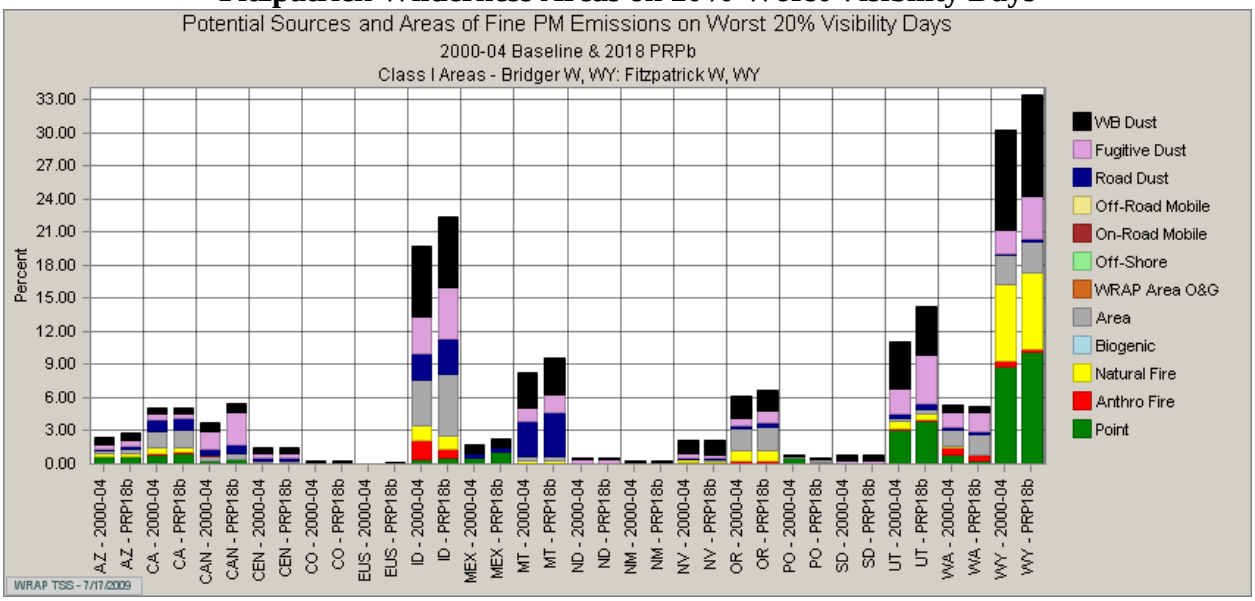
Figure 5.2.9-2. WEP Potential Contributions to Fine PM at North Absaroka Wilderness and Washakie Wilderness Areas on 20% Worst Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Dust sources in Montana are the overwhelming fine PM contributor for the 20% worst visibility days at North Absaroka, mainly due to the proximity of the monitoring site. The next largest contributor is Idaho, followed closely by Wyoming and Canada. The second largest source in Wyoming is natural fire, and in Idaho and Montana it is area sources. Dust sources in Washington and Oregon contribute to fine PM at North Absaroka, but to a much lesser degree.

Figure 5.2.9-3. WEP Potential Contribution to Fine PM at Bridger Wilderness and Fitzpatrick Wilderness Areas on 20% Worst Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% worst visibility days at Bridger, Wyoming is the dominant contributor to fine PM. Contributions are split fairly evenly between dust sources, point sources and natural fire, with dust sources being slightly more predominant. Idaho has quite sizeable contributions consisting of dust sources, followed by area sources. Utah is the next largest contributor with dust sources followed by point sources making up the majority of the components. Montana, Oregon, Washington, California and Canada, respectively, all have sizeable contributions of fine PM as well.

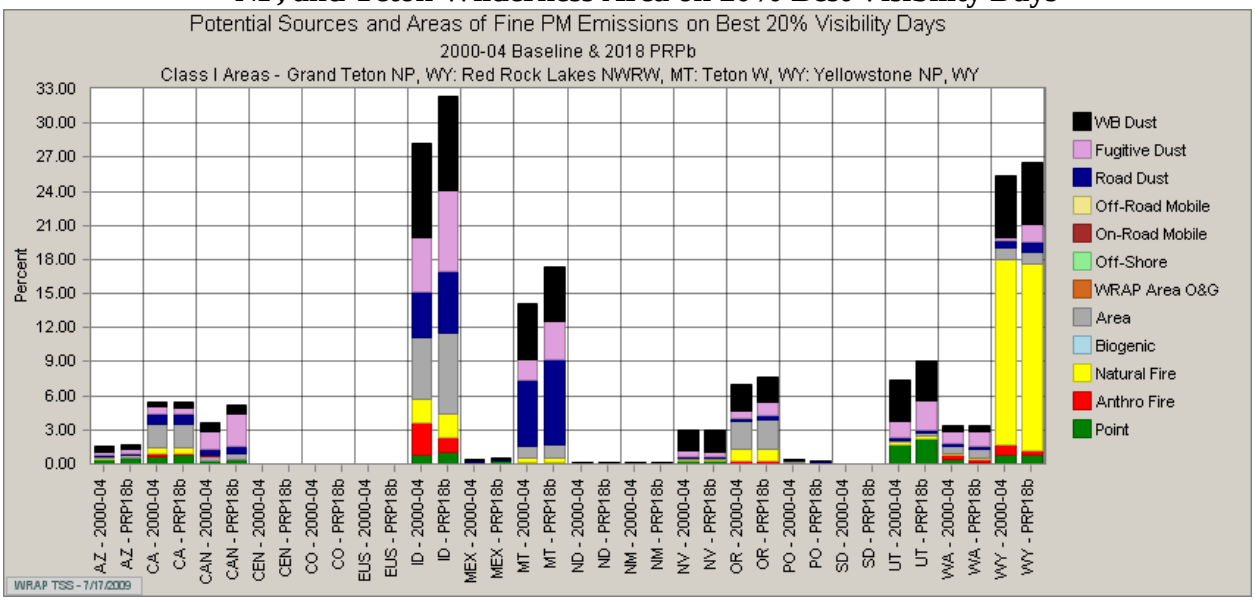
5.2.10 WEP Potential Contribution to Fine PM on 20% Best Days

Figures 5.2.10-1 through 5.2.10-3 in this section illustrate the contribution of fine PM to the 20% best days in Wyoming Class I areas for 2002 and 2018, based on the WEP profile for each IMPROVE monitoring site representing the nearest Class I areas.

In general, the figures below represent contributions which consist predominantly of dust sources (mining, construction, unpaved roads and agriculture), with smaller contributions from area sources (woodstoves, etc.) and point sources, followed by natural fire and anthropogenic fire. Note that the largest contribution from natural fire in all three figures originates in Wyoming, with the most sizeable contribution affecting the Yellowstone monitoring site.

When comparing 2002 and 2018, these figures indicate a consistent increase in most cases in fine PM emissions, primarily from dust sources. However, in all three figures, a small increase in point source contribution is noted.

Figure 5.2.10-1. WEP Potential Contribution to Fine PM at Yellowstone NP, Grand Teton NP, and Teton Wilderness Area on 20% Best Visibility Days

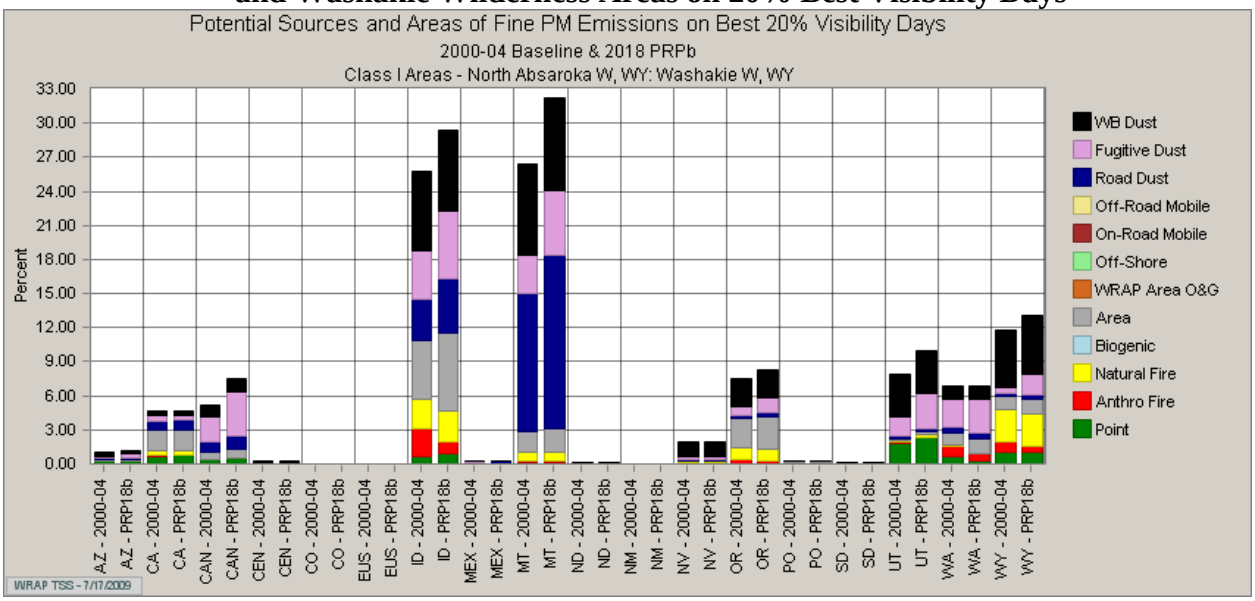


(WRAP TSS - http://vista.cira.colostate.edu/tss/)

The 20% best visibility days at Yellowstone are dominated by fine PM contributions from dust sources in Idaho, Wyoming and Montana. Idaho also contributes a sizeable amount of fine PM area source emissions. Wyoming's fine PM contributions originate mainly from natural fire

sources, followed by dust sources. Significant PM contributions from dust sources are also noted in Utah and Oregon, and to a lesser degree in California, Canada, Washington and Nevada.

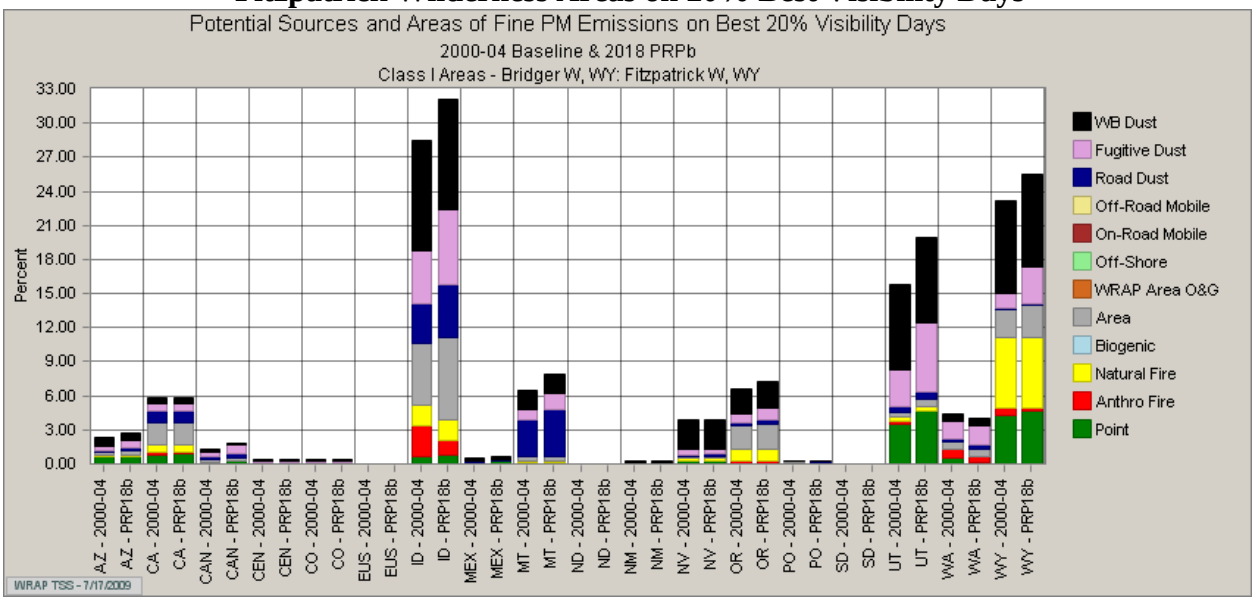
Figure 5.2.10-2. WEP Potential Contribution to Fine PM at North Absaroka Wilderness and Washakie Wilderness Areas on 20% Best Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Dust sources in Montana and Idaho are the overwhelming fine PM contributors for the 20% best visibility days at North Absaroka. The next largest contributor is Wyoming, followed closely by Utah, Oregon, Canada, Washington and California, respectively. The second largest source in Wyoming is natural fire, and in Montana and Idaho it is area sources.

Figure 5.2.10-3. WEP Potential Contribution to Fine PM at Bridger Wilderness and Fitzpatrick Wilderness Areas on 20% Best Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% best visibility days at Bridger, Idaho is the dominant contributor to fine PM, followed by Wyoming and Utah. Dust sources are predominant, followed by natural fire, point, and area sources. Montana, Oregon, California, Nevada and Washington, respectively, are the next largest contributors. Dust sources, followed by area and point sources, make up the majority of the contribution components from these states.

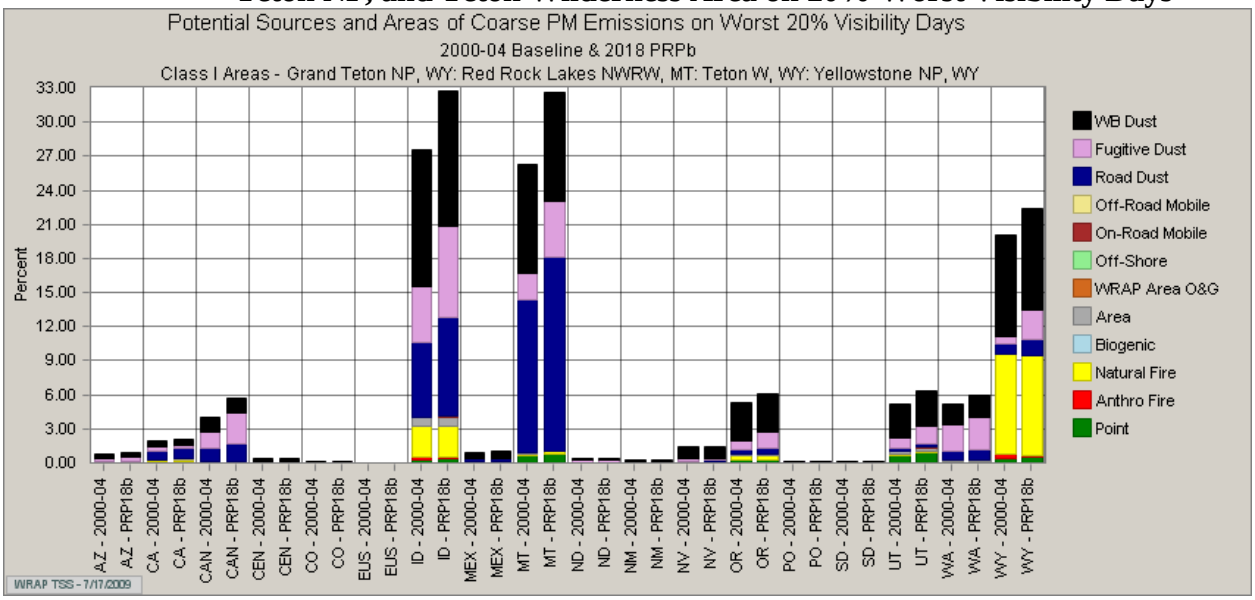
5.2.11 WEP Potential Contribution to Coarse PM on 20% Worst Days

Figures 5.2.11-1 through 5.2.11-3 in this section illustrate the contribution of coarse PM to the 20% worst days in Wyoming Class I areas for 2002 and 2018, based on WEP profiles for each IMPROVE monitoring site representing the nearest Class I areas.

The figures below show that the profile for coarse PM is dominated by road dust, windblown dust, and to a lesser extent, fugitive dust. These dust sources are generated mainly from Montana and Idaho, with the exception of the Bridger site, where most of the coarse PM emissions are generated in Wyoming. These dust sources are a combination of natural and human activity, such as construction, mining, unpaved and paved roads, and agriculture. There is some contribution from natural fire sources, mainly from Wyoming and Idaho, as well as contributions from point sources in Wyoming, Utah and Montana.

When comparing 2002 and 2018, most figures show increases in fugitive dust and road dust mainly due to population growth. Windblown dust remains constant in all figures.

Figure 5.2.11-1. WEP Potential Contribution to Coarse PM at Yellowstone NP, Grand Teton NP, and Teton Wilderness Area on 20% Worst Visibility Days

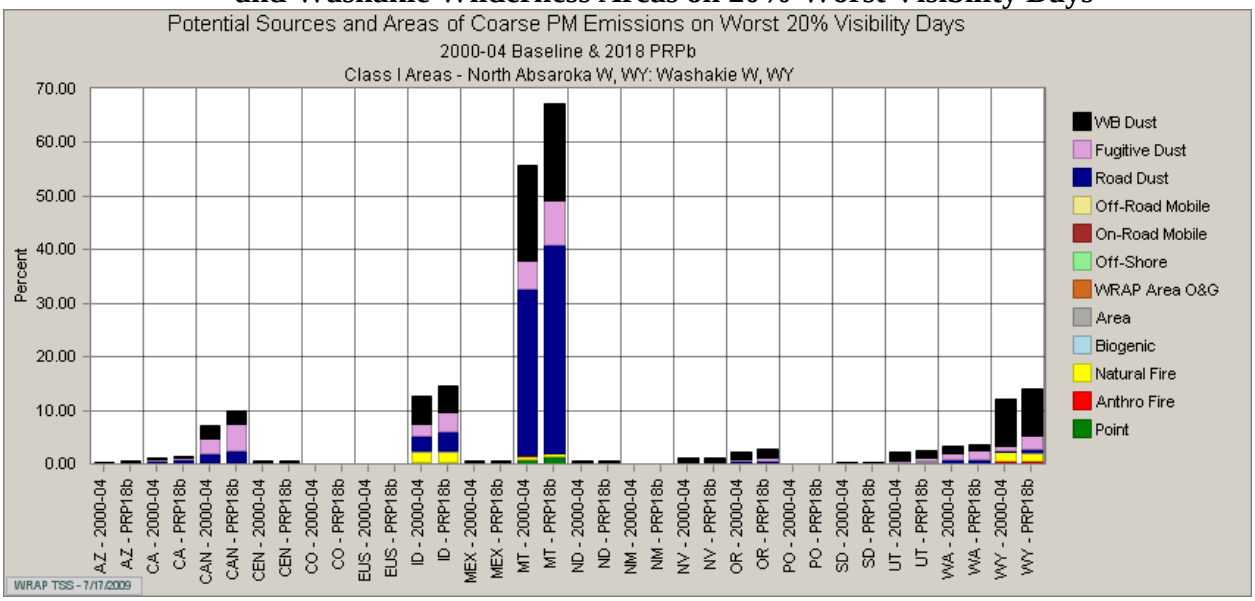


(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% worst visibility days at Yellowstone, the most sizeable coarse PM contributions are from dust sources originating in Montana and Idaho. Wyoming is the third largest contributor of coarse PM, with slightly less than 50% coming from natural fire sources and the remainder

mainly from dust sources. To a much lesser extent, Utah, Oregon, Washington and Canada also contribute coarse PM to the Yellowstone monitoring site.

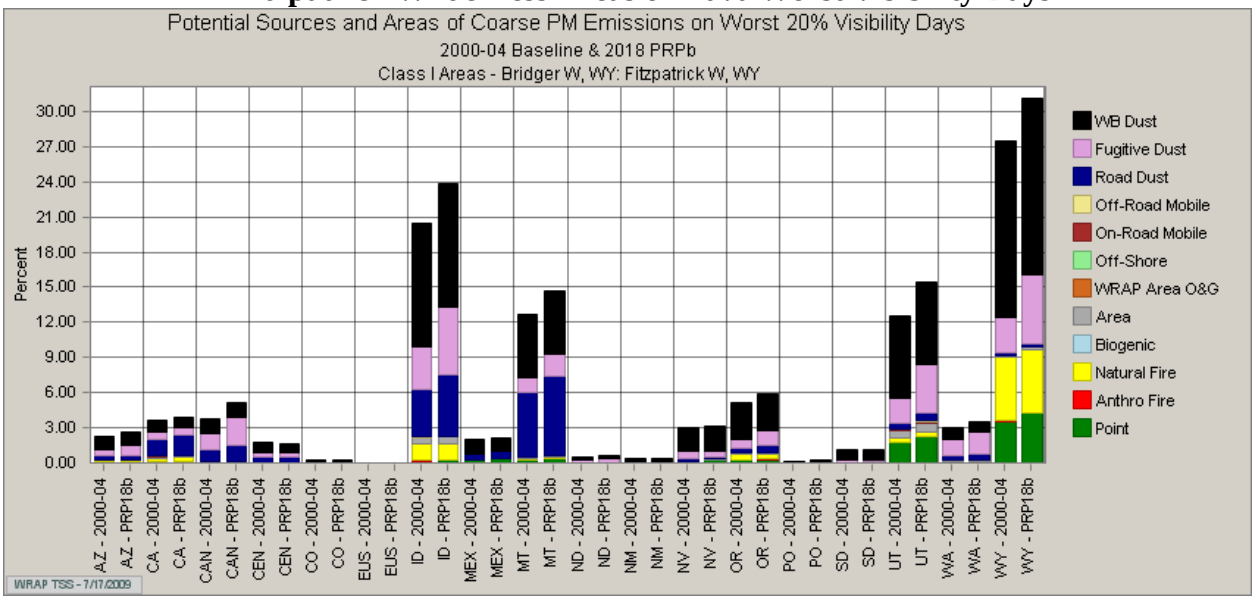
Figure 5.2.11-2. WEP Potential Contribution to Coarse PM at North Absaroka Wilderness and Washakie Wilderness Areas on 20% Worst Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Dust sources from Montana, by far, are the largest contributor to coarse PM on the 20% worst visibility days at North Absaroka. Idaho and Wyoming are the next largest contributors, followed by Canada.

Figure 5.2.11-3. WEP Potential Contribution to Coarse PM at Bridger Wilderness and Fitzpatrick Wilderness Areas on 20% Worst Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% worst visibility days at Bridger, Wyoming is the largest contributor of coarse PM, followed closely by Idaho, Utah and Montana, respectively. Point and natural fire sources from Wyoming comprise approximately one-third of the coarse PM contribution, while dust sources make up roughly two-thirds of the contribution. Oregon, Canada, California, Washington and Nevada contribute coarse PM to a much lesser extent at this site.

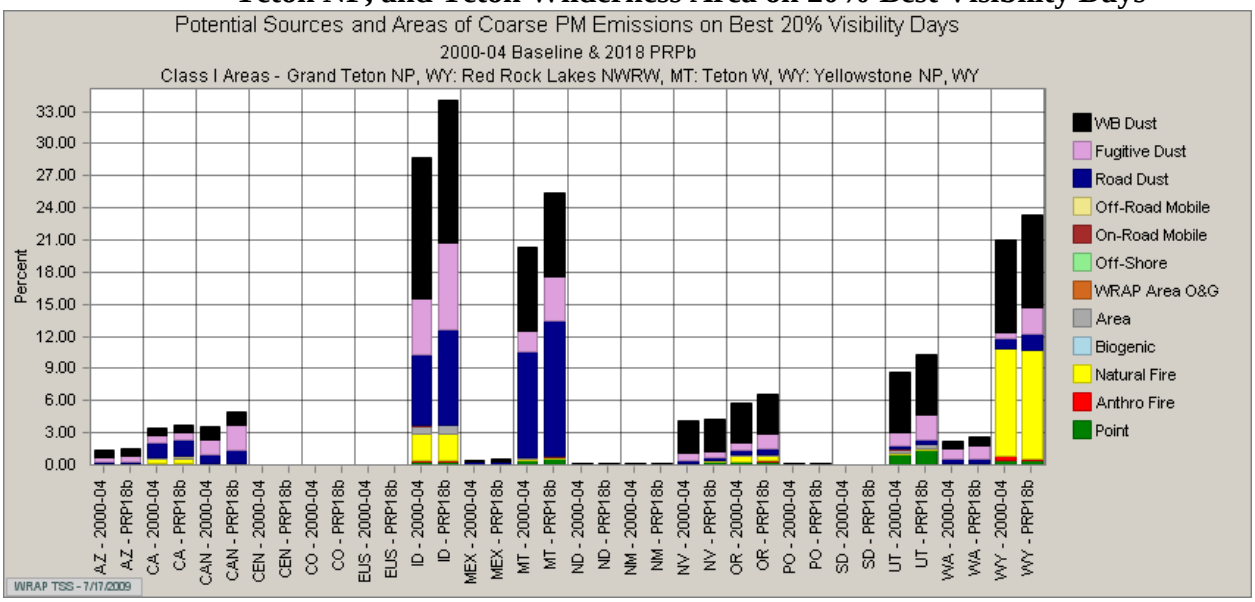
5.2.12 WEP Potential Contribution to Coarse PM on 20% Best Days

Figures 5.2.12-1 through 5.2.12-3 in this section illustrate the contribution of coarse PM to the 20% best days in Wyoming Class I areas for 2002 and 2018, based on WEP profiles for each IMPROVE monitoring site representing the nearest Class I areas.

The figures below show that the profile for coarse PM is dominated by road dust, windblown dust, and to a lesser extent, fugitive dust. These dust sources are generated mainly from Montana and Idaho, with the exception of the Bridger site, where most of the coarse PM emissions are generated in Idaho, Wyoming and Utah, respectively. Montana generates approximately one-third of the amount of dust compared to Idaho at the Bridger monitoring site. These dust sources are a combination of natural and human activity, such as construction, mining, unpaved and paved roads, and agriculture. There is some contribution from natural fire sources, mainly from Wyoming and Idaho, as well as smaller contributions from point sources in Utah, Wyoming, and Montana.

When comparing 2002 and 2018, most figures show increases in fugitive dust and road dust mainly due to population growth. Windblown dust remains constant in all figures.

Figure 5.2.12-1. WEP Potential Contribution to Coarse PM at Yellowstone NP, Grand Teton NP, and Teton Wilderness Area on 20% Best Visibility Days

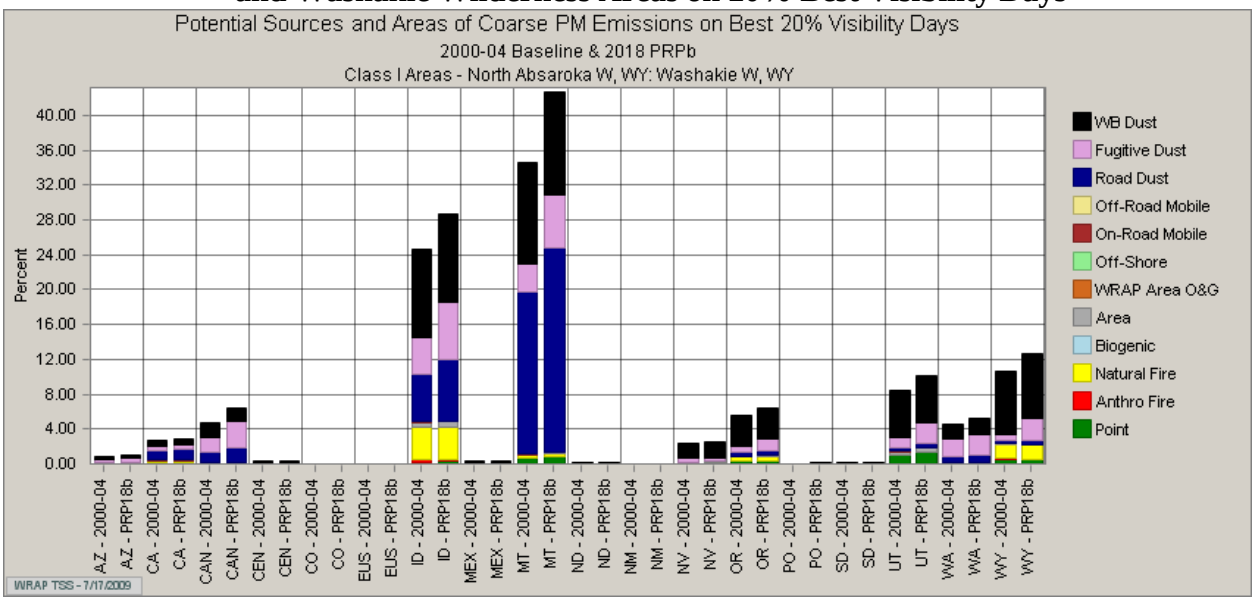


(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% best visibility days at Yellowstone, the most sizeable coarse PM contributions are from dust sources originating in Idaho and Montana. Wyoming is the third largest contributor of

coarse PM, with approximately 50% coming from natural fire sources and 50% from dust sources. Utah is the fourth largest contributor, with the majority attributable to dust sources, and a smaller amount coming from point sources. To a much lesser extent, Oregon, Canada, Nevada, California and Washington also contribute coarse PM to the Yellowstone monitoring site.

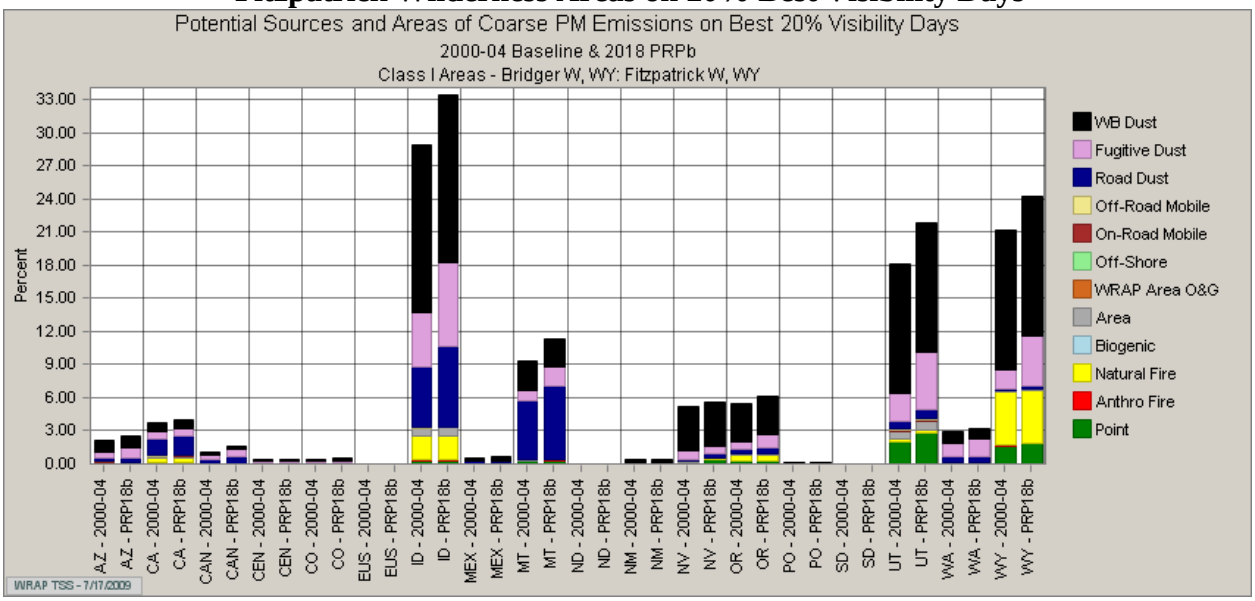
Figure 5.2.12-2. WEP Potential Contribution to Coarse PM at North Absaroka Wilderness and Washakie Wilderness Areas on 20% Best Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Dust sources from Montana and Idaho are the largest contributors to coarse PM on the 20% best visibility days at North Absaroka. Wyoming and Utah are the next largest contributors, followed by Oregon, Canada and Washington.

Figure 5.2.12-3. WEP Potential Contribution to Coarse PM at Bridger Wilderness and Fitzpatrick Wilderness Areas on 20% Best Visibility Days



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

For the 20% best visibility days at Bridger, Idaho is the largest contributor of coarse PM, followed by Wyoming, Utah and Montana, respectively. Dust sources are the dominant component of the coarse PM emissions at the Bridger site, followed by natural fire and point sources.

5.3 CMAQ 2018 Projected Visibility Conditions

This section summarizes the regional haze improvements projected using the CMAQ model for Wyoming's Class I areas. The CMAQ model was used to estimate 2018 visibility conditions in Wyoming and all Western Class I areas, based on emission inputs described in Section 5.1.2 of this chapter. The Division relied upon the results of the CMAQ modeling in establishing the Reasonable Progress Goals described in Chapter 7.

These visibility projections were calculated from modeled results by multiplying a species-specific relative response factor (RRF) with the baseline monitored result, and then converting to extinction and deciview. The RRF is defined as the ratio of future-to-current modeled mass. Chapter 7 details how the 2018 projected visibility conditions were used for setting Reasonable Progress Goals. Analysis of the WRAP 2018 preliminary reasonable progress modeling runs are contained in an August 2009 ENVIRON Memorandum in Chapter 5 of the Wyoming TSD.

Table 5.3-1 shows the 2018 visibility projections for the 20% worst and best days, compared to the 2018 Uniform Rate of Progress (URP) for Wyoming Class I areas (grouped by IMPROVE monitoring site). These 2018 projections are shown in deciview, and in the percent of the URP achieved by 2018 for the 20% worst days (first shaded column). Also indicated is whether the 20% best days for 2018 are projected to be under the 2000-2004 baseline (second shaded column).

This table shows that Wyoming's Class I areas are slightly less than half way to meeting the 2018 URP for the 20% worst days. Section 5.3.1 provides a breakdown by pollutant species to analyze the cause of this. For the 20% best days, all Class I areas are under the baseline, and thus show no visibility degradation by 2018.

Table 5.3-1. CMAQ Modeling Results for 20% Worst Days and 20% Best Days for Wyoming Class I Areas

Wyoming Class I Area	20% Worst Days				20% Best Days		
	2000-04 Baseline (dv)	2018 URP Goal (dv)	2018 Projected Visibility (dv)	% of 2018 URP Goal	2000-04 Baseline (dv)	2018 Projected Visibility (dv)	2018 Under Baseline?
Yellowstone National Park Grand Teton National Park Teton Wilderness	11.8	10.5	11.2	46%	2.6	2.4	Yes
North Absaroka Wilderness Washakie Wilderness	11.5	10.4	11.0	45%	2.0	2.0	Yes
Bridger Wilderness Fitzpatrick Wilderness	11.1	10.0	10.6	45%	2.1	2.0	Yes

(WRAP TSS - http://vista.cira.colostate.edu/tss/)

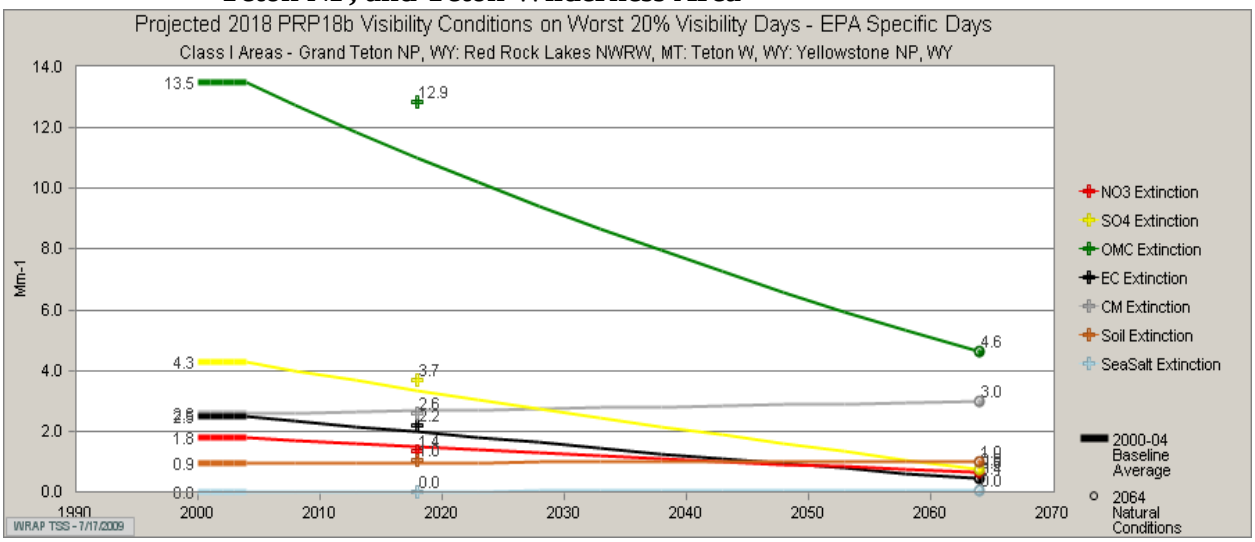
5.3.1 CMAQ Modeling Breakdown by Pollutant for 20% Worst Days

As indicated by the 2018 visibility projections using CMAQ modeling, none of the Class I areas meet the URP goal for 2018 for the 20% worst days. In order to determine the cause, it is necessary to break down these results to identify individual pollutants. The information provided below shows the contribution of each pollutant in extinction (Mm-1) to the total extinction level for each Class I area. As pointed out earlier in this chapter, it is important to note whether the pollutants affecting the modeling are anthropogenic, such as sulfates or nitrates, or the other pollutants that are mostly natural in origin (OC, EC, and PM). This assessment is important in the determination of reasonable progress, described in Chapter 7.

Figures 5.3.1-1 through 5.3.1-3 provide a breakdown of individual pollutant contribution (in extinction) by showing the glide slope of each pollutant in each Class I area, from the baseline to 2018, and beyond, for the 20% worst days. Below each figure is a table that shows the 2018 projections for each pollutant, and whether the projection is under the 2018 URP goal, and the percent improvement toward the 2018 URP goal.

The results of this breakdown by pollutant shows that at all Class I areas, nitrate exceeds or meets the 2018 URP goal. For sulfate, while none of the Class I areas meet the 2018 URP goal, the improvement is as high as 82% at the Bridger Class I area. Conversely, these tables and figures show that organic carbon is the highest contributor to extinction, and projections for 2018 show very little improvement. Much of the organic carbon can be attributed to fire, of which the majority is wildfire, and thus non-anthropogenic in origin. For fine soil there is no progress toward the 2018 URP goal because the projected 2018 values are higher than or equal to baseline conditions. Chapter 7 provides further discussion related to Reasonable Progress Goal demonstration.

Figure 5.3.1-1. Glide Slope by Pollutant on 20% Worst Days for Yellowstone NP, Grand Teton NP, and Teton Wilderness Area



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

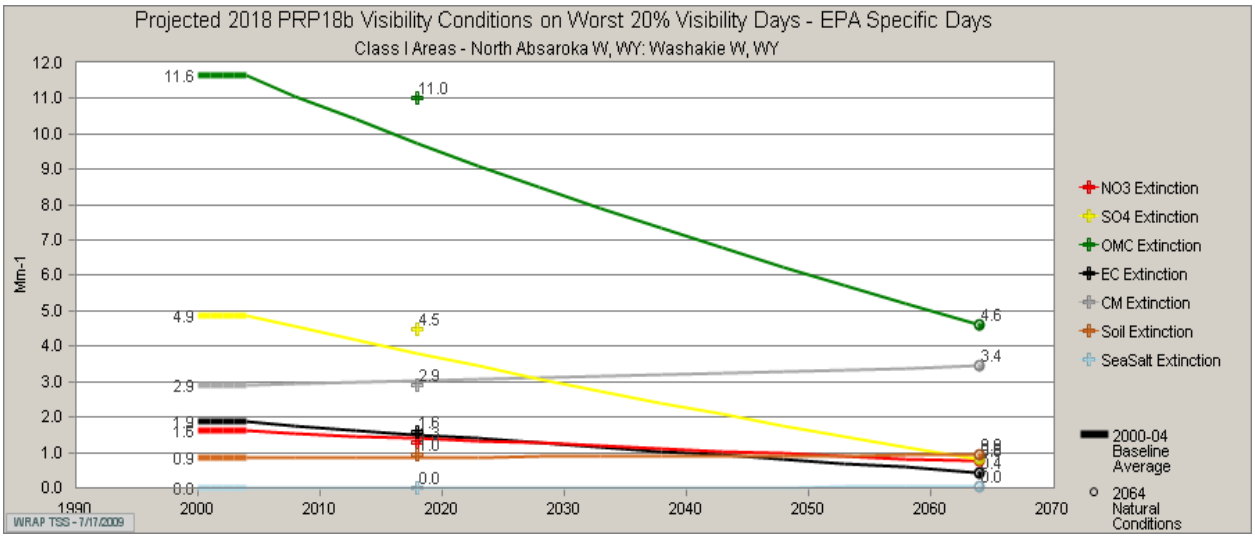
Table 5.3.1-1. Pollutant Breakdown on 20% Worst Days for Yellowstone NP, Grand Teton NP, and Teton Wilderness Area

Pollutant	Yellowstone NP, Grand Teton NP, and Teton Wilderness Area					
	2000-04 Baseline (Mm-1)	2018 URP Goal (Mm-1)	2018 Projected Visibility (Mm-1)	2064 Natural Conditions (Mm-1)	2018 Under URP Goal?	% of URP Goal
Sulfate	4.3	3.4	3.7	0.8	No	67%
Nitrate	1.8	1.5	1.4	0.6	Yes	>100%
Organic Carbon	13.5	11.0	12.9	4.6	No	24%
Elemental Carbon	2.5	2.0	2.2	0.4	No	60%
Fine Soil	1.0	1.0	1.0	1.0	Yes	None*
Coarse Material	2.6	2.7	2.6	3.0	Yes	>100%
Sea Salt	0.0	0.0	0.0	0.0	Yes	100%

*No progress towards URP goal because projected 2018 values are higher than or equal to baseline conditions.

(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Figure 5.3.1-2. Glide Slope by Pollutant on 20% Worst Days for North Absaroka and Washakie Wilderness Areas



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

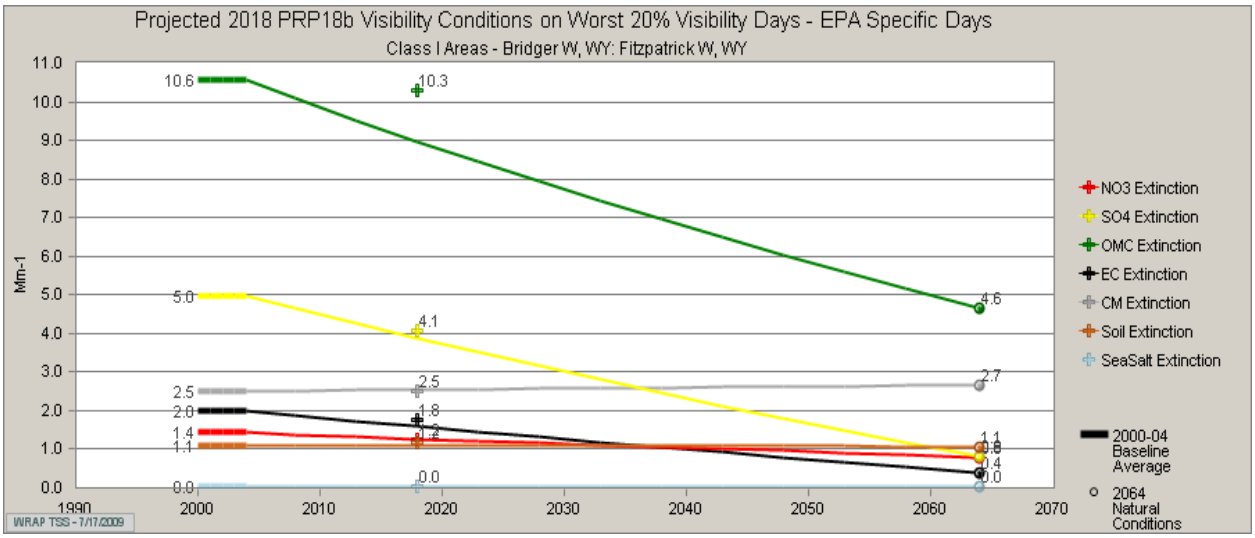
Table 5.3.1-2. Pollutant Breakdown on 20% Worst Days for North Absaroka and Washakie Wilderness Area

Pollutant	North Absaroka and Washakie Wilderness Areas					
	2000-04 Baseline (Mm-1)	2018 URP Goal (Mm-1)	2018 Projected Visibility (Mm-1)	2064 Natural Conditions (Mm-1)	2018 Under URP Goal?	% of URP Goal
Sulfate	4.9	3.8	4.5	0.8	No	45%
Nitrate	1.6	1.4	1.3	0.8	Yes	>100%
Organic Carbon	11.6	9.8	11.0	4.6	No	33%
Elemental Carbon	1.9	1.5	1.6	0.4	No	75%
Fine Soil	0.9	0.9	1.0	0.9	No	None*
Coarse Material	2.9	3.0	2.9	3.4	Yes	>100%
Sea Salt	0.0	0.0	0.0	0.0	Yes	100%

*No progress towards URP goal because projected 2018 values are higher than or equal to baseline conditions.

(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Figure 5.3.1-3. Glide Slope by Pollutant on 20% Worst Days for Bridger and Fitzpatrick Wilderness Areas



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Table 5.3.1-3. Pollutant Breakdown on 20% Worst Days for Bridger and Fitzpatrick Wilderness Areas

Pollutant	Bridger and Fitzpatrick Wilderness Areas					
	2000-04 Baseline (Mm-1)	2018 URP Goal (Mm-1)	2018 Projected Visibility (Mm-1)	2064 Natural Conditions (Mm-1)	2018 Under URP Goal?	% of URP Goal
Sulfate	5.0	3.9	4.1	0.8	No	82%
Nitrate	1.4	1.3	1.2	0.8	Yes	>100%
Organic Carbon	10.6	9.0	10.3	4.6	No	19%
Elemental Carbon	2.0	1.6	1.8	0.4	No	50%
Fine Soil	1.1	1.1	1.2	1.1	No	None*
Coarse Material	2.5	2.6	2.5	2.7	Yes	>100%
Sea Salt	0.0	0.0	0.0	0.0	Yes	100%

*No progress towards URP goal because projected 2018 values are higher than or equal to baseline conditions.

(WRAP TSS - http://vista.cira.colostate.edu/tss/)

CHAPTER 6
BEST AVAILABLE RETROFIT TECHNOLOGY (BART)

6.1 Introduction

One of the principal elements of Section 169A of the 1977 Clean Air Act Amendments addresses the installation of Best Available Retrofit Technology (BART) for certain existing sources of pollution. The provision, 169A(b)(2), demonstrates Congress' intent to focus attention directly on pollution from a specific group of existing sources. The U.S. EPA's Regional Haze Rule requires certain emission sources that may reasonably be anticipated to cause or contribute to visibility impairment in downwind Class I areas to install BART (see 40 CFR 51.308(e); see also 64 Fed. Reg. 35714 *et seq.* (July 1, 1999)). These requirements are intended to reduce emissions from certain large sources that, due to age, were exempted from other requirements of the Clean Air Act.

BART requirements pertain to 26 specified major point source categories including power plants, cement kilns and industrial boilers. To be considered BART-eligible, sources from these categories must have the potential to emit 250 tons or more of haze forming pollution and must have commenced operation in the 15-year period prior to August 7, 1977.

In addition to source-by-source command and control BART implementation, EPA has allowed for more flexible alternatives if they achieve greater progress toward the State's visibility goals than the standard BART approach.

On July 1, 1999, the EPA published regulations to address regional haze visibility impairment. The regulations required states to address BART requirements for regional haze visibility impairment, and allowed nine western states to develop plans that were based on the GCVTC recommendations for stationary SO_2 sources in lieu of BART.

In 2000 the Western Regional Air Partnership (WRAP) submitted an Annex to the GCVTC recommendations that provided more details regarding the regional SO_2 milestones and backstop trading program that had been recommended in the GCVTC Report, and included a demonstration that the milestones achieved greater reasonable progress than would have been achieved by the application of BART in the region. The Annex was approved by EPA in 2003, but this approval was later vacated by the DC Circuit Court of Appeals in 2005 due to problems with the methodology that was required in the regional haze rule for demonstrating greater reasonable progress than BART. [3]

On July 6, 2005 EPA revised the Regional Haze Rule in response to the judicial challenges to the BART requirements. On October 13, 2006 EPA published additional revisions to address alternatives to source-specific BART determinations.

[3] *Center for Energy and Economic Development v. EPA,* February 18, 2005; *American Corn Growers Association v. EPA*, May 24, 2002.

Five western states (Arizona, New Mexico, Oregon, Utah, and Wyoming) had submitted State Implementation Plans (SIPs) in 2003 under 40 CFR 51.309. Four of those states (Arizona, New Mexico, Utah, and Wyoming) have updated their SIPs to include new SO_2 milestones that are based on more recent emission inventories as well as the revised BART requirements in the Regional Haze Rule. The fifth state, Oregon, is no longer participating in the program. Details on the alternative to the BART program are contained in the 309 SIP submittal to EPA under a separate action.

6.2 SO_2: Regional SO_2 Milestone and Backstop Trading Program

Wyoming is a §309 state participating in the Regional SO_2 Milestone and Backstop Trading Program. §308(e)(2) provides states with the option to implement or require participation in an emissions trading program or other alternative measure rather than to require sources subject to BART to install, operate, and maintain additional control technology to meet an established emission limit on a continuous basis. However, the alternate program must achieve greater reasonable progress than would be accomplished by installing BART. A demonstration that the alternate program can achieve greater reasonable progress is prescribed by §308(e)(2)(i). Since the pollutant of concern is SO_2, this demonstration has been performed under §309 as part of the State Implementation Plan. §309(d)(4)(i) requires that the SO_2 milestones established under the Plan "…must be shown to provide for greater reasonable progress than would be achieved by application of BART pursuant to §51.308(e)(2)."

Wyoming participated in creating a detailed report entitled **Demonstration That the SO_2 Milestones Provide Greater Reasonable Progress Than BART** covering SO_2 emissions from all states participating in the Regional SO_2 Milestone and Backstop Trading Program. The document was submitted to EPA in support of the §309 Wyoming Regional Haze SIP in November of 2008.

As part of the §309 program, participating states, including Wyoming, must submit an annual Regional Sulfur Dioxide Emissions and Milestone Report that compares actual emissions to pre-established milestones. Participating states have been filing these reports since 2003. Each year, states have been able to demonstrate that actual SO_2 emissions are well below the milestones. The actual emissions and their respective milestones are shown below:

Table 6.2-1. Regional Sulfur Dioxide Emissions and Milestone Report Summary

Year	Reported SO_2 Emissions (tons)	3-year Milestone Average (tons)
2003	330,679	447,383
2004	337,970	448,259
2005	304,591	446,903
2006	279,134	420,194
2007	273,663	420,637

In addition to demonstrating successful SO_2 emission reductions, §309 states have also relied on visibility modeling conducted by the WRAP to demonstrate improvement at Class I areas. The

complete modeling demonstration showing deciview values was included as part of the visibility improvement section of the §309 SIP, but the SO_2 portion of the demonstration has been included as Table 6.2-2 to underscore the improvements associated with SO_2 reductions.

Table 6.2-2. Visibility - Sulfate Extinction Only

Class I Area Monitor (Class I Areas Represented)	20% Worst Visibility Days (Monthly Average, Mm^{-1})		20% Best Visibility Days (Monthly Average, Mm^{-1})	
	2018 [1] Base Case (Base 18b)	2018 [2] Preliminary Reasonable Progress Case (PRP18a)	2018 [1] Base Case (Base 18b)	2018 [2] Preliminary Reasonable Progress Case (PRP18a)
Bridger, WY (Bridger WA and Fitzpatrick WA)	5.2	4.3	1.6	1.3
North Absaroka, WY (North Absaroka WA and Washakie WA)	4.8	4.5	1.1	1.1
Yellowstone, WY (Yellowstone NP, Grand Teton NP and Teton WA)	4.3	3.9	1.6	1.4
Badlands, SD	17.8	16.0	3.5	3.1
Wind Cave, SD	13.0	12.1	2.7	2.5
Mount Zirkel, CO (Mt. Zirkel WA and Rawah WA)	4.6	4.1	1.4	1.3
Rocky Mountain, CO	6.8	6.2	1.3	1.1
Gates of the Mountains, MT	5.3	5.1	1.0	1.0
UL Bend, MT	9.7	9.6	1.8	1.7
Craters of the Moon, ID	5.8	5.5	1.5	1.5
Sawtooth, ID	3.0	2.8	1.2	1.1
Canyonlands, UT (Canyonlands NP and Arches NP)	5.4	4.8	2.1	1.9
Capitol Reef, UT	5.7	5.4	1.9	1.8

[1] Represents 2018 Base Case growth plus all established controls as of Dec. 2004. No BART or SO_2 Milestone assumptions were included.
[2] Represents 2018 Preliminary Reasonable Progress growth estimates and established SO_2 limits (including milestone levels established at the time of the model run).

All Class I areas in the surrounding states show a projected visibility improvement for 2018 with respect to SO_2 on the worst days and no degradation on the best days. More discussion on the visibility improvement of the §309 program can be found in the Wyoming §309 Regional Haze SIP revision submitted to EPA in November 2008.

Therefore, in accordance with §308(e)(2), Wyoming's §309 Regional Haze SIP, and WAQSR Chapter 6, Section 9, sources will not be required to install BART controls to meet an SO_2 emission limit. Instead, sources will be required to participate in the Regional SO_2 Milestone and Backstop Trading Program authorized under Chapter 14 of the WAQSR.

The remainder of this section, therefore, focuses on how Wyoming has satisfied the BART requirements with respect to NO_x and PM in EPA's Regional Haze Rule. Wyoming's review process is described and a list of BART-eligible sources is provided. A list of sources that are subject to BART is also provided, along with the requisite modeling analysis approach and justification. Wyoming made its BART determinations using the methodology in EPA's Guidelines for BART Determinations Under the Regional Haze Rule, 40 Fed. Reg. 39104 et seq.

(July 6, 2005) (hereinafter "Appendix Y"), and the Wyoming Air Quality Standards and Regulations (WAQSR) Chapter 6, Permitting Requirements, Section 9, Best available retrofit technology (BART). EPA's Guidelines for BART Determinations and Chapter 6, Section 9 of the WAQSR can be found in Chapter 6 of the Wyoming TSD.

6.3 Overview of Wyoming's BART Regulation

Wyoming's Environmental Quality Council approved a State-only BART regulation (Chapter 6, Permitting Requirements, Section 9, Best available retrofit technology (BART)) on October 10, 2006, that became effective in December 2006. The provisions of the regulation required BART-subject sources to submit an application, according to a schedule determined by the Air Quality Division, for a BART determination.

Wyoming's BART Rule is based largely upon EPA's BART Rule and related Appendix Y, which includes procedures to be followed when making BART determinations for individual sources. States are only required to follow Appendix Y procedures for sources which are electric generating units (EGUs) with greater than 750 MW generating capacity. EPA's BART Rule has no specific requirements for conducting BART determinations for sources that are not electric generating plants with greater than 750 MW capacities. EPA encourages states to use its guidelines for all source categories, but states are not required to do so.

6.4 SIP BART Requirements From EPA's Regional Haze Rule

The following sections address the SIP elements relative to BART contained in EPA's Regional Haze Rule. Section numbers refer to provisions in section 308(e), the BART provision of the Regional Haze Rule.

308(e)(1)(i) - A list of all BART-eligible sources within the State.

The U.S. EPA regulations for best available retrofit technology (BART) are contained in 40 CFR part 51, Appendix Y, published July 6, 2005 in the Federal Register, and provide the guidelines for BART determinations. Section II of Appendix Y discusses a three-step procedure for identifying BART-eligible sources. A source was BART-eligible if it 1) belonged to one of the 26 listed categories, 2) was "in existence" on August 7, 1977, but not "in operation" before August 7, 1962, and 3) had the potential to emit greater than 250 tons per year of any single visibility impairing pollutant. If a facility met all three criteria mentioned, then a screening analysis was used to determine if it was "subject to BART", per Section III of Appendix Y.

Using Appendix Y as a guideline, the State of Wyoming determined that there were fourteen (14) facilities with BART-eligible emission units. These facilities are listed below:

PacifiCorp - Jim Bridger	General Chemical
PacifiCorp - Naughton	P4 Production
FMC - Granger	OCI Wyoming
FMC - Green River	Dyno Nobel
Basin Electric - Laramie River	Sinclair - Casper Refinery

PacifiCorp - Wyodak	Black Hills - Neil Simpson 1
PacifiCorp - Dave Johnston	Sinclair - Sinclair Refinery

The Division completed a BART screening analysis on the fourteen facilities to determine which facilities had a significant impact on visibility in Class I areas in Wyoming, South Dakota, and Colorado.

As specified in the Division's BART Air Modeling Protocol dated March 2006 (see Chapter 6 of the Wyoming TSD), a source was deemed to produce a significant impact to visibility on a Class I area if the source had a modeled impact to visibility value greater than 0.5 deciview (dv) to determine a daily maximum change in visibility (Δdv) value for each Class I area and year of meteorological data. The visibility impact threshold to determine BART sources is a 98th percentile change in visibility (Δdv) of 0.5 dv above background conditions. Therefore, if the 8th highest Δdv value was equal to or greater than 0.5 dv, the source was considered to cause or contribute to visibility impairment in the subject Class I area, and therefore was "subject to BART". However, if the 8th highest value for all three years at each Class I area in a given domain was less than 0.5 dv, the source was not subject to BART. Using these criteria, the fourteen facilities were screened for BART subjectivity. The BART Facilities Emissions Inventory in Chapter 6 of the Wyoming TSD details the emission units at the BART-eligible sources. Screening results, which provide the maximum change in visibility, number of days >0.5 dv, and 8th high values, are summarized in the WY BART Screening Analysis Results and the WY BART Screening Analysis Results DV Frequency, which can also be found in Chapter 6 of the Wyoming TSD. After evaluating the results of the screening analysis, the following facilities were found to be subject to BART or not subject to BART.

Subject to BART	Not Subject to BART
PacifiCorp - Jim Bridger	P4 Production
PacifiCorp - Naughton	OCI Wyoming
FMC - Granger	Dyno Nobel
FMC - Green River	Sinclair - Casper Refinery
Basin Electric - Laramie River	Black Hills - Neil Simpson 1
PacifiCorp - Wyodak	Sinclair - Sinclair Refinery
PacifiCorp - Dave Johnston	
General Chemical	

308(e)(1)(ii) - A determination of BART for each BART-eligible source in the State that emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility in any mandatory Class I Federal area. All such sources are subject to BART.

The following table summarizes the Division's BART determinations for sources that cause or contribute to visibility impairment in Class I areas. These BART determinations are part of this Regional Haze SIP that will be submitted to EPA.

Table 6.4-1. BART Determinations for Wyoming Sources

Unit	NO_x Control Type	NO_x Emission Limit	Particulate Control Type	PM_{10} Emission Limit [1]
Basin Electric – Laramie [2] River Unit 1 (550 MW)	~~LNB + OFA~~	~~0.21 lb/MMBtu (30-day rolling)~~	ESP	0.030 lb/MMBtu
Basin Electric – Laramie [2] River Unit 2 (550 MW)	~~LNB + OFA~~	~~0.21 lb/MMBtu (30-day rolling)~~	ESP	0.030 lb/MMBtu
Basin Electric – Laramie [2] River Unit 3 (550 MW)	~~LNB + OFA~~	~~0.21 lb/MMBtu (30-day rolling)~~	ESP	0.030 lb/MMBtu
FMC Wyoming – Granger 14 (358.5 MMBtu)	n/a	n/a	n/a	n/a
FMC Wyoming – Granger 15 (358.5 MMBtu)	n/a	n/a	n/a	n/a
FMC Wyoming – Westvaco NS-1A (887 MMBtu)	LNB + OFA	0.35 lb/MMBtu (30-day rolling)	ESP	0.05 lb/MMBtu
FMC Wyoming – Westvaco NS-1B (887 MMBtu)	LNB + OFA	0.35 lb/MMBtu (30-day rolling)	ESP	0.05 lb/MMBtu
FMC Wyoming – Westvaco PH-3 (333.6 MMBtu)	n/a	n/a	n/a	n/a
General Chemical – Green River GR-2-L (534 lb/MMBtu)	LNB + SOFA or equivalent technology	0.28 lb/MMBtu (30-day rolling)	ESP	0.09 lb/MMBtu
General Chemical – Green River GR-3-W (880 lb/MMBtu)	LNB + SOFA or equivalent technology	0.28 lb/MMBtu (30-day rolling)	ESP	0.09 lb/MMBtu
PacifiCorp – Dave Johnston Unit 3 (230 MW)	~~LNB + OFA~~	~~0.28 lb/MMBtu (30-day rolling)~~	Fabric Filter	0.015 lb/MMBtu
PacifiCorp – Dave Johnston Unit 4 (330 MW)	LNB + OFA	0.15 lb/MMBtu (30-day rolling)	Fabric Filter	0.015 lb/MMBtu
PacifiCorp – Jim Bridger Unit 1 (530 MW)	LNB + OFA	0.26 lb/MMBtu (30-day rolling)	ESP + FGC	0.030 lb/MMBtu
PacifiCorp – Jim Bridger Unit 2 (530 MW)	LNB + OFA	0.26 lb/MMBtu (30-day rolling)	ESP + FGC	0.030 lb/MMBtu
PacifiCorp – Jim Bridger Unit 3 (530 MW)	LNB + OFA	0.26 lb/MMBtu (30-day rolling)	ESP + FGC	0.030 lb/MMBtu
PacifiCorp – Jim Bridger Unit 4 (530 MW)	LNB + OFA	0.26 lb/MMBtu (30-day rolling)	ESP + FGC	0.030 lb/MMBtu
PacifiCorp – Naughton Unit 1 (160 MW)	LNB + OFA	0.26 lb/MMBtu (30-day rolling)	ESP + FGC	0.040 lb/MMBtu
PacifiCorp – Naughton Unit 2 (210 MW)	LNB + OFA	0.26 lb/MMBtu (30-day rolling)	ESP + FGC	0.040 lb/MMBtu
PacifiCorp – Naughton Unit 3 (330 MW)	LNB + OFA + SCR	0.07 lb/MMBtu (30-day rolling)	Fabric Filter	0.015 lb/MMBtu
PacifiCorp – Wyodak Unit 1 (335 MW)	~~LNB + OFA~~	~~0.23 lb/MMBtu (30-day rolling)~~	Fabric Filter	0.015 lb/MMBtu

[1] Filterable portion only; [2] These emission limits reflect condition 7c in the Settlement Agreement between DEQ/AQD and Basin Electric, EQC Docket No. 10-2802.
ESP = electrostatic precipitator; FGC = flue gas conditioning; LNB = low NO_x burners; n/a = not subject to BART; OFA = overfire air; SCR = selective catalytic reduction; SOFA = separated overfire air

I. The Five-Factor Analysis

308(e)(1)(ii)(A) - The determination of BART must be based on an analysis of the best system of continuous emission control technology available and associated emission reductions achievable for each BART-eligible source that is subject to BART within the State. In this analysis, the State must take into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts of compliance, any pollution control equipment 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.

Details of how each of these factors is taken into consideration during the BART determination process are found below in the Facility Analysis section.

II. Compliance With Appendix Y

308(e)(1)(ii)(B) - The determination of BART for fossil-fuel fired power plants having a total generating capacity greater than 750 megawatts must be made pursuant to the guidelines in appendix Y of this part (Guidelines for BART Determinations Under the Regional Haze Rule).

EPA's guidelines are only mandatory with respect to plants greater than 750 megawatts (see 70 Fed. Reg. at 39108, 39131). EPA does not require that the guidelines be followed for other source types (see *id.*). In fact, EPA concluded that it "would not be appropriate for EPA to require states to use the guidelines in making BART determinations for other categories of sources" (*id*. at 39108). States thus "retain the discretion to adopt approaches that differ from the guidelines" (*id*. at 39158). The following fossil-fuel fired power plants have a total generating capacity greater than 750 megawatts:

Basin Electric Power Cooperative - Laramie River (1,650 MW)
PacifiCorp - Dave Johnston (772 MW)
PacifiCorp - Jim Bridger (2,120 MW)

EPA's guidelines in Appendix Y were followed for the three facilities listed above. Details of how the guidelines were followed are found in the Facility Analysis section below.

III. Expeditious Installation and Operation of BART

308(e)(1)(iv) - A requirement that each source subject to BART be required to install and operate BART as expeditiously as practicable, but in no event later than 5 years after approval of the implementation plan revision.

This requirement is addressed in Wyoming's BART Rule and compliance with this requirement is discussed in the specific Facility Analysis for each source below.

IV. Proper Maintenance and Operation of Control Equipment

308(e)(1)(v) - A requirement that each source subject to BART maintain the control equipment required by this subpart and establish procedures to ensure such equipment is properly operated and maintained.

This requirement is addressed in Wyoming's BART Rule and compliance with this requirement is discussed in Section V.

V. Monitoring and Recordkeeping Requirements

Startup Notification: The owner or operator shall furnish the Administrator written notification of: (i) the anticipated date of initial startup not more than 60 days or less than 30 days prior to such date, and; (ii) the actual date of initial startup within 15 days after such date in accordance with Chapter 6, Section 2(i) of the WAQSR.

Chapter 6, Section 3 Operating Permit: The owner or operator shall modify their Operating Permit in accordance with Chapter 6, Section 9(e)(vi) and Chapter 6, Section 3 of the WAQSR.

Initial Performance Tests: The owner or operator shall conduct initial performance tests in accordance with Chapter 6, Section 2(j) of the WAQSR, within 30 days of achieving a maximum design rate but not later than 90 days following initial startup, and a written report of the results shall be submitted. If a maximum design rate is not achieved within 90 days of startup, the Air Quality Division Administrator may require testing be done at the rate achieved and again when a maximum rate is achieved.

Periodic Particulate Performance Testing: Particulate testing shall be conducted annually, or more frequently as specified by the Air Quality Division Administrator following the test methods specified in this section.

Test Methods:

> NO_x Emissions - Compliance with the NO_x 30-day rolling average shall be determined using a continuous emissions monitoring system (CEMS) certified in accordance with 40 CFR part 60 (Non-EGUs) or 40 CFR part 75 (EGUs).
>
> PM/PM_{10} Emissions - Testing shall follow 40 CFR 60.46 and EPA Reference Test Methods 1-4 and 5.
>
> Prior to any testing, a test protocol shall be submitted to the Division for approval, at least 30 days prior to testing. Notification should be provided to the Division at least 15 days prior to any testing. Results of the tests shall be submitted to the Division office within 45 days of completing the tests.

NO_x CEM Requirements: At all times after the compliance deadline specified in Section 6.5, the owner/operator of each BART unit shall maintain, calibrate, and operate a CEMS in full compliance with the requirements found at 40 CFR part 60 (Non-EGUs) or 40 CFR part 75 (EGUs), to accurately measure NO_x, diluent (CO_2 or O_2), and stack gas volumetric flow rate from each BART unit. The CEMS shall be used to determine compliance with the NO_x BART emission limits for each BART unit.

BART Limits: The NO_x limits in terms of lb/MMBtu, lb/hr and tpy apply at all times, including periods of startup and shutdown. The PM/PM_{10} limits in terms of lb/hr and tpy apply at all

times, including periods of startup and shutdown. The PM/PM_{10} limits in terms of lb/MMBtu apply at all times except during startup. Emissions in excess of the BART limits due to unavoidable equipment malfunction are not considered a violation if the event is covered under Chapter 1, Section 5 of the WAQSR. The burden of proof is on the owner or operator of the source to provide sufficient information to demonstrate that an unavoidable equipment malfunction has occurred.

BART NO_x Limits: lb/MMBtu and lb/hr shall be 30-day rolling averages and the tpy shall be a calendar year total.

a. Exceedances of the NO_x limits shall be defined as follows:

i. Any 30-day rolling average which exceeds the lb/MMBtu NO_x limits as calculated using the following formula:

$$E_{avg} = \frac{\sum_{h=1}^{n} (C)_h}{n}$$

Where:

E_{avg} = Weighted 30-day rolling average emission rate (lb/MMBtu).

C = 1-hour average emission rate (lb/MMBtu) for hour "h" calculated using valid data from the CEM equipment certified and operated in accordance with part 75 and the procedures in 40 CFR part 60, Appendix A, Method 19. Valid data shall meet the requirements of WAQSR, Chapter 5, Section 2(j). Valid data shall not include data substituted using the missing data procedure in Subpart D of part 75, nor shall the data have been bias adjusted according to the procedures of part 75.

n = The number of unit operating hours in the last 30 successive boiler operating days with valid emissions data meeting the requirements of WAQSR, Chapter 5, Section 2(j). A "boiler operating day" shall be defined as any 24-hour period between 12:00 midnight and the following midnight during which any fuel is combusted at any time at the steam generating unit.

ii. Any 30-day rolling average which exceeds the lb/hr NO_x limits as calculated using the following formula:

$$E_{avg} = \frac{\sum_{h=1}^{n} (C)_h}{n}$$

Where:

E_{avg} = Weighted 30-day rolling average emission rate (lb/hr).

C = 1-hour average emission rate (lb/hr) for hour "*h*" calculated using valid data (output concentration and average hourly volumetric flowrate) from the CEM equipment certified and operated in accordance with part 75. Valid data shall meet the requirements of WAQSR, Chapter 5, Section 2(j). Valid data shall not include data substituted using the missing data procedure in Subpart D of part 75, nor shall the data have been bias adjusted according to the procedures of part 75.

n = The number of unit operating hours in the last 30 successive boiler operating days with valid emissions data meeting the requirements of WAQSR, Chapter 5, Section 2(j). A "boiler operating day" shall be defined as any 24-hour period between 12:00 midnight and the following midnight during which any fuel is combusted at any time at the steam generating unit.

iii. Any 12-month rolling emission rate which exceeds the tpy NO_x limit as calculated using the following formula:

$$E = \frac{\sum_{h=1} (C)_h}{2{,}000}$$

Where:

C = 1-hour average emission rate (lb/hr) for hour "*h*" calculated using data from the CEM equipment required by 40 CFR part 75. For monitoring data not meeting the requirements of WAQSR, Chapter 5, Section 2(j), Basin Electric shall provide substituted data for an emissions unit according to the missing data procedures of 40 CFR part 75 during any period of time that there is not monitoring data.

E = 12-month rolling emission rate (tpy).

iv. Any calendar year total calculated using valid data (output concentration and average hourly volumetric flow rate) from the CEM equipment and operating data from the boiler which exceeds the tpy NO_x limit. Valid data shall meet the requirements of WAQSR Chapter 5, Section 2(j). For EGUs, the owner or operator shall use EPA's Clean Air Markets reporting program to convert the monitoring system data to annual emissions. The owner or operator shall provide substituted data according to the missing data procedures of 40 CFR part 75 during any period of time that there is no monitoring data.

BART PM/PM_{10} Limits: lb/MMBtu and lb/hr limits shall be a 1-hour average based on the average of three performance tests. Compliance with lb/MMBtu and lb/hr shall be determined from the initial and annual performance tests. Annual emissions (tpy) shall be a calendar year total calculated using the lb/MMBtu performance test result and boiler operating data.

~~Recordkeeping and Reporting: The owner or operator shall comply with all reporting and recordkeeping requirements as specified in WAQSR Chapter 5, Section 2(g) and 40 CFR part 60, Subpart D. All excess emissions shall be reported using the procedures and reporting format specified in WAQSR Chapter 5, Section 2(g). Records shall be maintained for a period of at least five (5) years and shall be made available to the Division upon request.~~

6.5 Facility Analysis

Note that the following discussions of BART determinations are based upon proposed BART permit conditions that are undergoing public review and comment. Following issuance of final BART permits as required by Chapter 6, Section 9 of the WAQSR, the State of Wyoming will supplement the SIP with revised descriptions of the BART determinations, if necessary.

6.5.1 FMC Wyoming Corp. - Granger Facility

The State of Wyoming performed a refined CALPUFF visibility modeling analysis for the two BART-eligible units at the FMC Wyoming Granger Facility, and demonstrated that the predicted 98th percentile impacts at Bridger WA and Fitzpatrick WA would be below 0.5 dv for all meteorological periods modeled. This modeling used higher-resolution meteorological data as compared to the data used by the Division for the initial screening modeling that identified the facility as "subject" to BART. A single source is exempt from BART if the modeled 98th percentile change is less than 0.5 dv at all Class I areas for each year modeled, in accordance with Chapter 6, Section 9(d)(i)(C) of the WAQSR. Therefore, the State of Wyoming has determined that the two BART-eligible units at the FMC Wyoming Granger Facility are not subject to BART.

6.5.2 FMC Wyoming Corp. - Green River - Westvaco Facility

<u>I. The Five-Factor Analysis</u>

After considering (1) the costs of compliance, (2) the energy and non-air quality environmental impacts of compliance, (3) any pollution equipment in use or in existence at the source, (4) the remaining useful life of the source, and (5) the degree of improvement in visibility (all five statutory factors) from each proposed control technology, the Division determined BART for NO_x and PM_{10} emitted from two units at the Westvaco Facility. The State of Wyoming concluded that a third unit at the facility, a gas-fired boiler, was not a significant contributor to regional haze and a BART determination was not made for that source.

For control of NO_x emissions, the State of Wyoming requires that FMC install and operate low NO_x burners (LNB) with enhanced overfire air (OFA) as BART for boilers NS-1A and NS-1B. The use of LNB and enhanced OFA will result in a 1,360-ton reduction in annual NO_x emissions from each boiler. LNB/OFA on boilers NS-1A and NS-1B is cost effective, with an average cost effectiveness of $304 per ton of NO_x removed for each unit over a twenty-year operational life. Combustion control using LNB/OFA does not require non-air quality environmental mitigation for the use of chemical reagents (i.e., ammonia or urea) and there is a minimal energy impact.

For control of PM/PM_{10} emissions, the State of Wyoming requires that FMC utilize the existing ESPs as BART for boilers NS-1A and NS-1B.

Visibility impacts were addressed in a comprehensive visibility modeling analysis covering three visibility impairing pollutants and associated control options. The cumulative 3-year averaged visibility improvement from the baseline across Bridger WA and Fitzpatrick WA achieved with LNB/OFA (based on the 98th percentile modeled results) was 0.2 Δdv from each of the two boilers.

The State of Wyoming considers the BART-determined permit limit to be equivalent to the control effectiveness of a control technology. The limit is based on continuous compliance when the control equipment is well maintained and operated in a manner consistent with good air pollution control practices for minimizing emissions.

Unit-by-unit BART determinations for NO_x and PM/PM_{10}:

Units	Pollutant	Control Type	lb/MMBtu	lb/hr	tpy
NS-1A	NO_x	LNB/OFA	0.35 (30-day rolling)	284.0 (30-day rolling)	1244.0
	PM/PM_{10}[(a)]	ESP	0.05	45.0	197.0
NS-1B	NO_x	LNB/OFA	0.35 (30-day rolling)	284.0 (30-day rolling)	1244.0
	PM/PM_{10}[(a)]	ESP	0.05	45.0	197.0

[(a)] Filterable portion only
ESP = electrostatic precipitator
LNB = low NO_x burners
OFA = overfire air

III. Expeditious Installation and Operation of BART

The State of Wyoming requires that FMC install and operate new LNB with enhanced overfire air on boilers NS-1A and NS-1B to achieve the BART emissions limits for NO_x. Installation of LNB and enhanced overfire air has been completed. LNB with OFA will continue to operate on boilers NS-1A and NS-1B. The State of Wyoming requires that FMC continue the use of the existing ESPs on boilers NS-1A and NS-1B to achieve the BART emissions limits for PM/PM_{10}. Initial performance tests for NO_x and PM/PM_{10} have been completed for both boilers. NO_x and PM/PM_{10} compliance deadlines for both boilers was on or before October 17, 2009.

IV. Proper Maintenance and Operation of Control Equipment

The State of Wyoming requires that FMC follow the monitoring and recordkeeping requirements of Section 6.4 V. to ensure proper maintenance and operation of control equipment.

6.5.3 General Chemical - Green River Works

I. The Five-Factor Analysis

After considering (1) the costs of compliance, (2) the energy and non-air quality environmental impacts of compliance, (3) any pollution equipment in use or in existence at the source, (4) the

remaining useful life of the source, and (5) the degree of improvement in visibility (all five statutory factors) from each proposed control technology, the Division determined BART for NO_x and PM_{10} emitted from the two boilers at Green River Works.

For control of NO_x emissions, the State of Wyoming requires that General Chemical install and operate LNB and SOFA or an equivalent performing control technology as BART for boilers C and D. The use of LNB and SOFA will result in a 512-ton reduction from baseline for Boiler C and a 737-ton reduction from baseline for Boiler D. LNB and SOFA on boilers C and D is cost effective, with an average cost effectiveness of $1,280-1,480 per ton of NO_x removed for each unit over a twenty-year operational life. Combustion control using LNB and OFA does not require non-air quality environmental mitigation for the use of chemical reagents (i.e., ammonia or urea) and there is a minimal energy impact. Affording General Chemical the option to install an equivalent performing control technology does not change the basis of the BART determination as the BART determination is made based on currently available controls (e.g., existing LNB with new SOFA, SNCR, SCR), which were all deemed reasonable. Allowing the company to install an equivalent performing technology provides additional flexibility to control emissions to the specified BART levels, presumably in the most cost-effective manner.

For control of PM/PM_{10} emissions, the State of Wyoming requires that General Chemical utilize the existing ESPs as BART for boilers C and D.

Visibility impacts were addressed in a comprehensive visibility modeling analysis covering three visibility impairing pollutants and associated control options. The cumulative 3-year averaged visibility improvement from the baseline across Bridger WA and Fitzpatrick WA achieved with LNB and OFA (based on the 98th percentile modeled results) was 0.41 Δdv from the two boilers.

The State of Wyoming considers the BART-determined permit limit to be equivalent to the control effectiveness of a control technology. The limit is based on continuous compliance when the control equipment is well maintained and operated in a manner consistent with good air pollution control practices for minimizing emissions.

Unit-by-unit BART determinations for NO_x and PM/PM_{10}:

Units	Pollutant	Control Type	lb/MMBtu	lb/hr	tpy
C	NO_x	LNB/SOFA or equivalent technology	0.28 (30-day rolling)	149.5 (30-day rolling)	654.9
	PM/PM_{10} [(a)]	ESP	0.09	50	219.0
D	NO_x	LNB/SOFA or equivalent technology	0.28 (30-day rolling)	246.4 (30-day rolling)	1,079.2
	PM/PM_{10} [(a)]	ESP	0.09	80	350.4

[(a)] Filterable portion only
ESP = electrostatic precipitator
LNB = low NO_x burners
SOFA = separated overfire air

III. Expeditious Installation and Operation of BART

The State of Wyoming requires that General Chemical install and operate low NO_x burners with SOFA or equivalent performing technology on boilers C and D, in accordance with the Division's BART determination, and conduct the required initial performance tests to demonstrate compliance as expeditiously as practicable, but no later than five years after EPA approval of the state implementation plan revision. The State of Wyoming requires that General Chemical continue the use of the existing ESPs on boilers C and D to achieve the BART emissions limits. Initial performance tests for PM/PM_{10} have been completed for both boilers. The PM/PM_{10} compliance deadline for both boilers was on or before November 11, 2009.

IV. Proper Maintenance and Operation of Control Equipment

The State of Wyoming requires that General Chemical follow the monitoring and recordkeeping requirements of Section 6.4 V. to ensure proper maintenance and operation of control equipment.

6.5.4 PacifiCorp - Jim Bridger Power Plant

I. The Five-Factor Analysis

After considering (1) the costs of compliance, (2) the energy and non-air quality environmental impacts of compliance, (3) any pollution equipment in use or in existence at the source, (4) the remaining useful life of the source, and (5) the degree of improvement in visibility (all five statutory factors) from each proposed control technology, the Division determined BART for NO_x and PM/PM_{10} emitted from the four units subject to BART at the Jim Bridger Power Plant. In addition to the five-factor analysis, the Division also considered the unique situation PacifiCorp is in since they own and operate 19 coal-fired generating units in the West. The Division believes that the size of PacifiCorp's fleet of coal-fired units presents unique challenges when reviewing costs, timing of installations, customer needs, and state regulatory commission requirements. Information has been supplied by PacifiCorp elaborating on additional factors to be considered in PacifiCorp's BART determination (see "PacifiCorp's Emissions Reductions Plan" in Chapter 6 of the Wyoming TSD).

For control of NO_x emissions, the State of Wyoming requires that PacifiCorp install and operate LNB with separated OFA as BART for Units 1 through 4. Annual NO_x emission reductions from LNB with separated OFA on Units 1, 3, and 4 are 4,493 tons per unit for a total annual reduction at the Jim Bridger Power Plant of 13,479 tons per year. There are no NO_x reductions from Unit 2 as LNB separated OFA is baseline for the unit.

LNB with separated OFA on Units 1, 3, and 4 is cost effective, with an average cost effectiveness of $255 per ton of NO_x removed for each unit over a twenty-year operational life. LNB with separated OFA on Unit 2 did not require any additional capital cost or annual O&M cost. Combustion control using LNB with separated OFA does not require non-air quality environmental mitigation for the use of chemical reagents (i.e., ammonia or urea) and there is a minimal energy impact.

For control of PM/PM_{10} emissions, the State of Wyoming requires that PacifiCorp utilize the existing electrostatic precipitators (ESPs) with the addition of flue gas conditioning (FGC) as BART for Units 1-4. The control technology is cost effective for each unit, with costs per ton removed of $1,544 for Unit 1, $526 for Unit 2, and $857 for Unit 3. Unit 4 does not require additional capital cost. No negative non-air environmental impacts are anticipated from the use of the existing ESPs with FGC.

Visibility impacts were addressed in a comprehensive visibility modeling analysis covering three visibility impairing pollutants and associated control options. The cumulative 3-year averaged 98th percentile visibility improvement from the baseline across the three Class I areas (Bridger, Fitzpatrick, and Mt. Zirkel wilderness areas) achieved with LNB with separated OFA, upgraded wet FGD, and FGC for enhanced ESP control was 1.070 Δdv from Unit 1, 0.199 Δdv from Unit 2, 1.068 Δdv from Unit 3, and 0.892 Δdv from Unit 4. While the visibility improvement attributable to the installation of FGC on existing ESPs can't be directly determined from the visibility modeling, the Division does not anticipate the contribution from PM to be significant when compared to the contributions from NO_x and SO_2.

The State of Wyoming considers the BART-determined permit limit to be equivalent to the control effectiveness of a control technology. The limit is based on continuous compliance when the control equipment is well maintained and operated in a manner consistent with good air pollution control practices for minimizing emissions.

Unit-by-unit BART determinations for NO_x and PM/PM_{10}:

Units	Pollutant	Control Type	lb/MMBtu	lb/hr	tpy
1, 2, 3, & 4	NO_x	LNB/OFA	0.26 (30-day rolling)	1,560 (30-day rolling)	6,833
1, 2, 3, & 4	PM/PM_{10} [(a)]	ESP + FGC	0.030	180	788

[(a)] Filterable portion only
ESP = electrostatic precipitator
FGC = flue gas conditioning
LNB = low NO_x burners
OFA = overfire air

III. Expeditious Installation and Operation of BART

The State of Wyoming requires that PacifiCorp install and operate new LNB with separated OFA on Unit 1, in accordance with the Division's BART determination, and conduct the required initial performance tests to demonstrate compliance as expeditiously as practicable, but no later than five years after EPA approval of the state implementation plan revision. Installation of LNB and separated OFA has been completed and initial performance tests have been completed on Units 2, 3, and 4. The NO_x compliance deadline for Units 2-4 was on or before March 31, 2010. With respect to particulate matter, the State of Wyoming requires that PacifiCorp continue the use of the existing ESPs on Units 1 through 4 with FGC to achieve the BART emissions limits. Initial performance tests have been conducted and the PM/PM_{10} compliance deadline for Units 1-4 was on or before March 31, 2010.

IV. Proper Maintenance and Operation of Control Equipment

The State of Wyoming requires that PacifiCorp conduct initial NO_x performance tests on Unit 1, after the installation of LNB and separated OFA, within 30 days of achieving a maximum design rate, but not later than 90 days following initial start-up. If a maximum design rate is not achieved within 90 days of start-up, the AQD Administrator may require testing be done at the rate achieved and again when a maximum rate is achieved. A test protocol shall be submitted for Division approval prior to testing and a written report of the test results shall be submitted to the Division. Testing required by the WAQSR Chapter 6, Section 3 operating permit may be submitted to satisfy the testing required.

The State of Wyoming requires that PacifiCorp follow the monitoring and recordkeeping requirements of Section 6.4 V. to ensure proper maintenance and operation of control equipment.

6.5.5 PacifiCorp - Dave Johnston Power Plant

I. The Five-Factor Analysis

After considering (1) the costs of compliance, (2) the energy and non-air quality environmental impacts of compliance, (3) any pollution equipment in use or in existence at the source, (4) the remaining useful life of the source, and (5) the degree of improvement in visibility (all five statutory factors) from each proposed control technology, the Division determined BART for NO_x and PM_{10} emitted from the two units subject to BART at the Dave Johnston Power Plant.

For control of NO_x emissions, the State of Wyoming requires that PacifiCorp install and operate LNB with advanced OFA as BART for Unit~~s~~ 3 ~~and 4~~. ~~The State of Wyoming will require a NO_x control level of 0.28 lb/MMBtu on a 30-day rolling average, below EPA's applicable presumptive limit of 0.45 lb/MMBtu for cell-fired boilers burning subbituminous coal, for Unit 3.~~ For Unit 4, the State of Wyoming will require a NO_x control level of 0.15 lb/MMBtu on a 30-day rolling average, equal to EPA's applicable presumptive limit for tangential-fired boilers burning subbituminous coal. Annual NO_x emission reductions from LNB with advanced OFA on Unit ~~3 and~~ 4 are ~~2,723 tons and~~ 6,142 tons~~, respectively~~.

LNB with advanced OFA on Units 3 and 4 is cost effective, with an average cost effectiveness of $648 per ton of NO_x removed for Unit 3 and $137 per ton for Unit 4. Combustion control using LNB with advanced OFA does not require non-air quality environmental mitigation for the use of chemical reagents (i.e., ammonia or urea) and there is a minimal energy impact.

For control of PM/PM_{10} emissions, the State of Wyoming requires that PacifiCorp install and operate new full-scale fabric filters on Units 3 and 4 to meet corresponding BART emission limits on a continuous basis. When considering all the factors above and beyond the benefits associated with regional haze which include the existing precipitator's current condition and performance and end of life issues, the ability of the current electrostatic precipitator to meet an ESP BART rate of 0.23 lb/MMBtu on a continuous basis and the enhanced mercury removal co-benefits the baghouse provides, the Wyoming Air Quality Division has determined that the costs associated with the installation of a new full-scale fabric filter are reasonable. A full-scale fabric

filter is the most stringent PM/PM_{10} control technology and therefore the Division accepts it as BART. The Division considers the installation and operation of the BART-determined PM/PM_{10} controls of a new full-scale fabric filter on Unit 3 at Dave Johnston, as recently permitted in Air Quality Permit MD-5098, to meet the requirements of BART.

When considering all the factors above and beyond the benefits associated with regional haze which include the existing venturi scrubber's current condition and performance and end of life issues, the ability of the current venturi scrubber to meet a venturi scrubber BART rate of 0.21 lb/MMBtu on a continuous basis and the enhanced mercury removal co-benefits the baghouse provides, the Wyoming Air Quality Division has determined that the costs associated with the installation of a new full-scale fabric filter are reasonable. A full-scale fabric filter is the most stringent PM/PM_{10} control technology and therefore the Division accepts it as BART. The Division considers the installation and operation of the BART-determined PM/PM_{10} controls of a new full-scale fabric filter on Unit 4 at Dave Johnston, as recently permitted in Air Quality Permit MD-5098, to meet the requirements of BART.

Visibility impacts were addressed in a comprehensive visibility modeling analysis covering three visibility impairing pollutants and associated control options. The cumulative 3-year averaged 98th percentile visibility improvement from baseline, summed across all four Class I areas (Badlands and Wind Cave national parks, and Mt. Zirkel and Rawah wilderness areas) and achieved with LNB with advanced OFA, dry FGD, and a new full-scale fabric filter, was 3.558 Δdv from Unit 3 and 1.963 Δdv from Unit 4.

The State of Wyoming considers the BART-determined permit limit to be equivalent to the control effectiveness of a control technology. The limit is based on continuous compliance when the control equipment is well maintained and operated in a manner consistent with good air pollution control practices for minimizing emissions.

Unit-by-unit BART determinations for NO_x and PM/PM_{10}:

Unit	Pollutant	Control Type	lb/MMBtu	lb/hr	tpy
3	~~NO_x~~	~~LNB/OFA~~	~~0.28 (30-day rolling)~~	~~784 (30-day rolling)~~	~~3,434~~
	PM/PM_{10} [(a)]	Fabric Filter	0.015	42.1	184
4	NO_x	LNB/OFA	0.15 (30-day rolling)	615 (30-day rolling)	2,694
	PM/PM_{10} [(a)]	Fabric Filter	0.015	61.5	269

[(a)] Filterable portion only
LNB = low NO_x burners
OFA = overfire air

III. Expeditious Installation and Operation of BART

The State of Wyoming requires that PacifiCorp install and operate new low NO_x burners with advanced OFA on Units~~ 3 and ~~4, in accordance with the Division's BART determination, and conduct the required initial performance tests to demonstrate compliance as expeditiously as practicable, but no later than five years after EPA approval of the state implementation plan revision. The State of Wyoming requires that PacifiCorp install new full-scale fabric filters on

Units 3 and 4, in accordance with the Division's BART determination, and conduct the initial performance tests required to demonstrate compliance as expeditiously as practicable, but no later than five years after EPA approval of the state implementation plan revision.

~~IV. Proper Maintenance and Operation of Control Equipment~~

~~The State of Wyoming requires that PacifiCorp follow the monitoring and recordkeeping requirements of Section 6.4 V. to ensure proper maintenance and operation of control equipment.~~

6.5.6 PacifiCorp - Naughton Power Plant

I. The Five-Factor Analysis

After considering (1) the costs of compliance, (2) the energy and non-air quality environmental impacts of compliance, (3) any pollution equipment in use or in existence at the source, (4) the remaining useful life of the source, and (5) the degree of improvement in visibility (all five statutory factors) from each proposed control technology, the Division determined BART for NO_x and PM_{10} emitted from the three units subject to BART at the Naughton Power Plant.

For control of NO_x emissions, the State of Wyoming requires that PacifiCorp install and operate LNB with advanced OFA as BART for Units 1 and 2, and tune the existing LNB/OFA system on Unit 3 and install SCR. Annual NO_x emission reductions from baseline for LNB with advanced OFA on Units 1 and 2 are 2,334 and 2,649 tons, respectively. Annual NO_x emission reductions from baseline achieved by tuning the existing LNB/OFA and installing SCR on Unit 3 are 5,542 tons.

LNB with advanced OFA on Units 1 and 2 is cost effective, with an average cost effectiveness of $426 and $357, respectively, per ton of NO_x removed for each unit over a twenty-year operational life. Combustion control using LNB with advanced OFA for Units 1 and 2 does not require non-air quality environmental mitigation for the use of chemical reagents (i.e., ammonia or urea) and there is a minimal energy impact. The cost effectiveness of tuning the existing LNB with OFA and installing SCR on Unit 3 was reasonable, with a value of $2,830 per ton of NO_x removed.

For control of PM/PM_{10} emissions, the State of Wyoming requires that PacifiCorp utilize the existing ESPs and add FGC as BART for Units 1 and 2. The control technology is cost effective for each unit, with costs per ton removed of $1,721 for Unit 1 and $949 for Unit 2. No negative non-air environmental impacts are anticipated from the use of existing ESPs with FGC. For control of PM/PM_{10} emissions from Unit 3, the State of Wyoming requires that PacifiCorp install and operate a new, full-scale fabric filter to meet a corresponding BART emission limit on a continuous basis. When considering all the factors above and beyond the benefits associated with regional haze which include the existing precipitator's current condition and performance and end-of-life issues, the ability of the current electrostatic precipitator to meet an ESP BART rate of 0.04 lb/MMBtu on a continuous basis, the enhanced mercury removal co-benefits the baghouse provides, and the reduced ash loading on the SO_2 scrubber which will enhance the scrubber performance, the Wyoming Air Quality Division has determined that the costs

associated with the installation of a new full-scale fabric filter are reasonable. A full-scale fabric filter is the most stringent PM/PM_{10} control technology and therefore the Division accepts it as BART. The Division considers the installation and operation of the BART-determined PM/PM_{10} controls of a new full-scale fabric filter on Unit 3 to meet the statutory requirements of BART.

Visibility impacts were addressed in a comprehensive visibility modeling analysis covering three visibility impairing pollutants and associated control options. The cumulative 3-year averaged 98th percentile visibility improvement from the baseline across Bridger WA and Fitzpatrick WA achieved with LNB with advanced OFA, wet FGD, and FGC for enhanced ESP control was 1.716 Δdv from Unit 1 and 1.934 Δdv from Unit 2. While the visibility improvement attributable to the installation of FGC on existing ESPs can't be directly determined from the visibility modeling, the Division does not anticipate the PM contribution to be significant when compared to the NO_x and SO_2 contributions. For Unit 3, the cumulative 3-year averaged 98th percentile visibility improvement from the baseline summed across both Class I areas achieved by tuning the existing LNB with OFA, wet FGD and installing a new full-scale fabric filter, was 0.826 Δdv. The installation of SCR on Unit 3 produces an additional 1.023 Δdv in cumulative, 3-year averaged 98th percentile modeled visibility improvement across the two Class I areas.

The State of Wyoming considers the BART-determined permit limit to be equivalent to the control effectiveness of a control technology. The limit is based on continuous compliance when the control equipment is well maintained and operated in a manner consistent with good air pollution control practices for minimizing emissions.

Unit-by-unit BART determinations for NO_x and PM/PM_{10}:

Units	Pollutant	Control Type	lb/MMBtu	lb/hr	tpy
1	NO_x	LNB/OFA	0.26 (30-day rolling)	481 (30-day rolling)	2,107
	PM/PM_{10} [(a)]	ESP + FGC	0.040	74	324
2	NO_x	LNB/OFA	0.26 (30-day rolling)	624 (30-day rolling)	2,733
	PM/PM_{10} [(a)]	ESP + FGC	0.040	96	421
3	NO_x	Tune LNB/OFA + SCR	0.07 (30-day rolling)	259 (30-day rolling)	1,134
	PM/PM_{10} [(a)]	Fabric Filter	0.015	56	243

[(a)] Filterable portion only
ESP = electrostatic precipitator
FGC = flue gas conditioning
LNB = low NO_x burners
OFA = overfire air

III. Expeditious Installation and Operation of BART

The State of Wyoming requires that PacifiCorp install and operate new low NO_x burners with advanced OFA and install flue gas conditioning on the existing ESPs on Units 1 and 2, in accordance with the Division's BART determination, and conduct the required performance tests to demonstrate compliance as expeditiously as practicable, but no later than five years after EPA approval of the state implementation plan revision.

The State of Wyoming requires that PacifiCorp shall tune the existing low NO_x burners with OFA and install selective catalytic reduction and a full-scale fabric filter on Unit 3, in accordance with the Division's BART determination to demonstrate compliance as expeditiously as practicable, but no later than five years after EPA approval of the state implementation plan revision.

IV. Proper Maintenance and Operation of Control Equipment

The State of Wyoming requires that PacifiCorp follow the monitoring and recordkeeping requirements of Section 6.4 V. to ensure proper maintenance and operation of control equipment.

6.5.7 PacifiCorp - Wyodak Power Plant

I. The Five-Factor Analysis

After considering (1) the costs of compliance, (2) the energy and non-air quality environmental impacts of compliance, (3) any pollution equipment in use or in existence at the source, (4) the remaining useful life of the source, and (5) the degree of improvement in visibility (all five statutory factors) from each proposed control technology, the Division determined BART for NO_x and PM_{10} emitted from the single unit subject to BART at the Wyodak Power Plant.

~~For control of NO_x emissions, the State of Wyoming requires that PacifiCorp install and operate LNB with advanced OFA as BART for Unit 1. Annual NO_x emission reductions from baseline with LNB with advanced OFA on Unit 1 are 1,483 tons. LNB with advanced OFA on Unit 1 is cost effective, with an average cost effectiveness of $881 per ton of NO_x removed over a twenty-year operational life. Combustion control using LNB with advanced OFA does not require non-air quality environmental mitigation for the use of chemical reagents (i.e., ammonia or urea) and there is a minimal energy impact.~~

For control of PM/PM_{10} emissions from Unit 1, the State of Wyoming requires that PacifiCorp install and operate a new, full-scale fabric filter to meet a corresponding BART emission limit on a continuous basis. When considering all the factors above and beyond the benefits associated with regional haze which include the existing precipitator's current condition and performance and end of life issues, the ability of the current electrostatic precipitator to meet an ESP BART rate of 0.10 lb/MMBtu on a continuous basis, and the enhanced mercury removal co-benefits the baghouse provides, the Wyoming Air Quality Division has determined that the costs associated with the installation of a new full-scale fabric filter are reasonable. A full-scale fabric filter is the most stringent PM/PM_{10} control technology and therefore the Division accepts it as BART. The Division considers the installation and operation of the BART-determined PM/PM_{10} controls of a new full-scale fabric filter at Wyodak, as recently permitted under Air Quality Permit MD-7487, to meet the requirements of BART.

Visibility impacts were addressed in a comprehensive visibility modeling analysis covering three visibility impairing pollutants and associated control options. The cumulative 3-year averaged 98th percentile visibility improvement from the baseline summed across both Class I areas (Badlands and Wind Cave national parks) achieved with LNB with advanced OFA, upgrading the dry FGD, and a new full-scale fabric filter was 0.996 Δdv.

The State of Wyoming considers the BART-determined permit limit to be equivalent to the control effectiveness of a control technology. The limit is based on continuous compliance when the control equipment is well maintained and operated in a manner consistent with good air pollution control practices for minimizing emissions.

Unit-by-unit BART determinations for NO_x and PM/PM_{10}:

Unit	Pollutant	Control Type	lb/MMBtu	lb/hr	tpy
1	~~NO_x~~	~~LNB/OFA~~	~~0.23 (30-day rolling)~~	~~1,081.0 (30-day rolling)~~	~~4,735~~
	PM/PM_{10} [(a)]	Fabric Filter	0.015	71.0	309

[(a)] Filterable portion only
LNB = low NO_x burners
OFA = overfire air

III. Expeditious Installation and Operation of BART

The State of Wyoming requires that PacifiCorp install ~~new low NO_x burners with advanced OFA and~~ a new full-scale fabric filter on Unit 1, in accordance with the Division's BART determination, and conduct the initial performance tests to demonstrate compliance as expeditiously as practicable, but no later than five years after EPA approval of the state implementation plan revision.

~~IV. Proper Maintenance and Operation of Control Equipment~~

~~The State of Wyoming requires that PacifiCorp follow the monitoring and recordkeeping requirements of Section 6.4 V. to ensure proper maintenance and operation of control equipment.~~

6.5.8 Basin Electric Power Cooperative - Laramie River Station

The Air Quality Division issued a BART permit for Basin Electric Power Cooperative - Laramie River Station on December 31, 2009 under Permit No. MD-6047. A summary of the Division's five-factor analysis performed to support the BART permit issued on December 31, 2009 is included below. The detailed five-factor analysis is included in Attachment A of this SIP.

I. The Five-Factor Analysis

After considering (1) the costs of compliance, (2) the energy and non-air quality environmental impacts of compliance, (3) any pollution equipment in use or in existence at the source, (4) the remaining useful life of the source, and (5) the degree of improvement in visibility (all five statutory factors) from each proposed control technology, the Division determined BART for NO_x and PM_{10} emitted from the three units at the Laramie River Station.

~~For control of NO_x emissions, the State of Wyoming requires that Basin Electric install new LNB with OFA as BART for Units 1 through 3. Annual NO_x emission reductions from new LNB~~

with OFA on Units 1, 2, and 3 are 1,862-1,910 tons per unit for a total annual reduction of 5,645 tons.

LNB with separated OFA on Units 1 through 3 is cost effective, with an average cost effectiveness of $2,036-$2,088 per ton of NO_x removed for each unit over a twenty-year operational life. Combustion control using LNB with OFA does not require non-air quality environmental mitigation for the use of chemical reagents (i.e., ammonia or urea) and there is a minimal energy impact.

For control of PM/PM_{10} emissions, the State of Wyoming requires that Basin Electric utilize the existing ESPs as BART for Units 1 through 3. The cost of compliance for the sole technically feasible control option, a retrofit fabric filter on the Unit 3 ESP, is not reasonable over a twenty-year operational life. No negative non-air environmental impacts are anticipated from use of the existing ESPs.

Visibility impacts were addressed in a comprehensive visibility modeling analysis covering three visibility impairing pollutants and associated control options. The cumulative 3-year averaged visibility improvement from the baseline across Wind Cave NP and Badlands NP achieved with new LNB with OFA at the 30-day limit of 0.23 lb/MMBtu (based on the 98th percentile modeled results) was 0.14 Δdv from each of the three units. The expected visibility improvement over the course of a full annual period would be even greater due to the annual BART limit that is based on 0.19 lb/MMBtu.

The State of Wyoming considers the BART-determined permit limit to be equivalent to the control effectiveness of a control technology. The limit is based on continuous compliance when the control equipment is well maintained and operated in a manner consistent with good air pollution control practices for minimizing emissions.

Unit-by-unit BART determinations for NO_x and PM/PM_{10}:

Units	Pollutant	Control Type	lb/MMBtu	lb/hr	tpy
1	NO_x	LNB/OFA	0.23 (30-day rolling)	1,348 (30-day rolling)	5,343 (12-month rolling)
	PM/PM_{10} [(a)]	ESP	0.030	193	844
2	NO_x	LNB/OFA	0.23 (30-day rolling)	1,348 (30-day rolling)	5,343 (12-month rolling)
	PM/PM_{10} [(a)]	ESP	0.030	193	844
3	NO_x	LNB/OFA	0.23 (30-day rolling)	1,386 (30-day rolling)	5,493 (12-month rolling)
	PM/PM_{10} [(a)]	ESP	0.030	198	867

[(a)] Filterable portion only
ESP = electrostatic precipitator
LNB = low NO_x burners
OFA = overfire air

The performance/efficiency-based, 30-day rolling average emission rate of 0.23 lb/MMBtu is set to allow for continuous compliance with proper operation of the control equipment, while taking into account the normal operational variability that is typical for a boiler. The 30-day limits that

~~are expressed in terms of mass emissions (lb/hr) are based on 0.21 lb/MMBtu. Because reduced steam loads on a boiler can result in periods of increased emissions in terms of lb/MMBtu but lower emissions in terms of lb/hr, the Division has chosen to set the dual 30-day limits, one set at 0.23 lb/MMBtu and one expressed in lb/hr based on 0.21 lb/MMBtu. For the 12-month rolling emission limits, the Division considered the ability of the source to maintain a lower emission rate over a longer time period and set the long-term limit (expressed in tpy) based on 0.19 lb/MMBtu.~~

III. Expeditious Installation and Operation of BART

~~The State of Wyoming requires that Basin Electric install new low NO_x burners with separated OFA on Units 1 through 3, in accordance with the Division's BART determination, and conduct the required initial performance tests to demonstrate compliance as expeditiously as practicable, but no later than five years after EPA approval of the state implementation plan revision.~~

The State of Wyoming requires that Basin Electric continue the use of the existing ESPs on Units 1 through 3 to achieve the BART emissions limits. The PM/PM_{10} compliance deadline was March 31, 2010.

IV. Proper Maintenance and Operation of Control Equipment

The State of Wyoming requires that Basin Electric follow the monitoring and recordkeeping requirements of Section 6.4 V. to ensure proper maintenance and operation of control equipment.

Subsequent NO_x BART Determinations

On March 8, 2010, Basin Electric Power Cooperative appealed the BART permit for the Laramie River Station before the Wyoming Environmental Quality Council (EQC). The Department of Environmental Quality entered into a settlement agreement on November 16, 2010 with Basin Electric Power Cooperative (Docket No. 10-2802). On December 8, 2010, the Division held a State Implementation Plan (SIP) Hearing on Regional Haze. The SIP hearing was held in Cheyenne, Wyoming at the Laramie County Library, 2200 Pioneer Avenue. At that time, the Division collected public comment on the Regional Haze SIP revisions.

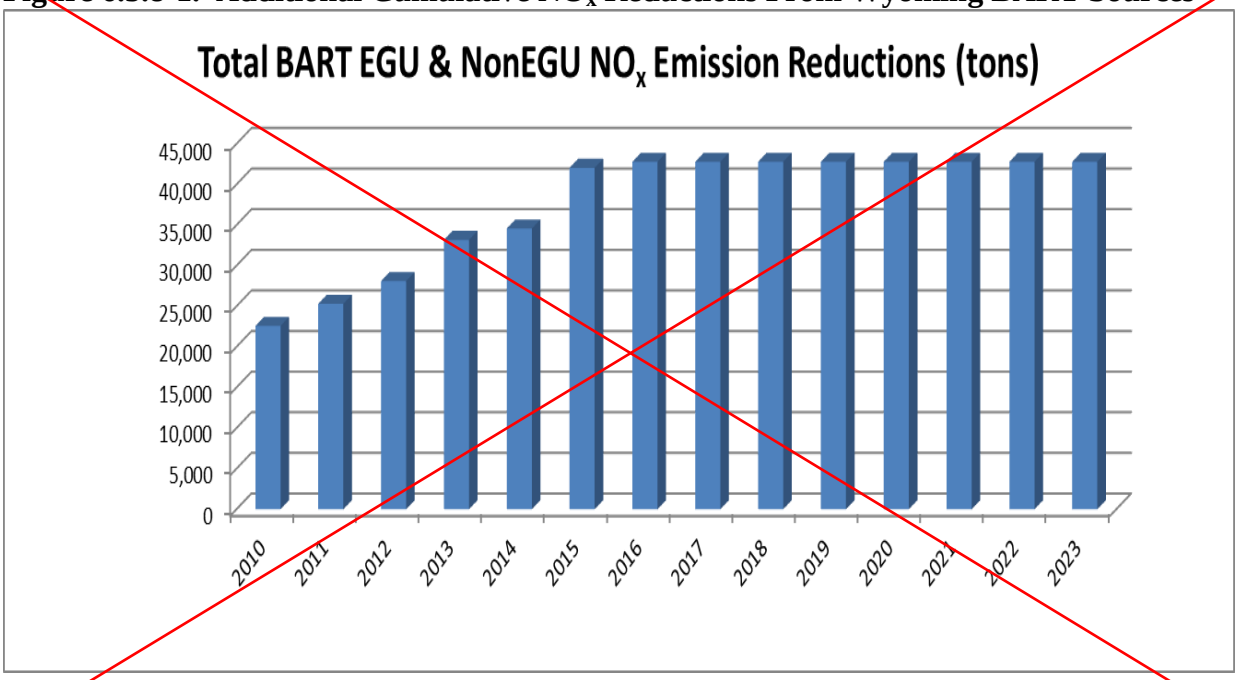
~~***After carefully considering all comments on revisions to the State Implementation Plan to address Regional Haze, the Division has determined that the following table, taken from the Settlement Agreement Filed November 16, 2010 before the Wyoming EQC and incorporated into the EQC Order approving the Settlement, shall establish the BART limits for three units at Laramie River Station with respect to NO_x and NO_x only, and that these BART limits shall replace the BART limits for NO_x determined by the Division in Permit MD-6047 issued on December 31, 2009. The Division has remodeled the emission limits established through this Settlement to determine the resulting visibility impacts. This impact analysis is included in Attachment A.***~~

Effective upon completion of the initial performance tests to verify the emission levels below, emissions from Laramie River Station Units 1 through 3 shall not exceed the levels below. The NO_x limits shall apply during all operating periods.			
Pollutant	***lb/MMBtu***	***lb/hr***	***tpy***
NO_x	***0.21 (30-day rolling)***	***Unit 1: 1,220*** ***Unit 2: 1,220*** ***Unit 3: 1,254*** ***(all 30-day rolling)***	***Unit 1: 4,780*** ***Unit 2: 4,780*** ***Unit 3: 4,914*** ***(all 12-month rolling)***

Overall NO_x Reductions in Wyoming

In the State of Wyoming, significant additional NO_x reductions will be made at the completion of the BART process. ~~The overall cumulative NO_x reductions from Wyoming BART sources over time are demonstrated in the figure below.~~ If regional funding becomes available, future regional modeling will demonstrate the additional progress towards 2018 visibility goals.

Figure 6.5.8-1. Additional Cumulative NO_x Reductions From Wyoming BART Sources



CHAPTER 7
REASONABLE PROGRESS GOALS

7.1 Overview

The fundamental purpose of the Regional Haze Rule (RHR) is to restore visibility in all mandatory Class I areas across the United States to natural conditions by the year 2064. As required by the RHR, each state must submit a State Implementation Plan (SIP) that addresses visibility reductions in Class I areas for the initial planning period of 2005-2018, with successive revisions occurring every ten years after 2018. In order to demonstrate incremental visibility improvement during the first planning period, the State of Wyoming was required to establish reasonable progress goals (RPGs) for the seven Class I areas within the state.

Reasonable progress goals listed in Section 7.5 of this chapter are used to gauge the progress that the State of Wyoming can reasonably make towards improving visibility to natural conditions in Class I areas within the state. Each Class I area RPG consists of two visibility values, expressed as deciviews (dv), that represent the most impaired visibility days (i.e., the average of the 20% most impaired days over an entire year) and the least impaired visibility days (i.e., the average of the 20% least impaired days over an entire year).

While the reasonable progress goals are not enforceable, the control measures adopted by the State of Wyoming are enforceable. To determine if reasonable progress is being made in improving visibility, the State will need to collect and analyze air quality data and update the 5-year visibility averages for the 20% worst visibility days and the 20% best visibility days and compare the 5-year average with the baseline conditions (after 2018, the 5-year average will be compared to the impairment levels reported in the previous SIP revision). If the control measures set by the State do not result in a reduction in visibility impairment equal to or greater than the RPG for 2018, then the State of Wyoming can either revise its control strategies to meet the RPG or revise the RPG for the next planning period.

RPGs are non-enforceable, interim goals, expressed in deciviews, which represent interim visibility improvement in an effort to eventually achieve natural visibility conditions in Class I areas. When RPGs are established, they must provide for visibility improvement for the 20% worst visibility days and ensure that there is not a reduction in visibility for the least impaired days, calculated as the 20% best visibility days, through 2018. For states with multiple Class I areas, RPGs can be established separately for each one. The established goals must represent greater visibility improvement than what would result from the other requirements of the Clean Air Act (CAA).

States must revisit their reasonable progress goals in 2018, as discussed in Chapter 10, by evaluating the progress towards natural conditions and the effectiveness of the long-term strategy for achieving the goals. If progress towards natural visibility conditions is unsatisfactory, the reasonable progress goals can be revised.

7.2 Process for Establishing Reasonable Progress Goals

Several steps for establishing reasonable progress goals were outlined in the RHR and are discussed in the following subsections.

- Calculate/Estimate Baseline and Natural Visibility Conditions

Baseline visibility conditions were determined by the Western Regional Air Partnership (WRAP) Technical Support System (TSS) using the Interagency Monitoring of Protected Visual Environments (IMPROVE) algorithm. The IMPROVE algorithm followed the established guidelines presented in the RHR. To determine baseline visibility conditions, the average degree of visibility (expressed as dv) for the 20% least impaired days and the 20% worst impaired days was calculated, using IMPROVE air quality monitoring data, for each calendar year from 2000 to 2004. The IMPROVE monitoring program collects speciated $PM_{2.5}$, and $PM_{2.5}$ and PM_{10} mass. IMPROVE is a nationwide network which began in 1988 and expanded significantly in 2000 in response to the EPA's Regional Haze Rule (RHR). The Regional Haze Rule specifically requires data from this program to be used by states and tribes to track progress in reducing haze. The annual values were then averaged over five years to determine the baseline visibility condition values. Baseline visibility is discussed in detail in Chapter 2.

Natural conditions are an estimate of the amount of visibility impairment that would occur if no human-caused visibility impairment existed. Natural conditions were determined by the WRAP through the Natural Haze Levels II Committee for the 20% worst visibility days and the 20% best visibility days using available monitoring data and the IMPROVE algorithm. The Natural Haze Levels II Committee was established in 2006 to review and refine the default approach. The committee included representatives from NOAA, NPS, Cooperative Institute for Research in the Atmosphere (CIRA), Regional Planning Organizations (RPOs) and industry representatives, and other participants. The final report of the committee can be found at: http://wrapair.org/forums/aoh/meetings/060726den/NaturalHazeLevelsIIReport.pdf. Additional information about the baseline and natural visibility impairment calculations can be found in Chapter 13.

- Determine the Uniform Rate of Progress (URP)

The URP (also known as the glide slope), which was determined by the State of Wyoming for all mandatory Class I areas within the state, is the rate of visibility change necessary to achieve natural visibility conditions by the year 2064. The URP represents the slope between baseline visibility conditions in 2004 and natural visibility conditions in 2064. Using interpolation, the improvement necessary by 2018 to achieve natural visibility conditions in 2064 can be calculated as shown in Table 7.2-1. The URP is discussed in greater detail in Chapters 3 and 5.

Table 7.2-1. 20% Best and Worst Days Baseline, Natural Conditions, and Uniform Rate of Progress Goal for Wyoming Class I Areas

IMPROVE Monitor Name	Wyoming Class I Areas	20% Worst Days					20% Best Days	
		2000-04 Baseline (dv)	2018 URP Goal (dv)	2018 Reduction Needed (dv)	2064 Natural Conditions (dv)	Future Date for Reaching Natural Conditions at Current Rate	2000-04 Baseline (dv)	2064 Natural Conditions (dv)
YELL2	Yellowstone National Park Grand Teton National Park Teton Wilderness	11.8	10.5	1.3	6.4	2130	2.6	0.4
NOAB1	North Absaroka Wilderness Washakie Wilderness	11.5	10.4	1.1	6.8	2136	2.0	0.6
BRID1	Bridger Wilderness Fitzpatrick Wilderness	11.1	10.0	1.1	6.5	2165	2.1	0.3

(WRAP TSS - http://vista.cira.colostate.edu/tss/)

- Four Factor Analysis

In an effort to reduce visibility impairing air pollutants, emission control measures had to be evaluated. The four factor analysis process was established in the RHR and is discussed in detail in Section 7.3 of this chapter. Each emission control strategy, as required by the four factor analysis guidelines, was evaluated based on 1) the cost of compliance, 2) time necessary for compliance, 3) the energy and non-air quality environmental impacts of compliance, and 4) the remaining useful life of any existing source subject to such emission controls.

- Consultation With Other States

According to the RHR, the State of Wyoming must consult with other states that may cause or contribute to visibility impairment in Wyoming Class I areas. For the State of Wyoming, consultations with other states contributing to visibility impairment in Class I areas were conducted through the WRAP. Additional information on the state consultations can be found in Chapter 11.

- Determination of Reasonable Progress Goals

Reasonable progress goals, when established, demonstrate the amount of visibility improvement the State of Wyoming believes to be feasible, based on the four factor analysis and Clean Air Act (CAA) requirements, during the first planning period. The reasonable progress goal may be the same, less stringent, or more stringent than the visibility improvement based on the URP. The reasonable progress goals, and the logic used to determine the goals, are discussed in Sections 7.5 and 7.6 of this chapter.

7.3 Four Factor Analysis Performed for Wyoming Sources

The four factor analysis, which is presented in the RHR, is a method for evaluating potential control strategies for facilities that are not eligible for Best Available Retrofit Technology (BART) or better-than-BART programs. The analysis considers 1) the cost of compliance, 2) the time necessary for compliance, 3) environmental impacts of compliance, and 4) the remaining useful life of the facility.

The WRAP hired EC/R Incorporated (EC/R), headquartered in Chapel Hill, North Carolina, to complete the four factor analysis. Control measures for NO_x and direct particulate matter emissions were evaluated for selected sources in Wyoming. A four factor analysis is not required for SO_2 since the State of Wyoming has addressed visibility impairment associated with this pollutant under the 309 SIP previously submitted to EPA.

7.3.1 Detailed Description of the Four Factors

- Cost of Compliance

Both control costs and net annual costs were analyzed for all control measures identified by EC/R. Control costs cover direct and indirect capital costs. Examples of direct capital expenses includes the costs associated with purchased equipment, construction, installation, instrumentation and process controls, ductwork and piping, electrical components, and structural and foundation components. Indirect capital expenses include costs such as engineering and design, contractor fees, startup and performance testing, contingency costs, and process modifications.

Net annual costs include the expenses associated with the typical operation of the control equipment over a year. Annual costs include items such as the utility expenses, labor, waste disposal expenses, and amortized costs of the capital investment. All cost estimates calculated by EC/R were updated to 2007 dollars using the Marshall and Swift Equipment Cost Index or the Chemical Engineering Plant Cost Index, which are both published in the journal Chemical Engineering.

- Time Necessary for Compliance

The time necessary for compliance includes the time needed for the State of Wyoming to develop and implement regulations for emissions controls, as well as the time the sources require to procure the capital to purchase the emission control equipment, design and fabricate the equipment, and to install the emission controls. When a retrofit control device is required, the time necessary for compliance includes the time for capital procurement, device design, fabrication, and installation.

- Energy and Other Non-Air Quality Environmental Impacts

Emission control devices often require some form of energy input to operate. To determine the energy requirements for a particular control device, the electricity needs, steam requirements, increased fuel requirements, and any additional energy inputs required were quantified. Only the direct energy requirements were considered; indirect energy needs, such as the amount of energy required to produce the fuel for the control device, were not analyzed. In addition, any impacts the control technologies had on other source processes, such as boiler efficiency, were not evaluated.

While the control devices reduce air pollution, they often produce waste. Environmental impacts of each control technology were analyzed by EC/R and included the waste generated, the wastewater generated, additional CO_2 produced, reduced acid deposition, and reduced nitrogen deposition. If available, the benefits from $PM_{2.5}$ and ozone reductions were also evaluated.

- Remaining Equipment Life at Source

The remaining equipment life of the source will impact the cost of emission control technologies if the expected life of the source is less than the lifetime of the pollution control device being considered. Therefore, if the remaining equipment life is less than the lifetime of the pollution control device, the capital cost of the pollution control device is amortized for the remaining life of the emission source. To determine the annual cost of the emission control device if the expected life of the source is less than the expected life on the control device, the following equation can be used:

$$A_1 = A_0 + C \times \frac{1-(1+r)^{-m}}{1-(1+r)^{-n}}$$

where:

A_1 = the annual cost of control for the shorter equipment life ($)
A_0 = the original annual cost estimate ($)
C = the capital cost of installing the control equipment ($)
r = the interest rate (0.07)
m = the expected remaining life of the emission source (years)
n = the projected lifetime of the pollution control equipment

7.3.2 Source Selection Process for Four Factor Analysis

To select the sources that would undergo the required four factor analysis, emission data for sources in Wyoming had to first be collected. This was accomplished using the WRAP Emissions Data Management System (EDMS), which contains inventories from stationary sources, fires, area sources, on-road mobile sources, off-road mobile sources, windblown dust, and biogenic sources across the state. After evaluating the emissions, it was determined that the primary emissions from anthropogenic sources, which are sources the State of Wyoming can regulate, were NO_x and SO_2 based on Tables 4.2-1 and 4.3-1, and Figures 5.2.1-1 through 5.2.1-3 and 5.2.3-1 through 5.2.3-3 found in Chapters 4 and 5. Since sources of SO_2 were addressed in great detail in the previous 309 submittal, this screening process focuses on NO_x sources.

A basic screening technique, referred to as the Quantity over Distance or "Q over D" analysis, was implemented by the State of Wyoming in order to select the sources to undergo the four factor analysis. There is no requirement to use this technique, but it has been employed by EPA and other states to roughly determine which sources had the largest contributions of visibility impairing pollutants in Class I areas in Wyoming and surrounding states. It is a basic, intuitive tool that allows the State to evaluate emissions from sources of concern. The sources of concern in this first SIP were the large sources that were similar in magnitude to the sources covered under BART, but were not covered by the timeframe requirements of BART.

The screening technique included sources when the following was met:

$$\frac{Q}{D} \geq 10$$

where Q represents the maximum emission rate, in tons per year, of the source and D is the distance in kilometers to the nearest Class I area. A spreadsheet showing all of the sources with a Q/D greater than 10 can be found in Chapter 7 of the Wyoming TSD. Three emission units were identified in the state having $\frac{Q}{D} \geq 10$ and thereby selected to undergo the four factor analysis.

7.3.3 PacifiCorp Dave Johnston Electric Generating Station

Two units, BW41 and BW42, at the Dave Johnston Electric Generating Station were selected for the four factor analysis in Wyoming. Both units are sub-bituminous coal-fired boilers capable of producing up to 114 megawatts (MW). Emissions are currently controlled with a cold-side electrostatic precipitator (ESP).

Four possible emission control devices were identified and analyzed using the four factor analysis process for the boilers: low NO_x burners (LNB), low NO_x burners with overfire air (LNB w/OFA), selective non-catalytic reduction (SNCR), and selective catalytic reduction (SCR). LNB technology reduces the amount of NO_x produced by reducing the flame temperature. The flame temperature is reduced by controlling the fuel and air mixing, which creates a larger, branched flame. LNB w/OFA reduces NO_x emissions by separating the combustion air into primary and secondary flows. When the combustion air is separated, a more complete burn occurs and forms N_2 rather than NO_x. With SNCR, an aqueous reagent, typically either ammonia or urea, is injected into the hot flue gas. The reagent reacts with the NO_x in the gas to form N_2 and water vapor. Similar to the SNCR technology, SCR technology uses ammonia to reduce NO_x to N_2 and H_2O. However, with SCR the NO_x in the flue gas reacts with the ammonia within a catalyst bed.

- Cost

The estimated capital costs, annual costs, and the cost effectiveness for the possible emission control devices at the Dave Johnston Electric Generating Station are shown in Table 7.3.3-1. The capital costs, which are expressed in terms of cost per MW size, were estimated based on a cost estimate document produced by the EPA.[4] The capital costs for the Dave Johnston boilers had to be extrapolated from the cost estimate data provided by the EPA reference due to their large size. To determine the annual costs for the control devices, the capital costs were amortized over 20 years at an interest rate of 7% and then multiplied by a factor to account for operation and maintenance (O&M) costs. While SCR is expected to be far more efficient in controlling NO_x emissions than LNB or LNB w/OFA, the estimated capital and annual costs are far higher than the costs associated with LNB or LNB w/OFA. As shown in Table 7.3.3-1, NO_x

[4] EPA (2002), *EPA Air Pollution Control Cost Manual*, *6th ed.*, EPA/452/B-02-001, U.S. EPA, Office of Air Quality Planning and Standards, RTP, NC, Section 5 - SO2 and Acid Gas Controls, pp 1-30 through 1-42, http://www.epa.gov/ttncatc1/products.html#cccinfo.

reductions using LNB or LNB w/OFA technology are far more cost effective than the SNCR and SCR technologies.

Table 7.3.3-1. Estimated Costs of Potential Emission Control Devices for Two Boilers at the Dave Johnston Electric Generation Station[x]

			Cost Estimates		
Unit ID	Control Technology	Estimated Control Efficiency (%)	Estimated Capital Cost ($)	Annual Cost ($/year)	Cost Effectiveness ($/ton)
BW41	LNB	51	4,030,000	631,000	528
	LNB w/OFA	65	5,760,000	962,000	632
	SNCR	40	4,160,000	2,490,000	2,659
	SCR	80	11,500,000	3,390,000	1,810
BW42	LNB	51	4,030,000	631,000	538
	LNB w/OFA	65	5,760,000	962,000	644
	SNCR	40	4,160,000	2,490,000	2,709
	SCR	80	11,500,000	3,390,000	1,844

[x]All values listed in Table 7.3.3-1 were obtained from the EC/R Incorporated report "Supplementary Information for Four-Factor Analyses for Selected Individual Facilities in Wyoming" and is included in Chapter 7 of the Wyoming TSD.

- Time Necessary for Compliance

EC/R estimated that it would take nearly five and a half years for NO_x reduction strategies to become effective. It was determined that roughly two years would be necessary for the State of Wyoming to develop the necessary regulations to implement the selected control measures. EC/R estimated that it would take up to a year for the source to secure the capital necessary to purchase emission control devices. Based on estimates calculated by the Institute of Clean Air Companies (ICAC), approximately 18 months would be required for a company to design, fabricate, and install SCR or SNCR technology. Since there are two boilers being evaluated at Dave Johnston, an additional year may be required for staging the installation process.

- Energy and Non-Air Quality Environmental Impacts

The energy required to operate the emission control devices, including electricity and steam, and the waste produced by the emission control devices, such as solid waste and wastewater, are shown in Table 7.3.3-2. As illustrated by the values in Table 7.3.3-2, none of the four technologies are expected to produce solid waste or wastewater. However, it should be noted that the SCR technology would periodically produce solid waste when the catalyst would need to be changed. While LNB and LNB w/OFA do not require steam, both SNCR and SCR require steam to operate. None of the technologies are expected to increase fuel consumption, though LNB and LNB w/OFA may reduce the fuel consumption due to optimized fuel combustion. In addition, LNB and LNB w/OFA technologies need roughly $1/6^{th}$ the electricity required by SNCR and $1/150^{th}$ the electricity required by SCR.

Table 7.3.3-2. Estimated Energy and Non-Air Environmental Impacts of Potential Emission Control Devices for Two Boilers at the Dave Johnston Electric Generation Station[x]

			Energy and Non-Air Pollution Impacts			
Unit ID	Control Technology	Estimated Control Efficiency (%)	Electricity Requirements (kW)	Steam Requirements (lb/hr)	Solid Waste Generated (ton/hr)	Wastewater Produced (gal/min)
BW41	LNB	51	5.4	N/A	N/A	N/A
	LNB w/OFA	65	5.4	N/A	N/A	N/A
	SNCR	40	31	439	N/A	N/A
	SCR	80	825	527	N/A	N/A
BW42	LNB	51	5.4	N/A	N/A	N/A
	LNB w/OFA	65	5.4	N/A	N/A	N/A
	SNCR	40	31	431	N/A	N/A
	SCR	80	825	517	N/A	N/A

[x]All values listed in Table 7.3.3-2 were obtained from the EC/R Incorporated report "Supplementary Information for Four-Factor Analyses for Selected Individual Facilities in Wyoming" and is included in Chapter 7 of the Wyoming TSD.

- Remaining Life of the Boilers

The remaining life of the boilers at the Dave Johnston facility is not expected to have an impact on the cost of the control technologies.

- Dave Johnston Boilers BW41 and BW42 Four Factor Analysis Conclusion

As discussed previously, the LNB and LNB w/OFA emission control technologies have a relatively low cost effectiveness value when compared with the SCR and SNCR technologies. While the LNB and LNB w/OFA estimated control efficiencies are between fifteen and twenty-nine percent lower than the SCR technology, the electricity requirements are far lower for LNB and LNB w/OFA and neither requires steam. In addition SCR will produce solid waste every time the catalyst must be replaced. Therefore, based on the relatively low cost effectiveness, the reasonable control efficiency, possible reduction in fuel usage, low electricity requirements, and the fact that solid waste and wastewater will not be produced, the LNB or LNB w/OFA seem to be the most reasonable choice for the Dave Johnston Electric Generating Station boilers BW41 and BW42 based on the four factor analysis. The implementation of new control technologies on the two boilers are discussed in further detail in Chapter 8 (Section 8.3.4), Long-Term Strategy.

7.3.4 Mountain Cement Company, Laramie Plant

At the Mountain Cement Company, Laramie Plant, only one unit was selected for the four factor analysis. The selected source, Cement Kiln #2, is a long dry kiln that can produce up to 1,500 tons of clinker per day.

Several options are available for the control of NO_x emissions and include both combustion and NO_x removal controls. Combustion control options include direct-fired low NO_x burners (LNB), indirect-fired LNB, and the CemStar process. NO_x removal control options include biosolid injection, $LoTO_x^{TM}$, selective catalytic reduction (SCR), selective non-catalytic reduction (SNCR), and NO_xOUT. Low NO_x burners, whether installed on direct or indirect-fired kilns, reduce the flame turbulence, delay the fuel/air mixing, and establish fuel-rich zones for initial

combustion. These three factors contribute to a reduction in thermal NO_x formation. The CemStar process introduces a small amount of steel slag to the kiln feed, which helps reduce the kiln operating temperature.

Biosolid injection uses wastewater treatment plant solids to reduce the kiln temperature required to produce clinker. The $LoTO_x$ system (licensed by the BOC group), which injects ozone into the kiln, oxidizes NO_x and the resulting higher oxides of nitrogen are then removed by a wet scrubber. SCR technology uses a catalyst such as titanium dioxide or vanadium pentoxide to convert NO_x to N_2 and H_2O. SNCR, while similar to SCR, uses ammonia or urea to reduce NO_x formation, but does not require a catalyst. NO_xOUT is similar to SNCR and uses urea to convert NO_x to nitrate and oxygen, but also has a proprietary additive that allows for a wider temperature range than the typical SNCR system.

- Cost

The estimated capital costs, annual costs, and the cost effectiveness for the possible emission control devices compiled by EC/R for the Mountain Cement Company, Laramie Plant are shown in Table 7.3.4-1. Two options, SCR and $LoTO_x^{TM}$ have high control efficiencies that are predicted to be over 80%. However, no cost data was available for the $LoTO_x^{TM}$ system, making it impossible to evaluate its viability at the Laramie facility. SCR, while an effective control technology, has a cost effectiveness value that makes it cost prohibitive. Of the more cost effective options, SNCR using either urea or ammonia appears to be the most reasonable. SNCR provides a control efficiency similar to many of the other control technologies, but with a far better cost effectiveness ratio.

Table 7.3.4-1. Estimated Costs of Potential Emission Control Devices for One Cement Kiln at the Mountain Cement Company, Laramie Plant.[x]

				Cost Estimates		
Unit ID	Control Technology	Estimated Control Efficiency (%)	Pollutant Controlled	Estimated Capital Cost ($)	Annual Cost ($/year)	Cost Effectiveness ($/ton)
Kiln #2	LNB (indirect)	30-40	NO_x	826,000	205,000	6,568-4,910
	LNB (direct)	40		2,460,000	449,000	13,853
	Biosolid Injection	50		474,000	-127,000	1,324
	NO_xOUT	35		960,000	507,000	8,023
	CemSTAR	20-60		Unknown	Unknown	Unknown
	$LoTO_x^{TM}$	80-90		Unknown	Unknown	Unknown
	SCR	80		27,042,000	7,553,000	82,535
	SNCR (urea)	35		Unknown	Unknown	1,223
	SNCR (ammonia)	35		Unknown	Unknown	1,223
	Fabric Filter	99	PM_{10}	5,261,000	4,451,000	262,489
	Dry ESP	95-98		10,926,000	6,475,000	483,356 - 470,292
	Fabric Filter	99	$PM_{2.5}$	5,261,000	4,451,000	647,472
	Dry ESP	95-98		10,926,000	6,475,000	1,242,915 – 1,160,054

[x]All values listed in Table 7.3.4-1 were obtained from the EC/R Incorporated report "Supplementary Information for Four-Factor Analyses for Selected Individual Facilities in Wyoming" and is included in Chapter 7 of the Wyoming TSD.

- Time Necessary for Compliance

EC/R estimated that it could potentially take seven years to achieve emission reductions at the Laramie facility. This estimate includes the two years that will be necessary for the State of

Wyoming to implement new regulations and the 1 year Mountain Cement will likely need to obtain the necessary capital for the purchase of new emission control technology. However, the total time necessary varies based on the control technology selected. For example, it is predicted that one and a half years will be required to design, fabricate, and install SCR or SNCR technology, while over two and a half years will be required to design, fabricate, and install $LoTO_x^{TM}$ technology.

- Energy and Non-Air Quality Environmental Impacts

Table 7.3.4-2 details the energy requirements and waste produced by the potential emission control devices. Energy requirements include direct electricity and steam requirements, but do not include the energy required to produce the steam and electricity. None of the NO_x control technologies require additional fuel and some are even predicted to increase fuel efficiency. The options that are expected to increase fuel efficiency are indirect and direct LNB, biosolid injection, and CemSTAR. However, there is no data indicating the expected fuel efficiency increase. Without adequate data, it is not possible to determine if the increase in fuel efficiency is substantial and if there is any advantage to selecting an option that increases fuel efficiency over an option that does not increase fuel efficiency.

Several of the NO_x control technologies are expected to require electricity and include both direct and indirect LNB, $LoTO_x^{TM}$, and SNCR using urea or ammonia. Many of the technologies did not have sufficient data to quantify the energy requirements. This made it difficult to adequately evaluate the control options based on electricity requirements. However, some of the NO_x control technologies are not predicted to have electricity requirements, which could make those options potentially more attractive. Those options include SCR, CemSTAR, NO_xOUT, and biosolid injection. None of the NO_x control technologies are expected to require steam.

Only a few of the NO_x control technologies are expected to produce waste, whether solid waste or wastewater. $LoTO_x$ is expected to produce both solid waste and wastewater, but estimates on the amount are not available at this time. Spent catalyst for SCR systems must be replaced periodically, which becomes solid waste. In addition, some fine particulate matter is produced by SCR systems that must be collected by a fabric filter or dry electrostatic precipitator (ESP). The particulate matter collected by a fabric filter or dry ESP must be disposed of as solid waste; the presence of fine particles from the catalyst may require disposal as a hazardous waste.

Table 7.3.4-2. Estimated Energy and Non-Air Environmental Impacts of Potential Emission Control Devices for Kiln #2 at the Mountain Cement Company, Laramie Plant[x]

					Energy and Non-Air Pollution Impacts (per ton of emission reduced)			
Unit ID	Control Technology	Potential Emission Reductions (1000 tons/yr)	Pollutant Controlled	Additional Fuel Requirements (%)	Electricity Requirements (kW-hr)	Steam Requirements (lb/hr)	Solid Waste Generated (ton/hr)	Wastewater Produced (gal/min)
Kiln #2	LNB (indirect)	157-210	NO_x	a	182	b	b	b
	LNB (direct)	210		a	182	b	b	b
	Biosolid Injection	262		a	b	b	b	b
	NO_xOUT	183		b	b	b	b	b
	CemSTAR	105-314		a	b	b	b	b
	$LoTO_x$™	419-472		b	c	b	d	d
	SCR	419		b	b	b	e	b
	SNCR (urea)	183		b	d	b	b	b
	SNCR (ammonia)	183		b	d	b	b	b
	Fabric Filter	37	PM_{10}	b	d	b	1	b
	Dry ESP	15		b	d	b	1	b
	Fabric Filter	36-37	$PM_{2.5}$	b	d	b	1	b
	Dry ESP	14-15		b	d	b	1	b

a - The control technology is expected to improve fuel efficiency.
b - Impact not expected.
c - Electricity requirements are expected to be high, but not enough data to quantify.
d - Technology expected to have an impact, but insufficient data available to evaluate requirements.
e - Spent catalyst will have to be disposed of on occasion.
[x]All values listed in Table 7.3.4-2 were obtained from the EC/R Incorporated report "Supplementary Information for Four-Factor Analyses for Selected Individual Facilities in Wyoming" and is included in Chapter 7 of the Wyoming TSD.

- Remaining Equipment Life

If Mountain Cement chooses to replace kiln #2, then the cost of the control technologies for the currently operating kiln would likely be cost prohibitive.

If Mountain Cement decides not to replace kiln #2, then the remaining life of the kiln would likely be indefinite. Under this scenario, the lifetime of the selected control technology could be assumed to be equal to or less than the lifetime of the cement kiln. The capital cost of the control technology would not have to be amortized over the kiln lifetime, thus eliminating the impact of the remaining equipment life on the cost of the control technology.

The implementation of new control technologies on the cement kiln is discussed in Chapter 8 (Section 8.3.4), Long-Term Strategy.

7.3.5 Oil and Gas Exploration and Production Field Operations

Oil and gas production, which is not limited to just one area of Wyoming, is an important and critical component of the state economy. Sources associated with oil and gas production emit NO_x and PM. Sources include turbines, diesel engines, glycol dehydrators, amine treatment units, flares and incinerators.

Emissions from large stationary oil and gas sources in the WRAP region have been well quantified over the years, while smaller field and production sources are not as well understood.

To better understand the emissions from all oil and gas sources across the region, the WRAP region instituted a three-phase emission inventory project. Phase I, which was completed in 2005, was an emission inventory project that estimated regional emissions from oil and gas field operations for the first time. Phase II, completed in late 2007, was an effort to more fully characterize the oil and gas field operations emissions. The WRAP inventory currently addresses only large stationary sources and a consistent reporting system for oil and gas emissions for WRAP member states has not yet been developed. Members of the Independent Petroleum Association of Mountain States (IPAMS) felt that still more improvement in the accuracy of these emission estimates was needed. So, in late 2007, IPAMS initiated a Phase III regional oil and gas emission inventory project funded by their organization. The project was undertaken in conjunction with the WRAP to assure that the products from Phase III were widely distributed among non-industry stakeholders (state/local agencies, tribal air programs, Federal Land Managers, environmental groups and EPA). Phase III results will not be ready for this SIP review.

While inventory work has not been completed on the oil and gas industry, the WRAP did engage EC/R to assist with the four factor analysis for oil and gas.

EC/R evaluated control technologies for common emission sources in the oil and gas industry: reciprocating engines and turbines, process heaters, flares and incinerators, and sulfur recovery units. For compressor engines and gas-fueled reciprocating engines, potential control options presented by EC/R include air-fuel ratio controls (AFRC), ignition timing retard, low-emission combustion (LEC) retrofit, selective catalytic reduction (SCR), selective non-catalytic reduction (SNCR), and replacement with electric motors. LEC retrofit technology requires modification of the combustion system to increase the air-to-fuel ratio, which creates very lean combustion conditions. Currently in Wyoming, many of the rich-burn engines associated with compressor stations utilize SNCR in conjunction with AFRC, while lean-burn engines often utilize an oxidation catalyst to reduce emissions.

Regulating drill rig engines is problematic for states. Drill rig engines are, for the most part, considered mobile sources and emission limits for mobile sources are set by the Federal government under Section 202 of the CAA. Several control options exist and include ignition timing retard, exhaust gas recirculation, SCR, replacement of Tier 2 engines with Tier 4 engines, and diesel oxidation catalyst.

Other common oil and gas exploration and production equipment also have emission control device options. Turbine emissions can be controlled by water or steam injection, low NO_x burners, SCR, and water or steam injection with SCR. NO_x emission control technologies for process heaters include LNB, ultra-low NO_x burners (ULNB), LNB with flue gas recirculation (FGR), SNCR, SCR, and LNB installed in conjunction with SCR. Glycol circulation rates on glycol dehydrators can be optimized to reduce VOC emissions. Control measures for flares, incinerators, and sulfur recovery units evaluated by EC/R control only SO_2 emissions and are not addressed in this SIP.

NO_x emissions vary based on the equipment and fuel source. Emissions from individual natural gas-fired turbines at production operations can be as high as 877 tons of NO_x per year (tpy),

while emissions from individual natural gas turbines at exploration operations can reach 131 tpy. Individual gas reciprocating engines have comparable NO_x emissions with up to 700 tpy at production operations and 210 tpy at exploration operations. Diesel engine emissions can approach 46 tpy for production operations and 10 tpy for exploration operations.

- Cost

Table 7.3.5-1 lists the various control technologies identified by EC/R for oil and gas field operations. Both the capital and annual costs for each technology is dependent on the engine size or on the process throughput. For several of the control technologies listed in Table 7.3.5-1, cost estimate ranges are provided. The lower end of the cost estimates represent the cost per unit for the larger units or higher production due to economy of scale, while the higher end of the cost estimates represent the cost per unit for the smaller units or lower production.

Flares, incinerators, sulfur recovery units, and glycol dehydrators were not included because the control technology evaluated by EC/R for those sources were only applicable for SO_2 or VOCs, which are not addressed by this SIP.

Table 7.3.5-1. Estimated Costs for Oil and Gas Exploration and Production Equipment[x]

				Cost Estimates			
Source Type	Control Technology	Estimated Control Efficiency (%)	Pollutant Controlled	Estimated Capital Cost ($/unit)	Annual Cost ($/year/unit)	Units	Cost Effectiveness ($/ton)
Compressor Engines	Air-fuel ratio control (AFRC)	10-40	NO_x	5.3 - 42	0.9 - 6.8	hp	68 - 2,500
	Ignition timing retard	15-30	NO_x	N/A	1-3	hp	42 – 1,200
	LEC retrofit	80 - 90	NO_x	120 – 820	30 – 210	hp	320 – 2,500
	SCR	90	NO_x	100 – 450	40 – 270	hp	870 – 31,000
	SNCR	90 – 99	NO_x	17 – 35	3 – 6	hp	16 - 36
	Replacement with electric motors	100 100 100	NO_x PM_{10} $PM_{2.5}$	120 - 140	38 - 44	hp	100 – 4,700 >79,000 >79,000
Drilling Rig Engines and Other Engines	Ignition timing retard	15 – 30	NO_x	16 - 120	14 – 66	hp	1,000 – 2,200
	Exhaust gas recirculation (EGR)	40	NO_x	100	26 – 67	hp	780 – 2,000
	SCR	80 – 95	NO_x	100 – 2,000	40 – 1,200	hp	3,000 – 7,700
	Replacement of Tier 2 engines with Tier 4	87 85 85	NO_x PM_{10} $PM_{2.5}$	125	20	hp	900 – 2,400 25,000 – 68,000 25,000 – 68,000
	Diesel oxidation catalyst	25 25	PM_{10} $PM_{2.5}$	10	1.7	hp	1,400
Turbines	Water or steam injection	68 – 80	NO_x	4.4 – 16	2 – 5	1000 BTU	560 – 3,100
	Low NO_x burners (LNB)	68 – 84	NO_x	8 – 22	2.7 – 8.5	1000 BTU	2,000 – 10,000
	SCR	90	NO_x	13 – 34	5.1 – 13	1000 BTU	1,000 – 6,700
	Water or steam injection with SCR	93 – 96	NO_x	13 – 34	5.1 – 13	1000 BTU	1,000 – 6,700
Process Heaters	LNB	40	NO_x	3.8 – 7.6	0.41 – 0.81	1000 BTU	2,100 – 2,800
	Ultra-Low NO_x Burners (ULNB)	75 – 85	NO_x	4.0 – 13	0.43 – 1.3	1000 BTU	1, 500 – 2,000
	LNB and FGR	48	NO_x	16	1.7	1000 BTU	2,600
	SNCR	60	NO_x	10 – 22	1.1 – 2.4	1000 BTU	4,700 – 5,200
	SCR	70 – 90	NO_x	33 – 48	3.7 – 5.6	1000 BTU	2,900 – 6,700
	LNB and SCR	70 – 90	NO_x	37 – 55	4 – 6.3	1000 BTU	2,900 – 6,300

[x]All values listed in Table 7.3.5-1 were summarized from the EC/R Incorporated report "Supplementary Information for Four Factor Analyses by WRAP States" and is included in Chapter 7 of the Wyoming TSD.

Based on available State permitting data, some of the larger compressor engines in the state can approach 2,900 hp, while coal bed methane engines can be as small as 98 hp. Some of the emissions control technologies for compressor engines, such as SCR, can become quite costly based on the horsepower (hp) of the engine. This also holds true for other oil and gas exploration and production equipment depending on the engine size or production. Drilling rig engines can range from 550 hp for diesel engines up to 2,119 hp for natural gas engines, with 1,476 hp engines common in the field. Turbines are generally around 112 MMBtu/hr, though turbines can be as small as 0.4 MMBtu/hr or as large as 380 MMBtu/hr. Process heaters in Wyoming commonly range from 0.87 MMBtu/hr to 1.5 MMBtu/hr, with process heaters having a throughput of 0.75 MMBtu/hr being common in the state.

In the case of compressor engines, many facilities throughout the state have already installed control equipment. For lean burn engines, oxidation catalysts are commonly installed while SNCR catalysts with AFRC are commonly installed for rich burn engines.

- Time Necessary for Compliance

EC/R predicted that up to two years would potentially be required for Wyoming to develop the necessary regulations. It is estimated that companies would require a year to procure the necessary capital to purchase the control equipment. The time required to design, fabricate, and install control technologies vary based on the control technology selected and other factors. It is predicted that 13 months would be required for the design, fabrication, and installation of SCR or SNCR technology, though some regulators have found that the time required is closer to 18 months. If multiple sources at a facility are to be controlled, an additional 12 months may be required for staging the installation process.

The implementation of new control technologies for oil and gas operations is discussed in further detail in Chapter 8, Long-Term Strategy.

7.4 309 SIP and 309(g)

51.309(g) allows the State to demonstrate reasonable progress for Wyoming's seven Class I areas by building upon and taking full credit for the strategies already adopted, and taking full credit for the strategies already adopted for protecting the 16 Class I areas on the Colorado Plateau with a primary emphasis on controlling SO_2 and anthropogenic smoke. All of those strategies have been submitted to EPA under a 309 SIP. Furthermore, those strategies have been included in the WRAP regional modeling demonstration establishing expected visibility conditions on the most impaired and least impaired days for all of Wyoming's Class I areas. A comparative review of Wyoming SO_2 source impact on the Colorado Plateau Class I areas and the Wyoming Class I areas shows that reductions in SO_2 have a much greater impact on Wyoming Class I areas than those on the Colorado Plateau. This Plan, which is submitted under 309(g), contains many additional measures focused on controlling NO_x and PM. The combined SO_2 control strategies of the 309 SIP and the 309(g) SIP, which have been modeled by the WRAP, provide the basis for established reasonable progress goals in Wyoming's Class I areas.

7.5 Setting Reasonable Progress Goals

Under Section 308(d)(1) of the Regional Haze Rule, states must "establish goals (expressed in deciviews) that provide for reasonable progress towards achieving natural visibility conditions" for each Class I area of the state. These RPGs must provide for an improvement in visibility for the most impaired visibility days, and ensure no degradation for the least impaired visibility days over the same period. The RPGs are interim goals that represent incremental visibility improvement over time, in this case out to the year 2018, to be compared to the 2018 Uniform Rate of Progress (URP) glide slope. ~~Based on the steps outlined in Section 7.2 and the Four-Factor Analysis in Section 7.3, the Division has established RPGs for each of Wyoming's seven Class I areas, as described below. These RPGs are based primarily on results of the CMAQ modeling described in Section 5.1.2, and on the four-factor analysis on major source categories. These goals do not reflect additional improvements in visibility from controls that were not included in the 2018 WRAP modeling. It would be difficult to set goals lower than the anticipated target without additional modeling.~~

Table 7.5-1 shows that for the 20% best days, the RPGs show an improvement over baseline conditions, and thus ensure no visibility degradation. For the 20% worst days, the RPGs are short of the 2018 URP, but can be justified based on the demonstration provided in Section 7.6.

Table 7.5-1. Reasonable Progress Goals for 20% Worst Days and 20% Best Days for Wyoming Class I Areas

Wyoming Class I Area	20% Worst Days			20% Best Days	
	Baseline Condition (dv)	2018 Uniform Progress Goal (dv)	2018 Reasonable Progress Goal (dv)	Baseline Condition (dv)	2018 Reasonable Progress Goal (dv)
Yellowstone National Park Grand Teton National Park Teton Wilderness	11.8	10.5	11.2	2.6	2.4
North Absaroka Wilderness Washakie Wilderness	11.5	10.4	11.0	2.0	2.0
Bridger Wilderness Fitzpatrick Wilderness	11.1	10.0	10.6	2.1	2.0

(WRAP TSS - http://vista.cira.colostate.edu/tss/)

7.6 Demonstration That the RPGs for 20 Percent Best and Worst Days are Reasonable

EPA guidance indicates that "States may establish an RPG that provides for greater, lesser or equivalent visibility improvement as that described by the glidepath." The 2018 RPGs identified in Table 7.5-1 for 20 percent worst days show an improvement in visibility, although less than the 2018 URP. The Division believes that RPGs are reasonable based on the following factors:

1. Emissions from natural sources greatly affect the State's ability to meet the 2018 deciview URP goal. The analysis in Chapters 4 and 5 of this Plan containing summaries of emissions data, source apportionment, and modeling shows the contribution from natural or nonanthropogenic sources, such as natural wildfire and windblown dust is the primary reason for not achieving the 2018 URP in Wyoming's Class I areas. The State has little or no control over OC, EC, $PM_{2.5}$, coarse PM and soil emissions associated with natural fire and windblown dust. Prolonged droughts in the West have resulted in extensive wildfires and increased dust emissions. The idea of setting deciview URP goals was developed before the causes of haze in the West were well understood. The extensive technical analysis of the causes of haze conducted by the WRAP has led to a better understanding of the role of wildfire and dust in visibility impairment. As long as there are wildfires in the Western United States, there will be significant impact to visibility in Class I areas and there is little states can do about it.

2. Emissions from sources outside the WRAP modeling domain (international emissions) also affect the State's ability to meet the 2018 URP goal. The analysis in Chapter 5 of this Plan containing monitoring and modeling results shows the emissions from international sources are a significant contributor to sulfate and nitrate concentrations at the monitors in most Western Class I areas, including those in Wyoming. The State has little or no control over emissions coming from other countries in the world.

3. Major reductions in SO_2 emissions established in the previously submitted Wyoming 309 SIP demonstrate the State's commitment to reducing visibility impairment. Tremendous progress has already been made toward capping and controlling SO_2 emissions from major point sources from the four states that have elected to participate in the Western Backstop Trading Program, including Wyoming.

4. The largest point source category of NO_x emissions is coal-fired power plants. In Wyoming, significant reductions from these plants will be achieved through the implementation of BART levels established in this Plan, as well as additional reductions committed to in the long-term strategy.

5. The second largest category of stationary sources in the West is oil and gas development and production. Increased oil and gas development is expected in many areas of the West, due in large part to increased leasing to oil and gas operators on Federal land. The WRAP has developed the first comprehensive oil and gas inventory in the Western United States, and many states are moving forward with evaluating control options. Wyoming is evaluating and testing many of the control strategies, but the specific strategies are not ready for incorporation into this first round of regional haze SIPs. Control options for ozone are being evaluated simultaneously and the State believes that many co-benefits from controlling emissions for ozone will be realized under the regional haze program. Numerous additional emission reductions from oil and gas are expected over the next ten-year period.

6. Wyoming Class I areas have some of the cleanest air in the United States. The haziest days in Wyoming generally have the same level of visibility impairment as the clearest days in the Eastern United States. Monitors at visibility sites in Wyoming Class I areas show fine particle loadings that are a fraction of those in the East, and Rayleigh, or natural light scattering, dominates the clearest days in the West. Therefore, it is more difficult to show improvement in visibility over time in Wyoming than it is in an Eastern state because the state is starting out so clean.

7. Wyoming is not alone in setting reasonable progress goals which do not achieve the uniform rate of progress. The vast majority of sites in the Western United States will not come close to URP goals primarily because controllable emissions are only a small fraction of the total contribution to visibility impairment in the Western Class I areas.[5]

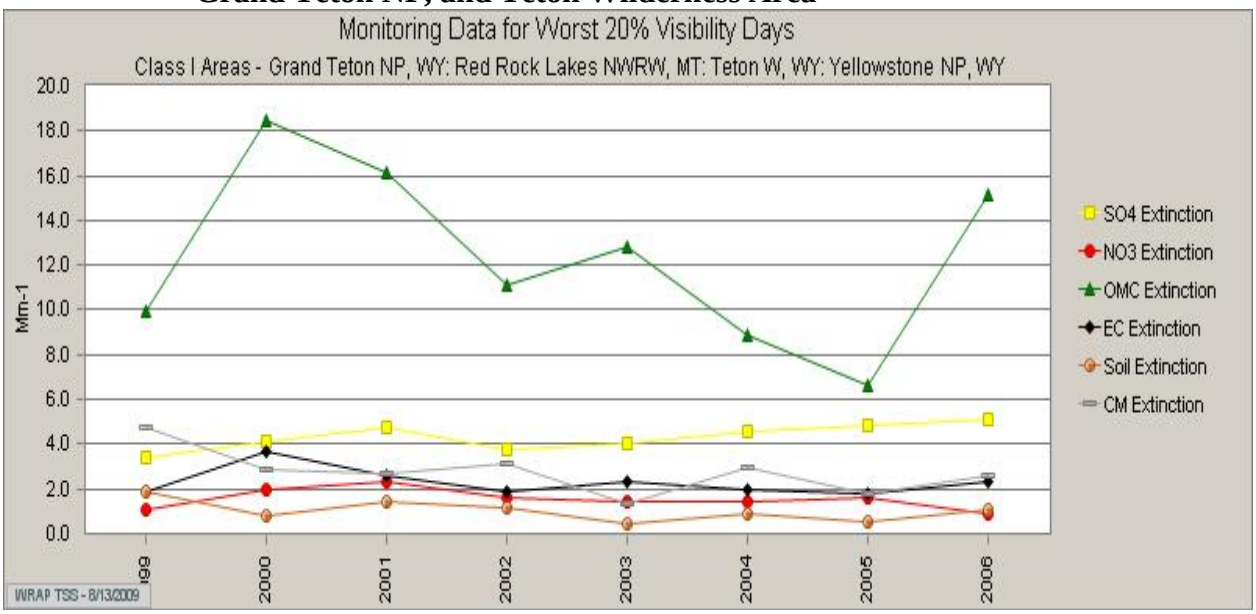
8. Reasonable progress goals in Wyoming have been based on the control strategies of two major State Implementation Plans - 309 and 309(g). Major work undertaken by the State of Wyoming along with three other Western states and one local entity to cap and reduce SO_2 emissions represents major progress towards controlling SO_2. Capping and reducing SO_2 from all of Wyoming's 100-ton sources has a bigger impact on nearby Wyoming Class I areas than Class I areas on the Colorado Plateau. The 309 program provides a declining cap for all non-BART 100-ton SO_2 sources through 2018. Visibility

[5] Source Contributions to Visibility Impairment in the Southeastern and Western United States (Patricia Brewer and Tom Moore)

~~improvement, as it relates to sulfate extinction, has been demonstrated at all of Wyoming's Class I areas as a result of the application of the 309 program. This visibility information is shown in Chapter 6 of this SIP in Table 6.2-2. Additional work completed for the 309(g) requirements, which is spelled out in great detail in this SIP, provides still further improvement.~~

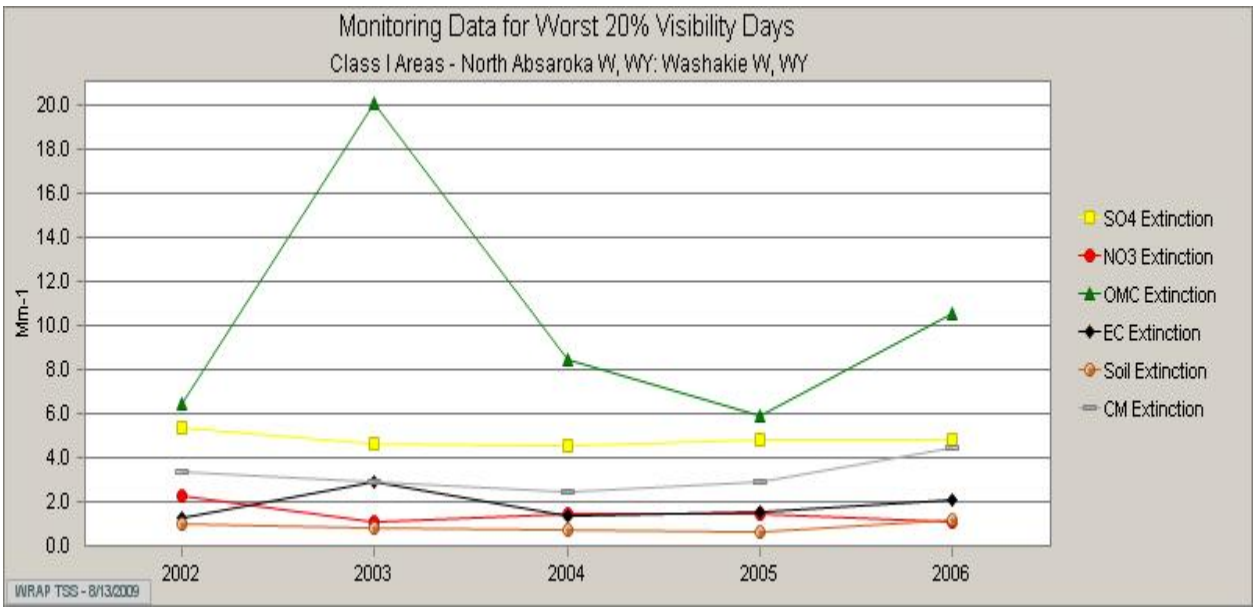
~~9. Wyoming air quality monitoring for visibility pollutants has not shown a trend toward degraded visibility resulting from anthropogenic sources thus far, in spite of industrial growth. Time series plots of individual chemical species measured for visibility on the worst days are shown below. While organic carbon measurements (primarily from forest fires) show a high degree of variability from year to year, sulfates and nitrates (primarily from anthropogenic sources) have not shown a significant degree of variation over time.~~

Figure 7.6-1. Time Series Plot by Pollutant on 20% Worst Days for Yellowstone NP, Grand Teton NP, and Teton Wilderness Area



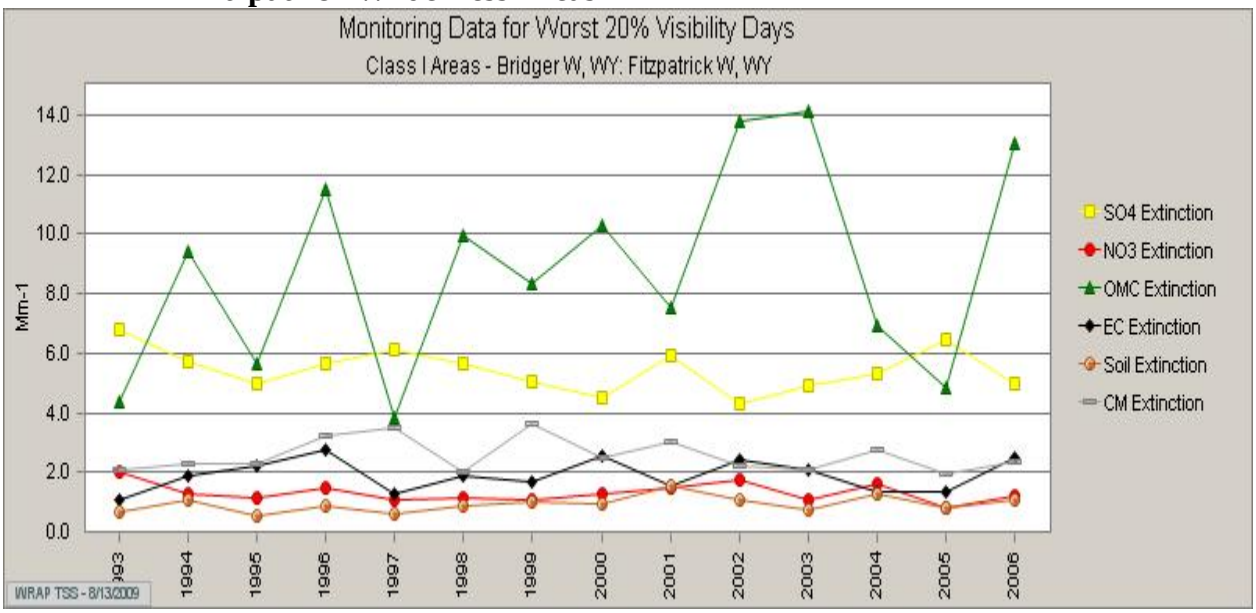
(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Figure 7.6-2. Time Series Plot by Pollutant on 20% Worst Days for North Absaroka and Washakie Wilderness Areas



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Figure 7.6-3. Time Series Plot by Pollutant on 20% Worst Days for Bridger and Fitzpatrick Wilderness Areas



(WRAP TSS - http://vista.cira.colostate.edu/tss/)

CHAPTER 8
LONG-TERM STRATEGY

8.1 Overview

The Regional Haze Rule requires states to submit a 10-15 year long-term strategy (LTS) to address regional haze visibility impairment in each Class I area in the state, and for each Class I area outside the state which may be affected by emissions from the state. The LTS must include enforceable measures necessary to achieve reasonable progress goals, and identify all anthropogenic sources of visibility impairment considered by the state in developing the long-term strategy. Where the state contributes to Class I visibility impairment in other states it must consult with those states and develop coordinated emission management strategies, and demonstrate it has included all measures necessary to obtain its share of the emission reductions. If the state has participated in a regional planning process, the state must include measures needed to achieve its obligations agreed upon through that process.

8.1.1 Summary of all Anthropogenic Sources of Visibility Impairment Considered in Developing the Long-Term Strategy

Section 51.308(d)(3)(iv) of the Regional Haze Rule requires the identification of "all anthropogenic sources of visibility impairment considered by the State when developing its long-term strategy." Chapter 4 of this Plan describes Wyoming statewide emissions, including projections of emissions reductions from anthropogenic sources from 2002 to 2018. Chapter 5 of this Plan provides source apportionment results, including projected reductions from anthropogenic sources during the same period. Chapter 5 addresses anthropogenic sources from all potential sources in the world. Chapter 7 includes the results of a screening analysis which identifies the major anthropogenic sources in the State of Wyoming. Together, these three chapters show the major anthropogenic sources affecting regional haze in Wyoming and in the West. Chapter 7 further describes the major anthropogenic source categories evaluated through the four-factor analysis.

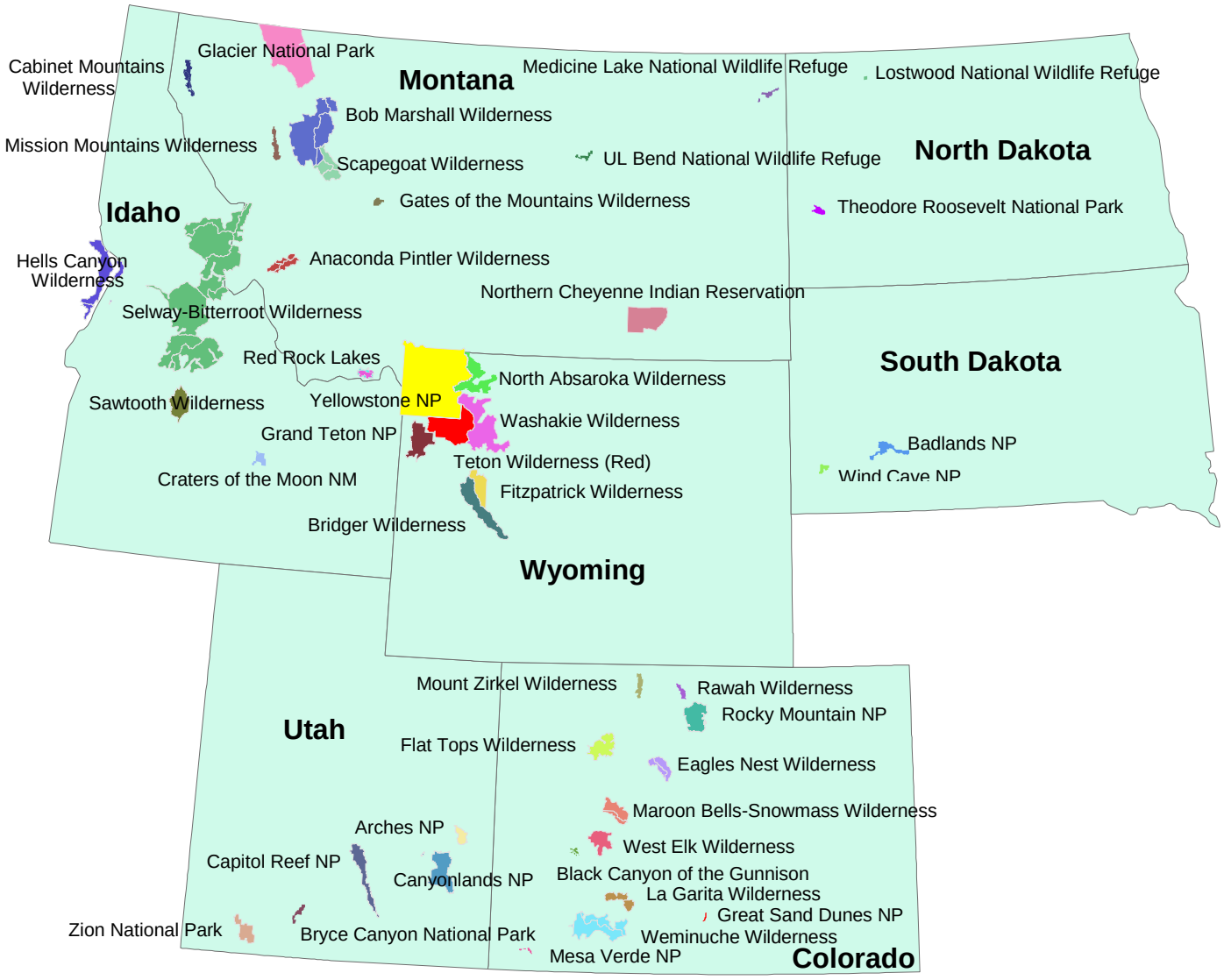
8.1.2 Summary of Interstate Transport and Contribution

Sections 51.308(d)(3)(i) and (ii) of the Regional Haze Rule requires that the Long-Term Strategy address the contribution of interstate transport of haze pollutants between states. Chapter 4 of this Plan illustrated Wyoming statewide emissions, while Chapter 5 identified interstate transport of pollutants and larger source categories based on source apportionment results.

8.1.2.1 Other States' Class I Areas Affected by Wyoming Emissions

Wyoming used baseline period visibility data from the IMPROVE monitors along with the WRAP baseline modeling results to estimate Wyoming's emissions impact on neighboring states' Class I areas (see Figure 8.1.2.1-1). Wyoming focused on anthropogenic emissions transported to other states, primarily sulfates and nitrates.

Figure 8.1.2.1-1
Wyoming, South Dakota, Montana, Idaho, Utah, North Dakota and Colorado Class I Areas



In the table below, the first column shows the contribution of nitrates to visibility impairment at surrounding Class I areas calculated from the IMPROVE monitoring data measured during the baseline period to provide perspective on the role of nitrates to overall impairment. The second column shows Wyoming's contribution to particle mass calculated from the modeled concentrations of nitrate for the baseline years. The table below illustrates two things: 1) the role of nitrates in visibility impairment at the Class I area, and 2) the probable share of Wyoming emissions contributing to the pollutant species.

Table 8.1.2.1-1. Nitrate Contribution to Haze in Baseline Years

State and Mandatory Class I Area	2000-2004 Average Annual Nitrate Share of Particle Light Extinction (measured values)		2000-2004 Wyoming's Average Annual Share of Nitrate Concentration (based on modeling)	
	Worst Days	Best Days	Worst Days	Best Days
South Dakota				
Wind Cave National Park	14%	5%	18%	34%
Badlands National Park	10%	6%	12%	34%
Colorado				
Mount Zirkel/Rawah Wilderness*	7%	4%	10%	8%
Rocky Mountain National Park	13%	3%	10%	8%
Utah				
Arches/Canyonlands National Park*	9%	4%	2%	3%
Idaho				
Craters of the Moon National Monument	27%	8%	3%	<1%
Montana				
Anaconda-Pintler/Selway-Bitterroot*	3%	3%	3%	<1%
Gates of the Mountains Wilderness	6%	4%	2%	<1%
North Dakota				
Theodore Roosevelt National Park	22%	7%	4%	7%
Lostwood National Wildlife Refuge	31%	8%	3%	2%

*These Class I areas share one monitor.

When modeled, Wyoming NO_x emissions contribute up to 18 percent of the nitrate concentrations at some neighboring states on worst days. As shown in the above table, however, nitrate contributes only 14 percent of the visibility impairment at the corresponding nearest Class I areas in neighboring states. Hence, only a small portion of out-of-state visibility degradation is due to nitrate formed from Wyoming emissions. By 2018, NO_x emissions from Wyoming are projected by the WRAP to decrease by 39,861 tons, which will help reduce Wyoming's impact to out of state Class I areas.

Table 8.1.2.1-2. Sulfate Contribution to Haze in Baseline Years

State and Mandatory Class I Area	2000-2004 Average Annual Sulfate Share of Particle Light Extinction (measured values)		2000-2004 Wyoming's Average Annual Share of Sulfate Concentration (based on modeling)	
	Worst Days	Best Days	Worst Days	Best Days
South Dakota				
Wind Cave National Park	26%	15%	11%	22%
Badlands National Park	33%	17%	6%	20%
Colorado				
Mount Zirkel/Rawah Wilderness*	17%	13%	7%	12%
Rocky Mountain National Park	19%	11%	5%	10%
Utah				
Arches/Canyonlands National Park*	18%	15%	3%	8%
Idaho				
Craters of the Moon National Monument	14%	10%	2%	1%
Montana				
Anaconda-Pintler/Selway-Bitterroot*	11%	8%	2%	<1%
Gates of the Mountains Wilderness	17%	8%	1%	<1%
North Dakota				
Theodore Roosevelt National Park	28%	17%	2%	1%
Lostwood National Wildlife Refuge	29%	19%	1%	<1%

* These Class I areas share one monitor.

When modeled, Wyoming sulfate emissions contribute up to 11 percent of the sulfate concentrations at some neighboring states on worst days. As shown in the above table, sulfate contributes 26 percent of the visibility impairment at the corresponding nearest Class I areas in neighboring states. By 2018, SO_2 emissions from Wyoming are projected by the WRAP to decrease by 22,794 tons, which will help reduce Wyoming's impact on out of state Class I areas.

8.1.2.2 Wyoming Class I Areas Affected by Other States, Nations and Areas of the World

The contribution of neighboring states of South Dakota, Colorado, Utah, Idaho and Montana to Wyoming Class I areas was examined to determine where significant emissions might be coming from. In the case of both nitrates and sulfates on best and worst days, the most significant impacts on all Wyoming Class I areas came from sources outside the modeling domain. These would be emissions from other parts of the world. This review has focused on nitrates and sulfates since those emissions tend to focus on anthropogenic sources. Data for this impact analysis comes from the PSAT runs performed by the WRAP and documented in the TSS.

Yellowstone National Park, Grand Teton National Park, and Teton Wilderness Area

- Sulfates

On the best days in the baseline years, 50 percent of the sulfates come from sources outside of the modeling domain. The next largest contribution of sulfates comes from Idaho showing a 14 percent contribution to sulfate extinction in the baseline years. Sulfates, overall, contribute 11% to visibility impairment in these Class I areas on the best days. Similarly, on the worst days, most of the impact (47%) comes from sources outside the modeling domain. The next largest contribution is from Idaho showing an eight percent contribution to sulfate extinction in the baseline years. Sulfates, overall, contribute 12% to visibility impairment in these Class I areas on the worst days. Other states surrounding Wyoming showed smaller contributions (less than five percent). Canadian impacts were between six and nine percent on the worst and best days, respectively. Wyoming has worked with Idaho through the WRAP process and believes that Idaho is working to reduce sulfate impacts to these Class I areas. Idaho is projected by the WRAP to reduce sulfate related emissions by 13,272 tons by 2018.

- Nitrates

On the best days in the baseline years, 25 percent of the nitrates come from sources outside the modeling domain. 22 percent is attributed to Idaho and approximately 14 percent to Utah. Other states surrounding Wyoming, and including Wyoming, showed less than five percent impact. Overall impact of nitrates on visibility impairment on the best days is six percent in these Class I areas. On the worst days in the baseline years, 31 percent of the nitrates come from sources outside of the modeling domain, and 28 percent is attributed to Idaho sources. Other states surrounding Wyoming, and including Wyoming, showed impacts between zero and eight percent. Overall impacts from nitrates on worst days in these Class I areas is five percent. Wyoming has worked with both Idaho and Utah through the WRAP process and believes that both states are working to reduce nitrate impacts to these Class I areas. Idaho is projected by the WRAP to reduce nitrate causing emissions by 32,418 tons by 2018 and Utah is projected by the WRAP to reduce nitrate causing emissions by 71,678 tons by 2018.

Bridger and Fitzpatrick Wilderness Areas

- Sulfates

On the best days in the baseline years, 56 percent of the sulfates come from sources outside of the modeling domain. The next largest contribution of sulfates comes from Idaho, showing an 18 percent contribution to sulfate extinction in the baseline years. Other states, including Wyoming, show less than nine percent contribution. Sulfates, overall, contribute 12% to visibility impairment in these Class I areas on the best days. Similarly, on the worst days, most of the impact (31%) comes from sources outside the modeling domain. The next largest contribution is from Wyoming, showing a 15 percent impact to sulfate extinction in the baseline years. Other states in the region showed less than eight percent impact. Sulfates, overall, contribute 16% to visibility impairment in these Class I areas on the worst days. Wyoming has worked with Idaho through the WRAP process and believes that Idaho is working to reduce

sulfate impacts to these Class I areas. Idaho is projected by the WRAP to reduce sulfate related emissions by 13,272 tons by 2018. Emission reductions from Wyoming sources are addressed through the 309 SIP, previously submitted to EPA.

- Nitrates

On the best days in the baseline years, 30 percent of the nitrates come from sources outside the modeling domain. 24 percent is attributed to Utah and approximately 15 percent to Idaho. Other states surrounding Wyoming, and including Wyoming, showed less than nine percent impact. Overall impact of nitrates on visibility impairment on the best days is three percent in these Class I areas. On the worst days in the baseline years, 22 percent of the nitrates come from sources outside of the modeling domain, and 19 percent is attributed to Wyoming. Utah and Idaho are estimated to contribute 16 and 11 percent, respectively. Other states surrounding Wyoming showed impacts between one and seven percent. Overall impacts from nitrates on worst days in these Class I areas is five percent. Wyoming has worked with both Idaho and Utah through the WRAP process and believes that both states are working to reduce nitrate impacts to these Class I areas. Idaho is projected by the WRAP to reduce nitrate causing emissions by 32,418 tons by 2018 and Utah is projected by the WRAP to reduce nitrate causing emissions by 71,678 tons by 2018. Wyoming is committed to reducing projected WRAP emissions by at least 39,861 tons by 2018.

North Absaroka and Washakie Wilderness Areas

- Sulfates

On the best days in the baseline years, 50 percent of the sulfates come from sources outside of the modeling domain. The next largest contribution of sulfates comes from Canada, showing an 18 percent contribution to sulfate extinction in the baseline years. Other states, including Wyoming, show less than ten percent contribution. Sulfates, overall, contribute nine percent to visibility impairment in these Class I areas on the best days. Similarly, on the worst days, most of the impact (50%) comes from sources outside the modeling domain. The next largest contribution is from Canada, showing a 13 percent contribution to sulfate extinction in the baseline years. States in the region showed less than seven percent impact. Sulfates, overall, contribute 15% to visibility impairment in these Class I areas on the worst days. EPA is working with Canadian officials to develop cooperative strategies for reducing sulfate emissions from Canada and the U.S.

- Nitrates

On the best days in the baseline years, 29 percent of the nitrates come from sources outside the modeling domain. 14 percent is attributed to Idaho, 13 percent to Canada, and approximately 11 percent from Utah. Other states surrounding Wyoming, and including Wyoming, showed less than seven percent impact. Overall impact of nitrates on visibility impairment on the best days is three percent in these Class I areas. On the worst days in the baseline years, 31 percent of the nitrates come from sources outside of the modeling domain, and 17 percent is attributed to Idaho. Montana and Canada are estimated to contribute 15 and 12 percent, respectively. Other states

surrounding Wyoming showed impacts between zero and five percent. Overall impacts from nitrates on worst days in these Class I areas is five percent. Wyoming has worked with Idaho through the WRAP process and believes that Idaho is working to reduce nitrate impacts to these Class I areas. Idaho is projected to reduce nitrate causing emissions by 32,418 tons by 2018. Montana's emissions are being addressed by EPA through a Federal Implementation Plan, and nitrate emissions are projected to decrease by 63,099 tons by 2018. EPA is also working with Canadian officials to develop cooperative strategies for reducing nitrate emissions from Canada and the U.S.

The Division consulted with neighboring states as part of this review, and discussed the need for coordinated strategies to address interstate transport. Based on this consultation, no significant contributions were identified that supported developing new interstate strategies. Both Wyoming and neighboring states agreed that the implementation of BART and other existing measures in state regional haze plans were sufficient to address the contributions discussed below. This interstate consultation is an on-going process and continuing commitment between states. See Chapter 11 for further information.

8.1.3 Summary of Interstate Consultation

In addition to evaluating interstate transport, the affected states are required to consult with each other under Section 51.308(d)(3)(i), in order to develop coordinated emission management strategies. See Section 11.1 for information on the state-to-state consultation process.

8.1.4 Estimated International and Global Contribution to Wyoming Class I Areas

Although not specifically addressed under the Regional Haze Rule in terms of interstate transport, it is important to identify the contribution to visibility impairment in Wyoming from international sources, such as Canada and Mexico, offshore marine shipping in the Pacific Ocean, and "global" sources of haze. The PSAT and WEP results in Chapter 5 describe the amount of contribution to visibility impairment in Wyoming from Canada, Mexico, offshore marine shipping in the Pacific and general global or "outside domain" sources. Because the State of Wyoming does not have any authority over any of the above-mentioned international sources, the Division is not pursuing any new strategy for haze impacts due to international sources.

The following text was extracted from EPA responses to state questions posed by the WRAP Implementation Work Group in March 2007:

The U.S. and Canada have been working on addressing transboundary emissions issues through the bilateral 1991 Canada-United States Air Quality Agreement. Information, including progress reports and articles, on this agreement can be found at http://www.epa.gov/airmarkets/resource/usaqa-resource.html. Under the agreement, Canada and the United States have looked at addressing transboundary air pollution, namely, acid rain and ground-level ozone. Over the last two years, Canada and the United States have continued to successfully reduce their emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x), the major contributors to acid rain and also to regional haze. Both countries have also made considerable

progress in meeting the requirements of the Ozone Annex to reduce emissions of NO_x and volatile organic compounds (VOCs), the precursors to ground-level ozone. Canada and the United States have focused their actions on reducing these emissions from major sources such as electric generating units, industrial sources, and on-road and nonroad transportation.

This Agreement has provided important opportunities for collaboration between Canada and the United States and has produced impressive results, not just in environmental improvements, but also in diplomacy and working relationships. Both countries rely on the Agreement as the mechanism to address air pollution issues and are committed to its continuing viability and relevance as new bilateral issues emerge. The Agreement's flexibility provides opportunities to go beyond the challenges identified by the Acid Rain and Ozone annexes, and the Parties look forward to considering whether and how to address bilateral issues associated with particulate matter, mercury, and other air pollutants.

EPA Region 10 has been meeting with their counterparts in the British Columbia Ministry of Environment for the past five years to identify air quality issues in the Georgia-Basin-Puget Sound Airshed, and to develop an International Airshed Strategy (IAS) to address these issues. The IAS includes protection of visibility as a goal, and the Canadian-United States Air Quality Agreement also addresses visibility. At the most recent IAS meeting in January 2007, the air program director of the BC Ministry of Environment gave a presentation on the process for developing a visibility rule in BC. This rule would be the first of its type in Canada and could be a model for the rest of Canada. This BC visibility rule would establish a visibility management framework and identify policies needed to achieve visibility protection. A Discussion Paper is being developed on this topic and will be the focus of a workshop this spring with representatives from Canadian air quality agencies, Canadian Tourism, Parks (National and Provincial), Forestry, U.S. EPA, Washington Dept. of Ecology, and U.S. National Park Service.

The relationship between the air quality improvement programs in Mexico and the United States received formal recognition through the Agreement between the United States and Mexico for Cooperation on the Environment on the U.S.-Mexico Border (the La Paz Agreement of 1983). This recognition provided the authority for EPA and Mexico's Environmental Ministry to conduct cooperative activities to reduce air pollution. In September 1989 the two countries signed Annex V to the La Paz Agreement through which they agreed to cooperatively monitor air quality in sister cities along the U.S.-Mexico border; Annex V was formally expanded in 1996. In February 1992, the environmental authorities of both Federal governments released the *Integrated Border Environmental Plan for the U.S.-Mexico Area* (IBEP). The IBEP, a two-year plan, was the first bi-national Federal initiative created under the assumption that increased liberalization of trade would place additional stress on the environment and human health along the border. The Border XXI Program was initiated in 1996 to build on the experiences of and improve the specific efforts undertaken under the IBEP and earlier environmental agreements.

Pursuant to the La Paz Agreement of 1983, the Administrator of the U.S. Environmental Protection Agency (U.S. EPA) and the Secretary of the Secretariat for the Environment and Natural Resources (SEMARNAT) agreed on October 2001 to work jointly with the ten border states and the U.S. border tribes to develop a new bi-national ten year plan to improve the environment and reduce the highest public health risks on the U.S.-Mexico border. On April 4,

2003, the representatives of the U.S. EPA, the Secretary of the Secretariat for the Environment and Natural Resources (SEMARNAT), the ten Border States, and the 26 U.S. Tribes, met in Tijuana, Baja California, Mexico to mark the beginning of a ten year joint effort, the Border 2012: U.S.-Mexico Environmental Program replacing the Border XXI Program.

The United States and Mexico, in partnership with border tribal, state, and local governments, have worked to increase the knowledge about air pollution sources and their impacts on both sides of the border, establish monitoring networks in several key areas, conduct emissions inventories, and build local capacity through training.

Pollutants from a number of sources including motor vehicles, power plants and industrial facilities, agricultural operations, mining, dust from unpaved roads, and open burning have affected urban and regional air quality along the U.S.-Mexico border. The most common and damaging pollutants from these sources include sulfur dioxide, suspended particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide, ground-level ozone, and carbon monoxide.

To provide technical assistance about air quality planning and management to government, academia, industry, and the general public in the border region, the U.S. and Mexico established the Centro de Informacion sobre Contaminacion de Aire (CICA, or Border Information Center on Air Pollution). The CICA Program, which is implemented by the Clean Air Technology Center of EPA's Office of Air Quality Planning and Standards, has established a website at http://www.epa.gov/ttn/catc/cica.

The Big Bend Regional Aerosol and Visibility Observational (BRAVO) Study was conducted to quantify the contribution to visibility degradation at Big Bend National Park (BBNP) from various air pollution source regions and source types in the U.S. and Mexico. The study included evaluation of the impacts from the Carbon 1-2 power plants in Coahuila, 18 miles from the U.S. border. Findings from the BRAVO study can be found at http://www2.nature.nps.gov/air/studies/bravo/index.htm.

Beginning in 2003 an effort was undertaken to understand better the smoke/haze from spring burning in Central America/Mexico, which prompted State Department of Health alerts for up to 70% of the population of Texas on some days. Components of this effort include an ambient study of particle chemical constituents to determine the sources of haze; remote sensing analysis to evaluate locations of the burning and to assess the potential seriousness of such burning to transport of particles in Texas; and on-the-ground assessment of ways to fight the fires and mitigate damage.

Under the Border 2012 Program bi-national efforts have continued with the transfer of the northern Baja California network to the State of Baja California, update of existing emissions inventories, and the completion of the first Mexico National Emissions Inventory.

Additionally, the United States and Mexico in partnership with border tribal, state, and local governments, are working together on projects such as retrofitting diesel trucks and school buses with either diesel oxidation catalysts or diesel particulate filters to operate on ultra low sulfur

diesel fuel, constructing "lower polluting" or "environmentally friendly" brick kilns, and road paving to reduce the levels of particulate matter in the border region.

8.2 Required Factors for the Long-Term Strategy

As required in Section 51.308(d)(3)(v) of the Regional Haze Rule, the State must consider, at a minimum, the following factors: 1) emission reductions due to ongoing air pollution control programs; 2) measures to mitigate the impacts of construction activities; 3) emission limitations and schedules for compliance; 4) source retirement and replacement schedules; 5) smoke management techniques for agricultural and forestry burning; 6) the enforceability of emission limitations and control measures; and 7) the anticipated net effect on visibility over the period of the long-term strategy. These factors are discussed in the following pages along with all measures to mitigate the impacts of anthropogenic sources. The seventh factor is discussed at the end of the Long-Term Strategy Chapter.

8.2.1 Emission Reductions Due to Ongoing Air Pollution Control Programs

The following summary describes ongoing programs and regulations in Wyoming that directly protect visibility, or can be expected to improve visibility in Wyoming Class I areas, by reducing emissions in general. This summary does not attempt to estimate the actual improvements in visibility that will occur, as many of the benefits are secondary to the primary air pollution objective of these programs/rules, and consequently would be extremely difficult to quantify due to the technical complexity and limitations in current assessment techniques.

8.2.1.1 New Source Review Program

The New Source Review (NSR) Program is a permit program for the construction of new sources and modification of existing sources as established by WAQSR Chapter 6, Section 2, Permit requirements for construction, modification and operation and Chapter 6, Section 4, Prevention of significant deterioration. Section 2 of Chapter 6 first became a State rule in 1974, with the most recent revision being in March of 2000. Section 2 was submitted to EPA on September 12, 2003, approved by EPA on July 28, 2004, and became effective on August 27, 2004. The primary purpose of the NSR Program is to assure compliance with ambient standards set to protect public health, assure that Best Available Control Technology (BACT) is utilized to reduce and eliminate air pollution emissions, and to prevent deterioration of clean air areas. Any amount of air contaminant emissions from a facility subjects it to Wyoming's NSR Program.

8.2.1.1.1 Prevention of Significant Deterioration (PSD) Program

Generally, Wyoming considers its Prevention of Significant Deterioration (PSD) program as being protective of visibility impairment from proposed major stationary sources or major modifications to existing facilities. Wyoming has a fully-approved PSD program, and has successfully implemented this program for many years. Wyoming's PSD rules (Chapter 6, Section 4, of the Wyoming Air Quality Standards and Regulations (WAQSR)) were revised effective October 6, 2006, to conform with Federal NSR Reform rules. These changes were

submitted to EPA on December 13, 2006, approved by EPA on July 16, 2008, and became effective on August 15, 2008.

8.2.1.1.2 Minor Source BACT Program

The BACT process is most appropriately defined as the elimination of pollutants from being emitted into the air whenever technically and economically feasible to do so. For example, by application of minor source BACT, the Division has required controls of NO_x and formaldehyde in coal bed methane (CBM) development and controls of NO_x, VOC and Hazardous Air Pollutant (HAP) emissions in oil and gas production development. The Division takes the State-required BACT review in minor source permitting actions very seriously, as the bulk of the Division's workload is made up of minor sources.

The Division will continue to review BACT considerations on each source type and size on a case-by-case basis with consideration to the technical practicability and economic reasonableness of eliminating or reducing the emissions from the proposed facility. The application of BACT in the minor source permitting program has resulted in minimized emissions in the state as a whole and will continue to do so as the Division continues to receive NSR permit applications for new and modified sources.

8.2.1.2 Title V Operating Permit Program

As required by Title V of the Clean Air Act Amendments of 1990 and the implementing regulations in 40 CFR part 70, Wyoming established an Operating Permit Program under Chapter 6, Section 3 of the WAQSR. Wyoming's proposed program was submitted to the Environmental Protection Agency (EPA) for approval on November 22, 1993. Notice of Interim Approval was published in the *Federal Register* on January 19, 1995. Final EPA approval of the Wyoming Operating Permit Program was published on February 22, 1999, and the approval was effective April 23, 1999.

A Title V Operating Permit consolidates all air quality regulatory requirements in a single document, so a permittee can clearly determine compliance with the air quality environmental laws governing its operation. The Title V Operating Permit also establishes appropriate compliance assurance monitoring on a pollutant-by-pollutant basis for large emission sources with add-on pollution control equipment, and/or establishes periodic monitoring for other regulated pollutants. The process of issuing the Operating Permit is designed to allow participation by the public, the EPA and nearby states to avoid misinterpretation of air quality regulatory requirements. This permitting is done to enhance enforceability by clearly defining the playing field for all concerned parties, such that all regulated industry is governed by the same rules. These permits are issued for a term of five years and must be renewed and updated to incorporate current regulatory requirements. Nationally, this program is intended to set minimum standards for all states to implement, in an attempt to foster consistency in air quality permitting from state to state. The Operating Permit Program is intended to be self supporting, and states are required under the Clean Air Act to charge regulated industry fees based upon their actual air pollutant emissions on an annual basis; thus, Title V permittees pay for the operation of the regulating program.

The Operating Permit Program currently affects only major sources of air pollution operating in the State. A major source is defined as a source which emits, or has the potential to emit, 100 tons per year of an air pollutant, or any source which emits, or has the potential to emit, 10 tons per year of an individual hazardous air pollutant (or 25 tons per year of any combination of hazardous air pollutants) which has been listed pursuant to section 112(b) of the Clean Air Act. The number of Title V sources within the State is highly variable but has typically ranged from 150 to 160 sources at any given time.

In December of 2000, WAQSR Chapter 6, Section 3 Operating permits, was revised to incorporate compliance assurance monitoring (CAM). CAM is intended to provide a reasonable assurance of compliance with applicable requirements under the Clean Air Act for large emission units that rely on pollution control device equipment to achieve compliance. Monitoring is conducted to determine that control devices, once installed or otherwise employed, are properly operated and maintained so that they continue to achieve a level of control that complies with applicable requirements. The Division is addressing the complex implementation of CAM in renewals, significant modifications and new permits, as applicable. The implementation of CAM will result in documenting continued operation of control devices, within ranges of specified indicators of performance, that are designed to provide reasonable assurance of compliance with applicable requirements.

8.2.1.3 New Source Performance Standards (NSPS)

The Air Quality Division annually incorporates by reference the Federal New Source Performance Standards (NSPS). These standards are incorporated via the Wyoming Air Quality Standards and Regulations, Chapter 5, Section 2. Section 2 first became an effective State rule in November 1976, with the latest revision becoming effective in May 2008. Section 2 was last submitted to the EPA on August 27, 2008, approved by EPA on March 9, 2009, and became effective on March 9, 2009. The list of NSPS incorporated by reference include:

40 CFR part 60, Subpart D -	Standards of Performance for Fossil-Fuel-Fired Steam Generators for Which Construction is Commenced After August 17, 1971
40 CFR part 60, Subpart Da -	Standards of Performance for Electric Utility Steam Generating Units for Which Construction is Commenced After September 18, 1978
40 CFR part 60, Subpart Db -	Standards of performance for Industrial-Commercial-Institutional Steam Generating Units

40 CFR part 60, Subpart Dc -	Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units
40 CFR part 60, Subpart E -	Standards of Performance for Incinerators
40 CFR part 60, Subpart Ea -	Standards of Performance for Municipal Waste Combustors for Which Construction is Commenced After December 20, 1989 and on or Before September 20, 1994
40 CFR part 60, Subpart Eb -	Standards of Performance for Large Municipal Waste Combustors for Which Construction is Commenced After September 20, 1994 or for Which Modification or Reconstruction is Commenced After June 19, 1996
40 CFR part 60, Subpart Ec -	Standards of Performance for Hospital/Medical/Infectious Waste Incinerators for Which Construction is Commenced After June 20, 1996
40 CFR part 60, Subpart F -	Standards of Performance for Portland Cement Plants
40 CFR part 60, Subpart G -	Standards of Performance for Nitric Acid Plants
40 CFR part 60, Subpart H -	Standards of Performance for Sulfuric Acid Plants
40 CFR part 60, Subpart I -	Standards of Performance for Hot Mix Asphalt Facilities
40 CFR part 60, Subpart J -	Standards of Performance for Petroleum Refineries
40 CFR part 60, Subpart K -	Standards of Performance for Storage Vessels for Petroleum Liquids for Which Construction, Reconstruction, or Modification Commenced After June 11, 1973, and Prior to May 19, 1978

40 CFR part 60, Subpart Ka -	Standards of Performance for Storage Vessels for Petroleum Liquids for Which Construction, Reconstruction, or Modification Commenced After May 18, 1978, and Prior to July 23, 1984
40 CFR part 60, Subpart Kb -	Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced After July 23, 1984
40 CFR part 60, Subpart L -	Standards of Performance for Secondary Lead Smelters
40 CFR part 60, Subpart M -	Standards of Performance for Secondary Brass and Bronze Production Plants
40 CFR part 60, Subpart N -	Standards of Performance for Primary Emissions from Basic Oxygen Process Furnaces for Which Construction is Commenced After June 11, 1973
40 CFR part 60, Subpart Na -	Standards of Performance for Secondary Emissions from Basic Oxygen Process Steelmaking Facilities for Which Construction is Commenced After January 20, 1983
40 CFR part 60, Subpart O -	Standards of Performance for Sewage Treatment Plants
40 CFR part 60, Subpart P -	Standards of Performance for Primary Copper Smelters
40 CFR part 60, Subpart Q -	Standards of Performance for Primary Zinc Smelters
40 CFR part 60, Subpart R -	Standards of Performance for Primary Lead Smelters
40 CFR part 60, Subpart S -	Standards of Performance for Primary Aluminum Reduction Plants

40 CFR part 60, Subpart T -	Standards of Performance for the Phosphate Fertilizer Industry: Wet-Process Phosphoric Acid Plants
40 CFR part 60, Subpart U -	Standards of Performance for the Phosphate Fertilizer Industry: Superphosphoric Acid Plants
40 CFR part 60, Subpart V -	Standards of Performance for the Phosphate Fertilizer Industry: Diammonium Phosphate Plants
40 CFR part 60, Subpart W -	Standards of Performance for the Phosphate Fertilizer Industry: Triple Superphosphate Plants
40 CFR part 60, Subpart X -	Standards of Performance for the Phosphate Fertilizer Industry: Granular Triple Superphosphate Storage Facilities
40 CFR part 60, Subpart Y -	Standards of Performance for Coal Preparation Plants
40 CFR part 60, Subpart Z -	Standards of Performance for Ferroalloy Production Facilities
40 CFR part 60, Subpart AA -	Standards of Performance for Steel Plants: Electric Arc Furnaces Constructed After October 21, 1974 and on or Before August 17, 1983
40 CFR part 60, Subpart AAa -	Standards of Performance for Steel Plants: Electric Arc Furnaces and Argon-Oxygen Decarburization Vessels Constructed After August 17, 1983
40 CFR part 60, Subpart BB -	Standards of Performance for Kraft Pulp Mills
40 CFR part 60, Subpart CC -	Standards of Performance for Glass Manufacturing Plants
40 CFR part 60, Subpart DD -	Standards of Performance for Grain Elevators

40 CFR part 60, Subpart EE -	Standards of Performance for Surface Coating of Metal Furniture
40 CFR part 60, Subpart GG -	Standards of Performance for Stationary Gas Turbines
40 CFR part 60, Subpart HH -	Standards of Performance for Lime Manufacturing Plants
40 CFR part 60, Subpart KK -	Standards of Performance for Lead-Acid Battery Manufacturing Plants
40 CFR part 60, Subpart LL -	Standards of Performance for Metallic Mineral Processing Plants
40 CFR part 60, Subpart MM -	Standards of Performance for Automobile and Light-Duty Truck Surface Coating Operations
40 CFR part 60, Subpart NN -	Standards of Performance for Phosphate Rock Plants
40 CFR part 60, Subpart PP -	Standards of Performance for Ammonium Sulfate Manufacture
40 CFR part 60, Subpart QQ -	Standards of Performance for the Graphic Arts Industry: Publication Rotogravure Printing
40 CFR part 60, Subpart RR -	Standards of Performance for Pressure Sensitive Tape and Label Surface Coating Operations
40 CFR part 60, Subpart SS -	Standards of Performance for Industrial Surface Coating: Large Appliances
40 CFR part 60, Subpart TT -	Standards of Performance for Metal Coil Surface Coating
40 CFR part 60, Subpart UU -	Standards of Performance for Asphalt Processing and Asphalt Roofing Manufacture
40 CFR part 60, Subpart VV -	Standards of Performance for Equipment Leaks of VOC in the Synthetic Organic Chemicals Manufacturing Industry

40 CFR part 60, Subpart WW -	Standards of Performance for the Beverage Can Surface Coating Industry
40 CFR part 60, Subpart XX -	Standards of Performance for Bulk Gasoline Terminals
40 CFR part 60, Subpart AAA -	Standards of Performance for New Residential Wood Heaters
40 CFR part 60, Subpart BBB -	Standards of Performance for the Rubber Tire Manufacturing Industry
40 CFR part 60, Subpart DDD -	Standards of Performance for Volatile Organic Compound (VOC) Emissions from the Polymer Manufacturing Industry
40 CFR part 60, Subpart FFF -	Standards of Performance for Flexible Vinyl and Urethane Coating and Printing
40 CFR part 60, Subpart GGG -	Standards of Performance for Equipment Leaks of VOC in Petroleum Refineries
40 CFR part 60, Subpart HHH -	Standards of Performance for Synthetic Fiber Production Facilities
40 CFR part 60, Subpart III -	Standards of Performance for Volatile Organic Compound (VOC) Emissions From the Synthetic Organic Chemical Manufacturing Industry (SOCMI) Air Oxidation Unit Processes
40 CFR part 60, Subpart JJJ -	Standards of Performance for Petroleum Dry Cleaners
40 CFR part 60, Subpart KKK -	Standards of Performance for Equipment Leaks of VOC From Onshore Natural Gas Processing Plants
40 CFR part 60, Subpart LLL -	Standards of Performance for Onshore Natural Gas Processing: SO_2 Emissions
40 CFR part 60, Subpart NNN -	Standards of Performance for Volatile Organic Compound (VOC) Emissions From Synthetic Organic Chemical Manufacturing Industry (SOCMI) Distillation Operations

40 CFR part 60, Subpart OOO -	Standards of Performance for Nonmetallic Mineral Processing Plants
40 CFR part 60, Subpart PPP -	Standards of Performance for Wool Fiberglass Insulation Manufacturing Plants
40 CFR part 60, Subpart QQQ -	Standards of Performance for VOC Emissions From Petroleum Refinery Wastewater Systems
40 CFR part 60, Subpart RRR -	Standards of Performance for Volatile Organic Compound Emissions from Synthetic Organic Chemical Manufacturing Industry (SOCMI) Reactor Processes
40 CFR part 60, Subpart SSS -	Standards of Performance for Magnetic Tape Coating Facilities
40 CFR part 60, Subpart TTT -	Standards of Performance for Industrial Surface Coating: Surface Coating of Plastic Parts for Business Machines
40 CFR part 60, Subpart UUU -	Standards of Performance for Calciners and Dryers in Mineral Industries
40 CFR part 60, Subpart VVV -	Standards of Performance for Polymeric Coating of Supporting Substrates Facilities
40 CFR part 60, Subpart WWW -	Standards of Performance for Municipal Solid Waste Landfills
40 CFR part 60, Subpart AAAA -	Standards of Performance for Small Municipal Waste Combustion Units for Which Construction is Commenced After August 30, 1999 or for Which Modification or Reconstruction is Commenced After June 6, 2001
40 CFR part 60, Subpart CCCC -	Standards of Performance for Commercial and Industrial Solid Waste Incineration Units for Which Construction is Commenced After November 30, 1999 or for Which Modification or Reconstruction is Commenced on or After June 1, 2001

40 CFR part 60, Subpart EEEE -	Standards of Performance for Other Solid Waste Incineration Units for Which Construction is Commenced After December 9, 2004, or for Which Modification or Reconstruction is Commenced on or After June 16, 2006

8.2.1.4 MACT - HAPs Program

The Air Quality Division annually incorporates by reference the Federal National Emission Standards for Hazardous Air Pollutants (NESHAPs). To the extent that NESHAPs regulate visibility impairing pollutants through surrogates, these programs may prove helpful in reducing visibility impairment. These standards are incorporated via the Wyoming Air Quality Standards and Regulations, Chapter 5, Section 3. Section 3 first became an effective State rule in August of 1997, with the latest revision becoming effective in May 2008. The delegation request for Section 3 was submitted to the EPA in June of 2008. The list of NESHAP (MACT) standards incorporated by reference include:

40 CFR part 63, Subpart D -	Regulations Governing Compliance Extensions for Early Reductions of Hazardous Air Pollutants
40 CFR part 63, Subpart F -	National Emission Standards for Organic Hazardous Air Pollutants From the Synthetic Organic Chemical Manufacturing Industry
40 CFR part 63, Subpart G -	National Emission Standards for Organic Hazardous Air Pollutants From the Synthetic Organic Chemical Manufacturing Industry for Process Vents, Storage Vessels, Transfer Operations, and Wastewater
40 CFR part 63, Subpart H -	National Emission Standards for Organic Hazardous Air Pollutants for Equipment Leaks
40 CFR part 63, Subpart I -	National Emission Standards for Organic Hazardous Air Pollutants for Certain Processes Subject to the Negotiated Regulation for Equipment Leaks

40 CFR part 63, Subpart J -	National Emission Standards for Hazardous Air Pollutants for Polyvinyl Chloride and Copolymers Production
40 CFR part 63, Subpart L -	National Emission Standards for Coke Oven Batteries
40 CFR part 63, Subpart M -	National Perchloroethylene Air Emission Standards for Dry Cleaning Facilities
40 CFR part 63, Subpart N -	National Emission Standards for Chromium Emissions From Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks
40 CFR part 63, Subpart O -	Ethylene Oxide Emissions Standards for Sterilization Facilities
40 CFR part 63, Subpart Q -	National Emission Standards for Hazardous Air Pollutants for Industrial Process Cooling Towers
40 CFR part 63, Subpart R -	National Emission Standards for Gasoline Distribution Facilities (Bulk Gasoline Terminals and Pipeline Breakout Stations)
40 CFR part 63, Subpart S -	National Emission Standards for Hazardous Air Pollutants from the Pulp and Paper Industry
40 CFR part 63, Subpart T -	National Emission Standards for Halogenated Solvent Cleaning
40 CFR part 63, Subpart U -	National Emission Standards for Hazardous Air Pollutant Emissions: Group I Polymers and Resins

40 CFR part 63, Subpart W -	National Emission Standards for Hazardous Air Pollutants for Epoxy Resins Production and Non-Nylon Polyamides Production
40 CFR part 63, Subpart X -	National Emission Standards for Hazardous Air Pollutants from Secondary Lead Smelting
40 CFR part 63, Subpart Y -	National Emission Standards for Marine Tank Vessel Loading Operations
40 CFR part 63, Subpart AA -	National Emission Standards for Hazardous Air Pollutants From Phosphoric Acid Manufacturing Plants
40 CFR part 63, Subpart BB -	National Emission Standards for Hazardous Air Pollutants From Phosphate Fertilizers Production Plants
40 CFR part 63, Subpart CC -	National Emission Standards for Hazardous Air Pollutants From Petroleum Refineries
40 CFR part 63, Subpart DD -	National Emission Standards for Hazardous Air Pollutants from Off-Site Waste and Recovery Operations
40 CFR part 63, Subpart EE -	National Emission Standards for Magnetic Tape Manufacturing Operations
40 CFR part 63, Subpart GG -	National Emission Standards for Aerospace Manufacturing and Rework Facilities
40 CFR part 63, Subpart HH -	National Emission Standards for Hazardous Air Pollutants From Oil and Natural Gas Production Facilities

40 CFR part 63, Subpart II -	National Emission Standards for Shipbuilding and Ship Repair (Surface Coating)
40 CFR part 63, Subpart JJ -	National Emission Standards for Wood Furniture Manufacturing Operations
40 CFR part 63, Subpart KK -	National Emission Standards for the Printing and Publishing Industry
40 CFR part 63, Subpart LL -	National Emission Standards for Hazardous Air Pollutants for Primary Aluminum Reduction Plants
40 CFR part 63, Subpart MM -	National Emission Standards for Hazardous Air Pollutants for Chemical Recovery Combustion Sources at Kraft, Soda, Sulfite, and Stand-Alone Semichemical Pulp Mills
40 CFR part 63, Subpart OO -	National Emission Standards for Tanks - Level 1
40 CFR part 63, Subpart PP -	National Emission Standards for Containers
40 CFR part 63, Subpart QQ -	National Emission Standards for Surface Impoundments
40 CFR part 63, Subpart RR -	National Emission Standards for Individual Drain Systems
40 CFR part 63, Subpart SS -	National Emission Standards for Closed Vent Systems, Control Devices, Recovery Devices and Routing to a Fuel Gas System or a Process
40 CFR part 63, Subpart TT -	National Emission Standards for Equipment Leaks - Control Level 1
40 CFR part 63, Subpart UU -	National Emission Standards for Equipment Leaks - Control Level 2 Standards

40 CFR part 63, Subpart VV -	National Emission Standards for Oil-Water Separators and Organic-Water Separators
40 CFR part 63, Subpart WW -	National Emission Standards for Storage Vessels (Tanks) - Control Level 2
40 CFR part 63, Subpart XX -	National Emission Standards for Ethylene Manufacturing Process Units: Heat Exchange Systems and Waste Operations
40 CFR part 63, Subpart YY -	National Emission Standards for Hazardous Air Pollutants for Source Categories: Generic Maximum Achievable Control Technology Standards
40 CFR part 63, Subpart CCC -	National Emission Standards for Hazardous Air Pollutants for Steel Pickling - HCl Process Facilities and Hydrochloric Acid Regeneration Plants
40 CFR part 63, Subpart DDD -	National Emission Standards for Hazardous Air Pollutants for Mineral Wool Production
40 CFR part 63, Subpart EEE -	National Emission Standards for Hazardous Air Pollutants from Hazardous Waste Combustors
40 CFR part 63, Subpart GGG -	National Emission Standards for Pharmaceuticals Production
40 CFR part 63, Subpart HHH -	National Emission Standards for Hazardous Air Pollutants From Natural Gas Transmission and Storage Facilities
40 CFR part 63, Subpart III -	National Emission Standards for Hazardous Air Pollutants for Flexible Polyurethane Foam Production

40 CFR part 63, Subpart JJJ -	National Emission Standards for Hazardous Air Pollutant Emissions: Group IV Polymers and Resins
40 CFR part 63, Subpart LLL -	National Emission Standards for Hazardous Air Pollutants From the Portland Cement Manufacturing Industry
40 CFR part 63, Subpart MMM -	National Emission Standards for Hazardous Air Pollutants for Pesticide Active Ingredient Production
40 CFR part 63, Subpart NNN -	National Emission Standards for Hazardous Air Pollutants for Wool Fiberglass Manufacturing
40 CFR part 63, Subpart OOO -	National Emission Standards for Hazardous Air Pollutant Emissions: Manufacture of Amino/Phenolic Resins
40 CFR part 63, Subpart PPP -	National Emission Standards for Hazardous Air Pollutants for Polyether Polyols Production
40 CFR part 63, Subpart QQQ -	National Emission Standards for Hazardous Air Pollutants for Primary Copper Smelting
40 CFR part 63, Subpart RRR -	National Emission Standards for Hazardous Air Pollutants for Secondary Aluminum Production
40 CFR part 63, Subpart TTT -	National Emission Standards for Hazardous Air Pollutants for Primary Lead Smelting
40 CFR part 63, Subpart UUU -	National Emission Standards for Hazardous Air Pollutants for Petroleum Refineries: Catalytic Cracking Units, Catalytic Reforming Units, and Sulfur Recovery Units

40 CFR part 63, Subpart VVV -	National Emission Standards for Hazardous Air Pollutants: Publicly Owned Treatment Works
40 CFR part 63, Subpart XXX -	National Emission Standards for Hazardous Air Pollutants for Ferroalloys Production: Ferromanganese and Silicomanganese
40 CFR part 63, Subpart AAAA -	National Emission Standards for Hazardous Air Pollutants: Municipal Solid Waste Landfills
40 CFR part 63, Subpart CCCC -	National Emission Standards for Hazardous Air Pollutants: Manufacturing of Nutritional Yeast
40 CFR part 63, Subpart DDDD -	National Emission Standards for Hazardous Air Pollutants: Plywood and Composite Wood Products
40 CFR part 63, Subpart EEEE -	National Emission Standards for Hazardous Air Pollutants: Organic Liquids Distribution (Non-Gasoline)
40 CFR part 63, Subpart FFFF -	National Emission Standards for Hazardous Air Pollutants: Miscellaneous Organic Chemical Manufacturing
40 CFR part 63, Subpart GGGG -	National Emission Standards for Hazardous Air Pollutants: Solvent Extraction for Vegetable Oil Production
40 CFR part 63, Subpart HHHH -	National Emission Standards for Hazardous Air Pollutants for Wet-Formed Fiberglass Mat Production
40 CFR part 63, Subpart IIII -	National Emission Standards for Hazardous Air Pollutants: Surface Coating of Automobiles and Light-Duty Trucks

40 CFR part 63, Subpart JJJJ -	National Emission Standards for Hazardous Air Pollutants: Paper and Other Web Coating
40 CFR part 63, Subpart KKKK -	National Emission Standards for Hazardous Air Pollutants: Surface Coating of Metal Cans
40 CFR part 63, Subpart MMMM -	National Emission Standards for Hazardous Air Pollutants for Surface Coating of Miscellaneous Metal Parts and Products
40 CFR part 63, Subpart NNNN -	National Emission Standards for Hazardous Air Pollutants: Surface Coating of Large Appliances
40 CFR part 63, Subpart OOOO -	National Emission Standards for Hazardous Air Pollutants: Printing, Coating, and Dyeing of Fabrics and Other Textiles
40 CFR part 63, Subpart PPPP -	National Emission Standards for Hazardous Air Pollutants for Surface Coating of Plastic Parts and Products
40 CFR part 63, Subpart QQQQ -	National Emission Standards for Hazardous Air Pollutants: Surface Coating of Wood Building Products
40 CFR part 63, Subpart RRRR -	National Emission Standards for Hazardous Air Pollutants: Surface Coating of Metal Furniture
40 CFR part 63, Subpart SSSS -	National Emission Standards for Hazardous Air Pollutants: Surface Coating of Metal Coil
40 CFR part 63, Subpart TTTT -	National Emission Standards for Hazardous Air Pollutants for Leather Finishing Operations
40 CFR part 63, Subpart UUUU -	National Emission Standards for Hazardous Air Pollutants for Cellulose Products Manufacturing

40 CFR part 63, Subpart VVVV -	National Emission Standards for Hazardous Air Pollutants for Boat Manufacturing
40 CFR part 63, Subpart WWWW -	National Emissions Standards for Hazardous Air Pollutants: Reinforced Plastic Composites Production
40 CFR part 63, Subpart XXXX -	National Emission Standards for Hazardous Air Pollutants: Rubber Tire Manufacturing
40 CFR part 63, Subpart YYYY -	National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines
40 CFR part 63, Subpart ZZZZ -	National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines
40 CFR part 63, Subpart AAAAA -	National Emissions Standards for Hazardous Air Pollutants for Lime Manufacturing Plants
40 CFR part 63, Subpart BBBBB -	National Emission Standards for Hazardous Air Pollutants for Semiconductor Manufacturing
40 CFR part 63, Subpart CCCCC -	National Emission Standards for Hazardous Air Pollutants for Coke Ovens: Pushing, Quenching, and Battery Stacks
40 CFR part 63, Subpart DDDDD -	National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters
40 CFR part 63, Subpart EEEEE -	National Emission Standards for Hazardous Air Pollutants for Iron and Steel Foundries

40 CFR part 63, Subpart FFFFF -	National Emission Standards for Hazardous Air Pollutants for Integrated Iron and Steel Manufacturing Facilities
40 CFR part 63, Subpart GGGGG -	National Emission Standards for Hazardous Air Pollutants: Site Remediation
40 CFR part 63, Subpart HHHHH -	National Emission Standards for Hazardous Air Pollutants: Miscellaneous Coating Manufacturing
40 CFR part 63, Subpart IIIII -	National Emission Standards for Hazardous Air Pollutants: Mercury Emissions From Mercury Cell Chlor-Alkali Plants
40 CFR part 63, Subpart JJJJJ -	National Emission Standards for Hazardous Air Pollutants for Brick and Structural Clay Products Manufacturing
40 CFR part 63, Subpart KKKKK -	National Emission Standards for Hazardous Air Pollutants for Clay Ceramics Manufacturing
40 CFR part 63, Subpart LLLLL -	National Emission Standards for Hazardous Air Pollutants: Asphalt Processing and Asphalt Roofing Manufacturing
40 CFR part 63, Subpart MMMMM -	National Emission Standards for Hazardous Air Pollutants: Flexible Polyurethane Foam Fabrication Operations
40 CFR part 63, Subpart NNNNN -	National Emission Standards for Hazardous Air Pollutants: Hydrochloric Acid Production
40 CFR part 63, Subpart PPPPP -	National Emission Standards for Hazardous Air Pollutants for Engine Test Cells/Stands

40 CFR part 63, Subpart QQQQQ -	National Emission Standards for Hazardous Air Pollutants for Friction Materials Manufacturing Facilities
40 CFR part 63, Subpart RRRRR -	National Emission Standards for Hazardous Air Pollutants: Taconite Iron Ore Processing
40 CFR part 63, Subpart SSSSS -	National Emission Standards for Hazardous Air Pollutants for Refractory Products Manufacturing
40 CFR part 63, Subpart TTTTT -	National Emissions Standards for Hazardous Air Pollutants for Primary Magnesium Refining

The Air Quality Division also determines case-by-case MACT determinations through Chapter 6, Section 6.

8.2.1.5 Phase I Visibility Rules - Wyoming Reasonably Attributable Visibility Impairment Rules

In response to EPA's Phase I visibility rules, Wyoming adopted the Wyoming State Implementation Plan for Class I Visibility Protection, effective May 10, 1988. It was approved by the U.S. EPA by notice in the Federal Register on February 15, 1989, under 40 CFR part 52, and became effective on April 17, 1989. This visibility rule contains short and long-term strategies for making reasonable progress toward the national goal, related to addressing reasonably attributable impairment in the State's Class I areas through visibility monitoring and control strategies. This rule incorporates PSD requirements for visibility protection from new or modified major stationary sources, and if necessary applying BART to existing stationary sources if certified as causing reasonably attributable visibility impairment.

8.2.1.6 Ongoing Implementation of Federal Mobile Source Regulations

The Federal Motor Vehicle Control Program (FMVCP) has produced and is continuing to produce large reductions in motor vehicle emissions of NO_x, PM, and VOCs. Beginning in 2006, EPA mandated new standards for on-road (highway) diesel fuel, known as ultra-low sulfur diesel (ULSD). This regulation dropped the sulfur content of diesel fuel from 500 ppm to 15 ppm. ULSD fuel enables the use of cleaner technology diesel engines and vehicles with advanced emissions control devices, resulting in significantly lower emissions. Diesel fuel intended for locomotive, marine and non-road (farming and construction) engines and equipment was required to meet the low sulfur diesel fuel maximum specification of 500 ppm sulfur in 2007 (down from 5,000 ppm). By 2010, the ULSD fuel standard of 15-ppm sulfur will apply to all non-road diesel fuel. Locomotive and marine diesel fuel will be required to meet the ULSD

standard beginning in 2012, resulting in further reductions of diesel emissions. These rules not only reduce SO_2 emissions, but also NO_x and PM emissions.

In addition to the ULSD standard, listed below are several other significant Federal programs:

Federal On-Road Measures
- Tier 2 vehicle emission standards and Federal low-sulfur gasoline
- National low emissions vehicle standards (NLEV)
- Heavy-duty diesel standards

Federal Non-Road Measures
- Lawn and garden equipment
- Tier 2 heavy-duty diesel equipment
- Locomotive engine standards
- Compression ignition standards for vehicles and equipment
- Recreational marine engine standards

In addition, the *Renewable Fuel Standard Under Section 211(o) of the Clean Air Act as Amended by the Energy Policy Act of 2005*, is determined annually (must be published in the Federal Register by November 30 of each year) by EPA and is applicable to refiners, importers and blenders of gasoline.

8.2.1.7 Ongoing Implementation of Programs to Meet PM_{10} NAAQS

Currently, only one community in Wyoming, Sheridan, is designated as a nonattainment area under the PM_{10} National Ambient Air Quality Standard (NAAQS). The significance of this nonattainment area in terms of regional haze is that significant reductions in PM_{10} emissions have been made in the last ten years, by adopting strategies to address the primary emission sources in the community. The major contributing sources causing nonattainment in this community are road dust, residential woodstoves, outdoor burning, and to a lesser degree, industry.

8.2.1.7.1 Nonattainment SIP (PM_{10}) - City of Sheridan

Because Sheridan, Wyoming was designated a Group I area under the PM_{10} Regulations promulgated by the EPA on July 20, 1987, the Air Quality Division was required to develop a State Implementation Plan outlining control strategies with a demonstration of attainment and maintenance of the standards. In cooperation with the Sheridan City government, a plan was developed which addressed four PM_{10} control measures.

The first control measure involved implementing a sanding plan or air quality maintenance plan (AQMP), which aimed to reduce PM_{10} emissions by designating specific limitations/guidelines for sanding routes, sanding mediums, application rates, and street cleaning.

The second control measure was a voluntary curtailment of solid fuels combustion, whereby an ordinance was enacted allowing the designation of voluntary “no burn days” when PM_{10}

concentrations exceed or are predicted to exceed established criteria levels. The Division collects "real time" particulate data and uses the information in conjunction with weather predictions to trigger requests for burning curtailment.

Fugitive dust concerns comprised the third control measure. Several industrial areas in the City of Sheridan were identified as significant sources of fugitive dust. The Division required that these facilities submit a dust control plan specifying as a minimum, application of asphalt, oil, or suitable chemical dust control agents on unpaved roads within their operations. One facility was asked to use more durable washed sand rather than scoria for skid control.

Because some of the streets of Sheridan are maintained by the County and the Highway Department, as a fourth control measure these agencies were also contacted by the Division in an effort to implement similar sanding practices in the City. Sanding plans were submitted by both the County and Highway Department specifying sanding mediums, routes, and application rates.

8.2.1.7.2 Natural and Uncontrollable Sources Program - Natural Events Action Plan

On May 30, 1996, the Environmental Protection Agency (EPA) issued a Natural Events Policy (NEP) which recognized that certain uncontrollable natural events, such as high winds, wildland fires, and volcanic/seismic activity can result in adverse consequences for the National Ambient Air Quality Standard (NAAQS). The NEP set forth procedures for protecting public health through the development of a Natural Events Action Plan (NEAP) which implements Best Available Control Measures (BACM) for human-generated particulate emissions in areas where the PM_{10} (particulate matter having a nominal aerodynamic equal to or less than 10 microns) standard may be violated due to these uncontrolled natural events. The NEP also provides that if an approved NEAP is implemented, future air quality exceedances due to uncontrollable natural events may be flagged, and, if demonstrated to be a natural event, not be considered when determining the region's air quality designation if BACM measures are being implemented.

A number of Federal Reference or Equivalent PM_{10} monitors are located in Wyoming's Powder River Basin (PRB) at several large mining operations. Some of the monitors have recorded exceedances of the 24-hour NAAQS for PM_{10}. Each of the monitored exceedances was associated with high winds and blowing dust resulting from prolonged periods of low precipitation and consequential low soil moisture content.

Recognizing the need to protect public health in the Powder River Basin where measured PM_{10} values exceeded the NAAQS because of wind generated dust, in early 2007 the State of Wyoming, with the aid of stakeholders, prepared a Natural Events Action Plan based on EPA Natural Event Policy (NEP) guidance. This plan outlines specific procedures to be taken in response to future high wind events. In short, the purpose of the plan is to:

- Educate the public about the problem;
- Mitigate health impacts on exposed populations during future events; and
- Identify and implement Best Available Control Measures (BACM) for significant, anthropogenic sources of windblown dust.

All coal mines in the Wyoming PRB employ Best Available Control Technology (BACT). This Natural Events Action Plan for the Powder River Basin identifies BACT measures in place as the result of existing permit requirements, additional potential control measures identified as BACM, and reactionary control measures directed at transient problem sites that may be implemented during Natural Events. Implementation of BACT, BACM, and reactionary control measures will assure that anthropogenic dust emissions from the coal mines in the PRB are controlled to the greatest extent possible. The goal is to protect public health and to minimize exceedances of the PM_{10} NAAQS through the continued implementation of BACT, and implementation of BACM and reactionary control measures.

The Natural Events Action Plan may be accessed at: http://deq.state.wy.us/aqd/NEAP.asp.

8.2.2 Measures to Mitigate the Impacts of Construction Activities

Chapter 3 of the Wyoming Air Quality Standards and Regulations (WAQSR) establishes limits on the quantity, rate, or concentration of emissions of air pollutants, including any requirements which limit the level of opacity, prescribe equipment, set fuel specifications, or prescribe operation or maintenance procedures. Specifically, Chapter 3, Section 2(f), prescribes measures to ensure the control of fugitive dust emissions during construction or demolition activities, handling, storage and transporting of materials and agricultural practices. Chapter 3, Section 2(f) was originally adopted by the State of Wyoming on February 22, 1972. The entire section was restructured on October 29, 1999. Section 2(f) was revised on March 30, 2000 and submitted to EPA on August 13, 2001, then resubmitted on September 12, 2003 as part of the restructuring of the rules. Revisions to Chapter 3 were most recently approved by EPA on July 28, 2004. The State believes these regulations address common construction activities.

Wyoming believes point and area sources of emissions from these regulated sources are in part attributed to impacting regional haze in Wyoming. Wyoming relies on the particulate emission control measures specified in Chapter 3 to most directly address these sources of fine and coarse particles known to have a minor, but measured, impact on visibility in Class I areas of the state.

8.2.3 Emission Limitations and Schedules of Compliance

The implementation of BART, as described in Chapter 6, will contain emission limits and schedules of compliance for those sources either installing BART controls or taking Federally enforceable permit limitations. The four-factor analysis identifies some additional measures that are appropriate for this first Regional Haze Plan. The evaluation of non-BART sources as part of the LTS identifies additional emission reductions and improves visibility by 2018.

8.2.4 Source Retirement and Replacement Schedules

Part of this LTS contains an evaluation of non-BART sources, described in Sections 8.3.4 and 8.3.5. The Division is not currently aware of any specific scheduled shutdowns, retirements in upcoming years, or replacement schedules, such as planned installation of new control equipment to meet other regulations or routine equipment replacement or modernization. As the Division becomes aware of such actions, they will be factored into upcoming reviews.

8.2.5 Agricultural and Forestry Smoke Management Techniques

Wyoming Air Quality Standards and Regulations (WAQSR) Chapter 10, Smoke Management, was originally adopted by the State of Wyoming on February 10, 1970. Chapter 10 has been revised several times, most recently becoming an effective State rule on April 5, 2005. Chapter 10 was submitted to EPA on April 23, 2004 and is awaiting EPA approval. A smoke management certification was submitted to EPA on November 17, 2005. The last EPA approval was part of the entire restructuring of the rules, approved on July 28, 2004. Chapter 10 is utilized in Wyoming to establish restrictions and requirements on specific burning practices. Section 2 regulates refuse burning; open burning of trade wastes, for salvage operations, for fire hazards, and for firefighting training; and vegetative material open burning. Section 2 includes the permitting of prescribed fires occurring on Federal and State lands, and requires Federal land and State land managers to perform modeling to determine meteorological conditions under which burning can occur and maintain compliance with ambient air quality standards. Section 3 specifically regulates emissions from wood waste burners. Section 4 regulates sources of vegetative burning for the management of air quality emissions and impacts from smoke on public health and visibility.

A Smoke Management Program Guidance Document was developed in November 2004, to assist burners in understanding the requirements and aid in the implementation of Section 4. The intent of Chapter 10 is to provide an equitable and workable program for all burners that is simple to implement and is the least burdensome possible, thereby focusing on the most common situations rather than extreme or isolated circumstances. Burners must comply with all local (city and county), State and Federal laws, regulations and ordinances relating to burning in addition to complying with the regulatory requirements for air quality.

Division staff actively participate in the WRAP Fire Emissions Joint Forum (FEJF), formed to address both policy and technical issues concerning smoke effects that are caused by wildland and agricultural fires on public, tribal, and private lands. The FEJF is guided by the recommendations contained in the GCVTC Final Report and the requirements of the Regional Haze Rule regarding fire emissions and visibility. The FEJF has developed several policies for the WRAP through a stakeholder-based consensus process to assist the WRAP states and tribes in addressing emissions from fire sources. In these policies, the WRAP seeks to provide a consistent framework that states and tribes can use to efficiently develop their individual regional haze implementation plans, long-term strategies, and periodic progress reports.

The WRAP has advanced the following policies developed by the FEJF as viable tools for both Section 308 and 309 states to meet the requirements of the Rule.

- The *WRAP Policy for Categorizing Fire Emissions*[6] was developed to clarify the complex relationship between what is considered a natural source of fire and what is considered a human-caused source, as acknowledged in the Rule. A methodology to categorize fire emissions as either “natural” or “anthropogenic” is the basis of the Policy;

[6] Western Regional Air Partnership, Fire Emissions Joint Forum, Natural Background Task Team, Policy for Categorizing Fire Emissions, November 15, 2001.

thus providing the foundation for fire's inclusion in natural background condition values and ultimately, the tracking of reasonable progress.

- The *WRAP Policy on Enhanced Smoke Management Programs for Visibility*[7] defines the enhanced smoke management program as smoke management efforts that specifically address visibility, thereby, going beyond the EPA Interim Policy and the AAQTF Air Quality Policy specific guidance provided for smoke management programs that address public health and nuisance concerns. The Policy identifies for states/tribes in the WRAP region the elements of an enhanced smoke management program to address visibility effects from all types of fire that contribute to visibility impairment in mandatory Federal Class I areas.

- The WRAP defines the annual emission goal as a quantifiable value that is used to measure progress each year toward the desired outcome of achieving the minimum emission increase from fire. In the *WRAP Policy on Annual Emissions Goals for Fire*[8], the WRAP outlines a process by which states/tribes may establish annual emission goals, based on the utilization of currently available emission reduction techniques, to include in their Regional Haze SIPs.

- It is the position of the *WRAP Policy on Fire Tracking Systems*[9] that it is necessary to track fire activity information in the WRAP region using a fire tracking system, which will also provide the information essential to create a fire emissions inventory. The Policy identifies seven essential components of a fire tracking system that represent the minimum spatial and temporal fire activity information necessary to consistently calculate emissions and to meet the requirements of the Rule.

The Air Quality Division is required to conduct an Annual Program Evaluation to assess the adequacy of the design, impact and implementation of Wyoming's Smoke Management Program. The first Evaluation covered the program implementation during calendar years 2005 and 2006.

8.2.6 Enforceability of Wyoming's Measures

Section 51.308(d)(3)(v)(F) of the Regional Haze Rule requires states to ensure that emission limitations and control measures used to meet reasonable progress goals are enforceable.

Wyoming has ensured that all existing emission limitations and control measures, for which the State of Wyoming is responsible, used to meet reasonable progress goals are enforceable at the State level through the Wyoming Air Quality Standards and Regulations (WAQSR) or State-issued permits. Many of the actions included in the SIP are already federally enforceable.

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[7] Western Regional Air Partnership, Fire Emissions Joint Forum, Enhanced Smoke Management Task Team, WRAP Policy on Enhanced Smoke Management Programs for Visibility, November 12, 2002.
[8] Western Regional Air Partnership, Fire Emissions Joint Forum, Annual Emission Goals Task Team, WRAP Policy on Annual Emission Goals for Fire, DRAFT December 16, 2002.
[9] Western Regional Air Partnership, Fire Emissions Joint Forum, WRAP Policy on Fire Tracking Systems, DRAFT December 19, 2002.

However, BART permit conditions and long-term strategy commitments for the Laramie River Station and the Jim Bridger Power Plant are currently only enforceable at the State level. Once EPA approves this SIP, these measures will be federally enforceable. The BART determinations are summarized in Table 6.4-1 and the long-term strategy commitments can be found in Section 8.3.3.

8.3 Additional Measures in the Long-Term Strategy

This section of the LTS identifies new measures being proposed by the Division for achieving reasonable progress. These reasonable progress measures will be evaluated and discussed in the next Plan update in 2013.

8.3.1 Future Federal Mobile Programs

A new rule, "Control of Emissions of Air Pollution from Locomotives and Marine Compression-Ignition Engines Less Than 30 Liters per Cylinder", was signed on March 14, 2008. EPA estimates that by 2030, this program will reduce annual emissions of NO_x by about 800,000 tons and PM emissions by 27,000 tons. Emission reductions are expected to continue as fleet turnover is completed. These standards are intended to achieve these large reductions in emissions through the use of technologies such as in-cylinder controls, aftertreatment, and low sulfur fuel, perhaps as early as 2011.

In June 2009, EPA announced a rule (Control of Emissions from New Marine Compression-Ignition Engines at or Above 30 Liters per Cylinder) proposing more stringent exhaust emission standards for the largest marine diesel engines used for propulsion on oceangoing vessels (called Category 3 engines). The proposed engine standards are equivalent to the nitrogen oxides limits recently adopted in amendments to Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL). The near-term standards for newly-built engines would apply beginning in 2011. Long-term standards would begin in 2016, and are based on the application of high-efficiency aftertreatment technology. By 2030, this strategy to address emissions from oceangoing vessels is expected to reduce annual emissions of NO_x in the U.S. by approximately 1.2 million tons and particulate matter emissions by about 143,000 tons. When fully implemented, the coordinated strategy is anticipated to reduce NO_x emissions by 80 percent and PM emissions by 85 percent, compared to the current limits applicable to these engines.

A proposed rule, the Renewable Fuel Standard (RFS2), was signed by Administrator Jackson on May 5, 2009. EPA is proposing that this rule take effect on January 1, 2010; however, this date is tentative and it could be mid-2010 or January 1, 2011 before this rule becomes final. This rule intends to address changes to the Renewable Fuel Standard program as required by the Energy Independence and Security Act of 2007 (EISA). The revised statutory requirements establish new specific volume standards for cellulosic biofuel, biomass-based diesel, advanced biofuel, and total renewable fuel that must be used in transportation fuel each year. The revised statutory requirements also include new definitions and criteria for both renewable fuels and the feedstocks used to produce them, including new greenhouse gas emission (GHG) thresholds for renewable fuels. The regulatory requirements for RFS will apply to domestic and foreign producers and importers of renewable fuel. It is estimated that annual GHG emissions from

transportation will be reduced by approximately 160 million tons, the equivalent of the removal of 24 million vehicles from the highways. In addition, 36 billion gallons of renewable fuel will displace approximately 11% of gasoline and diesel consumption in 2022. The majority of the reductions are expected to come from reduced petroleum imports.

8.3.2 Efforts to Address Offshore Shipping

As depicted by PSAT results in Chapter 5, offshore marine vessel emissions contribute to Wyoming Class I areas. Wyoming has no authority to regulate offshore shipping emissions and must rely upon other states such as California for adoption of regulations. On February 28, 2003 EPA adopted emission standards for new marine diesel engines installed on vessels flagged or registered in the United States with displacement at or above 30 liters per cylinder. Also adopted in this rulemaking were additional standards for new engines with displacement at or above 2.5 liters per cylinder but less than 30 liters per cylinder. This rule established a deadline of April 27, 2007 for EPA to promulgate a second set of emission standards for these engines. Because much of the information necessary to develop more stringent Category 3 marine diesel engines standards has become available only recently, a new deadline for the rulemaking to consider the next tier of Category 3 marine diesel engine standards has been set for December 17, 2009. On December 7, 2007, EPA announced an advance notice of proposed rulemaking regarding the above-referenced standards, first set in 2003. The advanced notice of proposed rulemaking stated that EPA was considering standards for achieving large reductions in oxides of nitrogen (NO_x) and particulate matter (PM) through the use of technologies such as in-cylinder controls, aftertreatment, and low sulfur fuel, starting as early as 2011.

On July 24, 2008, the State of California adopted new strict regulations for marine vessels within 24 miles of shore. The Division expects that implementation of these new regulations for marine vessels will have benefits in Wyoming.

In October 2008, Member States of the International Maritime Organization (IMO) adopted new international standards for marine diesel engines and their fuels (2008 Amendments to MARPOL Annex VI) that apply globally, and establishes additional, more stringent emission requirements for ships that operate in specially-designated coastal areas where air quality problems are acute.

Under the new global standards, NO_x emissions will be reduced, and the fuel sulfur cap will drop to 5,000 ppm in 2020 (pending a fuel availability review in 2018). Under the new geographic standards, ships operating in designated areas will be required to use engines that meet the most advanced technology-forcing standards for NO_x emissions, and to use fuel with sulfur content at or below 1,000 ppm.

On March 27, 2009, the United States submitted a joint proposal with Canada to the IMO to designate specific areas of our coastal waters as an Emission Control Area (ECA). Compared to fuels used in ships today, ECA standards will lead to a 96 percent reduction in sulfur in ships' fuels, as well as a cut in emissions of PM by 85 percent and NO_x by 80 percent. To achieve these reductions, ships must use fuel with no more than 1,000 parts per million sulfur beginning in 2015, and new ships will have to use advanced emission control technologies beginning in 2016.

8.3.3 Long-Term Control Strategies for BART Facilities

In addition to the control strategies identified in Chapter 6 (Best Available Retrofit Technology (BART)) as BART determinations, the following requirements will be established through permit conditions or orders from the Environmental Quality Council for the individual BART facilities listed below:

Laramie River Station:

On March 8, 2010, Basin Electric Power Cooperative appealed the BART permit for the Laramie River Station before the Wyoming Environmental Quality Council (EQC). The Department of Environmental Quality entered into a settlement agreement on November 16, 2010 with Basin Electric Power Cooperative to modify the BART permit. On December 8, 2010, the Division held a State Implementation Plan (SIP) Hearing on Regional Haze. The SIP hearing was held in Cheyenne, Wyoming at the Laramie County Library, 2200 Pioneer Avenue. At that time, the Division collected public comment on the Regional Haze SIP revisions.

After carefully considering all comments on revisions to the State Implementation Plan to address Regional Haze, the Division has determined that the following requirements for further NO_x reduction taken from the Settlement Agreement Filed November 16, 2010 before the Wyoming EQC and incorporated into the EQC Order approving the Settlement, shall establish the NO_x reduction requirements under the Long-Term Strategy of the Wyoming Regional Haze SIP for three units at Laramie River Station with respect to NO_x and NO_x only.

1. Total NO_x emissions from Laramie River Station Units 1, 2 and 3 shall be further reduced to a plant-wide emission limit of 12,773 tons of NO_x per year by December 31, 2017 and continuing thereafter, unless changed pursuant to new regulatory or permit requirements.

2. Basin Electric Power Cooperative shall submit to the Division a permit application for the 12,773 ton plant-wide NO_x emission limit at the Laramie River Station by December 31, 2015.

Jim Bridger Power Plant (Units 1 and 2):

With respect to Bridger Units 1 and 2, PacifiCorp shall: (i) install SCR; (ii) install alternative add-on NO_x control systems; or (iii) otherwise reduce NO_x emissions not to exceed a 0.07 lb/MMBtu 30-day rolling average NO_x emissions rate. These installations shall occur, and/or this emission rate will be achieved, on Unit 2 prior to December 31, 2021 and Unit 1 prior to December 31, 2022. These installations shall occur, and/or this emission rate will be achieved, in conjunction with PacifiCorp's planned overhaul schedule for these units and pursuant to a construction or other permit application to be submitted by PacifiCorp to AQD no later than December 31, 2017.

Jim Bridger Power Plant (Units 3 and 4):

With respect to Bridger Units 3 and 4, PacifiCorp shall: (i) install SCR; (ii) install alternative add-on NO_x control systems; or (iii) otherwise reduce NO_x emissions to achieve a 0.07 lb/MMBtu 30-day rolling average NO_x emissions rate. These installations shall occur, and/or this emission rate will be achieved, on Unit 3 prior to December 31, 2015 and Unit 4 prior to December 31, 2016. These installations shall occur, and/or this emission rate will be achieved, in conjunction with PacifiCorp's planned overhaul schedule for these units and pursuant to a construction or other permit application to be submitted by PacifiCorp to AQD no later than December 31, 2012.

8.3.4 Evaluation of Control Strategies for Sources Identified in the Reasonable Progress - Four-Factor Analysis

The previous chapter evaluated certain non-BART sources through a four-factor analysis for additional controls, as was required by the Federal Regional Haze Rule. This evaluation was limited, in that no guidance was provided for identifying "significant sources", and no contribution to visibility impairment thresholds were established (a potential fifth factor). The Division applied a "Quantity over Distance" (Q/D) process for screening out the most significant stationary source contributors, but that was only the first step in identifying control options. The Air Quality Administrator cannot, per Wyoming Statute 35-11-202, establish emission control requirements except through State rule or regulation. Furthermore, the Wyoming statute requires the Administrator to consider the character and degree of injury of the emissions involved. In this case, visibility modeling would be required to assess the degree of injury caused by the emissions. Modeling is not available at this time to determine impacts from emission reduction. The State believes it has taken a strong and reasonable first step in identifying potential contributors to visibility impairment, and that the next step of creating an appropriate rule or regulation will be accomplished in the next SIP revision. The visibility progress was designed as a long-term program going out to 2064.

8.3.5 Oil and Gas

As discussed in Section 7.3.5, oil and gas production, which is not limited to just one area of Wyoming, is a large, important, and critical component of the State economy. However, the sources associated with oil and gas production emit NO_x, and to a lesser extent, PM. An extensive fleet of field equipment and an array of processing plants operate continuously conducting exploration, production, and gathering activities. Exploration and drilling includes seismic studies, engineering, well testing, drilling operations, and transportation of personnel or equipment to and from sites. Oil and gas production includes operation, maintenance, and servicing of production properties, including transportation to and from sites. Sources include turbines, drill rig engines, glycol dehydrators, amine treatment units, flares and incinerators.

Understanding the sources and volume of emissions at oil and gas production sites is key to recognizing the impact that these emissions have on visibility. To better understand the emissions from these sources, the WRAP instituted a three-phase project. One of the issues was

to quantify emission inventories from stationary and mobile equipment operated as part of oil and gas field operations.

Phase I, which was completed in 2005, was an emission inventory project that estimated regional emissions from oil and gas field operations. Phase II, completed in late 2007, was an effort to more fully characterize the oil and gas field operations emissions. Phase III which began in late 2007 with the Independent Petroleum Association of Mountain States (IPAMS) in conjunction with WRAP initiating a regional oil and gas emission inventory project is underway. The Division cannot complete the evaluation of oil and gas on visibility until this study has been completed.

8.3.6 Projection of the Net Effect on Visibility

The WRAP has projected the net effect on visibility from emission reductions by point, area and mobile sources throughout the WRAP region through 2018. The first emission projection inventory was compiled in 2006. The inventory was revised in 2007 to make preliminary evaluations of reasonable progress towards Class I areas visibility goals. The 2007 inventory focused on the most significant point and area sources of visibility impairing pollution in states and Native American Reservations. This effort included updating projections of electric generating units and incorporating known and presumed BART emission levels. Then, in the spring of 2009, the WRAP once again updated emission inventory projections for point and area sources in the WRAP region to give the most current assessment of reasonable progress towards visibility goals. Again, the updated projection inventory reflected new information about BART determinations and projection of future fossil fuel plants needed to achieve 2018 Federal electrical generation demands. More information on the specifics of the most recent emission inventory work collected for the 2018 visibility projections is contained in Chapter 4 of the Wyoming TSD in the April 29, 2009 ERG Technical Memorandum.

Chapter 5 of this Plan shows the specific results of the CMAQ modeling which was used to make all projections of visibility. Those results show anthropogenic emissions sources generally declining across the West through 2018. However, natural sources such as wildfires and dust, international sources in Mexico and Canada, global transport of emissions and off shore shipping in the Pacific Ocean all appear to offset improvements in visibility from controls on manmade sources. In spite of the large number of growing uncontrollable sources in the WRAP region, however, Wyoming does see a net visibility improvement at the Wyoming Class I areas through 2018. The net effect of all of the reductions in the WRAP region, known at the time of the most recent model run is demonstrated in the WRAP Class I Summary Tables shown below for each of the Class I areas in Wyoming.

Table 8.3.6-1. Class I Area Visibility Summary for YELL2 on 20% Worst Days

	Class I Area Visibility Summary: Grand Teton NP, WY: Red Rock Lakes NWRW, MT: Teton W, WY: Yellowstone NP, WY **Visibility Conditions:** Worst 20% Days **RRF Calculation Method:** Specific Days (EPA) **Emissions Scenarios:** 2000-04 Baseline (plan02d) & 2018 PRPb (prp18b)						
	Monitored	**Estimated**		**Projected**			
	2000-04 Baseline Conditions (Mm-1)	2064 Natural Conditions (Mm-1)	2018 Uniform Rate of Progress Target (Mm-1)[1]	2018 Projected Visibility Conditions (Mm-1)	Baseline to 2018 Change In Statewide Emissions (tons / %)	Baseline to 2018 Change In Upwind Weighted Emissions[2] (%)	Baseline to 2018 Change In Anthropogenic Upwind Weighted Emissions[2] (%)
Sulfate	4.26	0.76	3.35	3.71	-22,794 -15%	-26%	-32%
Nitrate	1.77	0.63	1.5	1.36	-39,861 -14%	-26%	-34%
Organic Carbon	13.48	4.61	11.02	12.87	-730 -3%	-4%	-29%
Elemental Carbon	2.48	0.43	1.97	2.2	-1,217 -15%	-11%	-50%
Fine Soil	0.95	1.02	0.97	1.04	5,223 31%	14%	25%
Coarse Material[3]	2.58	2.99	2.67	Not Applicable	13,394 27%	19%	42%
Sea Salt[3]	0.02	0.03	0.02		Not Applicable		
Total Light Extinction	34.55	19.47	30.25	32.77			
Deciview	11.76	6.44	10.52	11.23			

1) 2018 Uniform Rate of Progress Target for Best 20% Days is not defined.
2) Results based on Weighted Emissions Potential analysis using the 2000-04 Baseline (plan02d) & 2018 PRPb (prp18b) emissions scenarios.
3) Visibility projections not available due to model performance issues.

(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Table 8.3.6-2. Class I Area Visibility Summary for NOAB1 on 20% Worst Days

Class I Area Visibility Summary: North Absaroka W, WY: Washakie W, WY
Visibility Conditions: Worst 20% Days
RRF Calculation Method: Specific Days (EPA)

Emissions Scenarios: 2000-04 Baseline (plan02d) & 2018 PRPb (prp18b)

	Monitored	Estimated		Projected			
	2000-04 Baseline Conditions (Mm-1)	2064 Natural Conditions (Mm-1)	2018 Uniform Rate of Progress Target (Mm-1)[1]	2018 Projected Visibility Conditions (Mm-1)	Baseline to 2018 Change In Statewide Emissions (tons / %)	Baseline to 2018 Change In Upwind Weighted Emissions[2] (%)	Baseline to 2018 Change In Anthropogenic Upwind Weighted Emissions[2] (%)
Sulfate	4.87	0.81	3.8	4.5	-22,794 -15%	-11%	-12%
Nitrate	1.61	0.75	1.4	1.29	-39,861 -14%	-22%	-28%
Organic Carbon	11.64	4.62	9.75	11	-730 -3%	-5%	-21%
Elemental Carbon	1.86	0.44	1.51	1.59	-1,217 -15%	-17%	-47%
Fine Soil	0.85	0.92	0.86	0.95	5,223 31%	17%	28%
Coarse Material[3]	2.91	3.44	3.03	Not Applicable	13,394 27%	20%	35%
Sea Salt[3]	0.01	0.03	0.01		Not Applicable		
Total Light Extinction	32.74	20.02	29.21	31.25			
Deciview	11.45	6.83	10.38	11			

1) 2018 Uniform Rate of Progress Target for Best 20% Days is not defined.
2) Results based on Weighted Emissions Potential analysis using the 2000-04 Baseline (plan02d) & 2018 PRPb (prp18b) emissions scenarios.
3) Visibility projections not available due to model performance issues.

(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Table 8.3.6-3. Class I Area Visibility Summary for BRID1 on 20% Worst Days

Class I Area Visibility Summary: Bridger W, WY: Fitzpatrick W, WY
Visibility Conditions: Worst 20% Days
RRF Calculation Method: Specific Days (EPA)

Emissions Scenarios: 2000-04 Baseline (plan02d) & 2018 PRPb (prp18b)

	Monitored	Estimated		Projected			
	2000-04 Baseline Conditions (Mm-1)	2064 Natural Conditions (Mm-1)	2018 Uniform Rate of Progress Target (Mm-1)[1]	2018 Projected Visibility Conditions (Mm-1)	Baseline to 2018 Change In Statewide Emissions (tons / %)	Baseline to 2018 Change In Upwind Weighted Emissions[2] (%)	Baseline to 2018 Change In Anthropogenic Upwind Weighted Emissions[2] (%)
Sulfate	4.99	0.82	3.89	4.06	-22,794 -15%	-31%	-32%
Nitrate	1.43	0.79	1.27	1.24	-39,861 -14%	-19%	-21%
Organic Carbon	10.55	4.64	8.98	10.31	-730 -3%	-4%	-18%
Elemental Carbon	1.99	0.39	1.59	1.77	-1,217 -15%	-17%	-50%
Fine Soil	1.1	1.07	1.1	1.19	5,223 31%	13%	23%
Coarse Material[3]	2.51	2.67	2.55	Not Applicable	13,394 27%	16%	39%
Sea Salt[3]	0.04	0.04	0.04		Not Applicable		
Total Light Extinction	31.6	19.42	28.23	30.12			
Deciview	11.12	6.45	10.03	10.63			

1) 2018 Uniform Rate of Progress Target for Best 20% Days is not defined.
2) Results based on Weighted Emissions Potential analysis using the 2000-04 Baseline (plan02d) & 2018 PRPb (prp18b) emissions scenarios.
3) Visibility projections not available due to model performance issues.

(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Table 8.3.6-4. Class I Area Visibility Summary for YELL2 on 20% Best Days

	Class I Area Visibility Summary: Grand Teton NP, WY: Red Rock Lakes NWRW, MT: Teton W, WY: Yellowstone NP, WY **Visibility Conditions:** Best 20% Days **RRF Calculation Method:** Specific Days (EPA) **Emissions Scenarios:** 2000-04 Baseline (plan02d) & 2018 PRPb (prp18b)						
	Monitored	**Estimated**		**Projected**			
	2000-04 Baseline Conditions (Mm-1)	2064 Natural Conditions (Mm-1)	2018 Uniform Rate of Progress Target (Mm-1)[1]	2018 Projected Visibility Conditions (Mm-1)	Baseline to 2018 Change In Statewide Emissions (tons / %)	Baseline to 2018 Change In Upwind Weighted Emissions[2] (%)	Baseline to 2018 Change In Anthropogenic Upwind Weighted Emissions[2] (%)
Sulfate	1.47	0.33	Not Applicable	1.43	-22,794 -15%	-20%	-26%
Nitrate	0.72	0.29	Not Applicable	0.57	-39,861 -14%	-27%	-36%
Organic Carbon	1.13	0.48	Not Applicable	1.1	-730 -3%	-3%	-28%
Elemental Carbon	0.31	0.07	Not Applicable	0.22	-1,217 -15%	-10%	-50%
Fine Soil	0.1	0.08	Not Applicable	0.14	5,223 31%	13%	25%
Coarse Material[3]	0.24	0.2	Not Applicable	Not Applicable	13,394 27%	18%	44%
Sea Salt[3]	0.01	0	Not Applicable		Not Applicable		
Total Light Extinction	12.99	10.45	Not Applicable	12.71			
Deciview	2.58	0.43	Not Applicable	2.36			

1) 2018 Uniform Rate of Progress Target for Best 20% Days is not defined.
2) Results based on Weighted Emissions Potential analysis using the 2000-04 Baseline (plan02d) & 2018 PRPb (prp18b) emissions scenarios.
3) Visibility projections not available due to model performance issues.

(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Table 8.3.6-5. Class I Area Visibility Summary for NOAB1 on 20% Best Days

	Class I Area Visibility Summary: North Absaroka W, WY: Washakie W, WY **Visibility Conditions:** Best 20% Days **RRF Calculation Method:** Specific Days (EPA) **Emissions Scenarios:** 2000-04 Baseline (plan02d) & 2018 PRPb (prp18b)						
	Monitored	**Estimated**		**Projected**			
	2000-04 Baseline Conditions (Mm-1)	2064 Natural Conditions (Mm-1)	2018 Uniform Rate of Progress Target (Mm-1)[1]	2018 Projected Visibility Conditions (Mm-1)	Baseline to 2018 Change In Statewide Emissions (tons / %)	Baseline to 2018 Change In Upwind Weighted Emissions[2] (%)	Baseline to 2018 Change In Anthropogenic Upwind Weighted Emissions[2] (%)
Sulfate	1.11	0.27	Not Applicable	1.1	-22,794 -15%	-22%	-24%
Nitrate	0.37	0.23	Not Applicable	0.33	-39,861 -14%	-28%	-34%
Organic Carbon	0.8	0.46	Not Applicable	0.77	-730 -3%	-6%	-23%
Elemental Carbon	0.16	0.05	Not Applicable	0.14	-1,217 -15%	-21%	-50%
Fine Soil	0.12	0.11	Not Applicable	0.15	5,223 31%	16%	26%
Coarse Material[3]	0.71	0.49	Not Applicable		13,394 27%	19%	40%
Sea Salt[3]	0.02	0.02	Not Applicable	Not Applicable			
Total Light Extinction	12.28	10.61	Not Applicable	12.22			
Deciview	2.02	0.58	Not Applicable	1.97	Not Applicable		

1) 2018 Uniform Rate of Progress Target for Best 20% Days is not defined.
2) Results based on Weighted Emissions Potential analysis using the 2000-04 Baseline (plan02d) & 2018 PRPb (prp18b) emissions scenarios.
3) Visibility projections not available due to model performance issues.

(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Table 8.3.6-6. Class I Area Visibility Summary for BRID1 on 20% Best Days

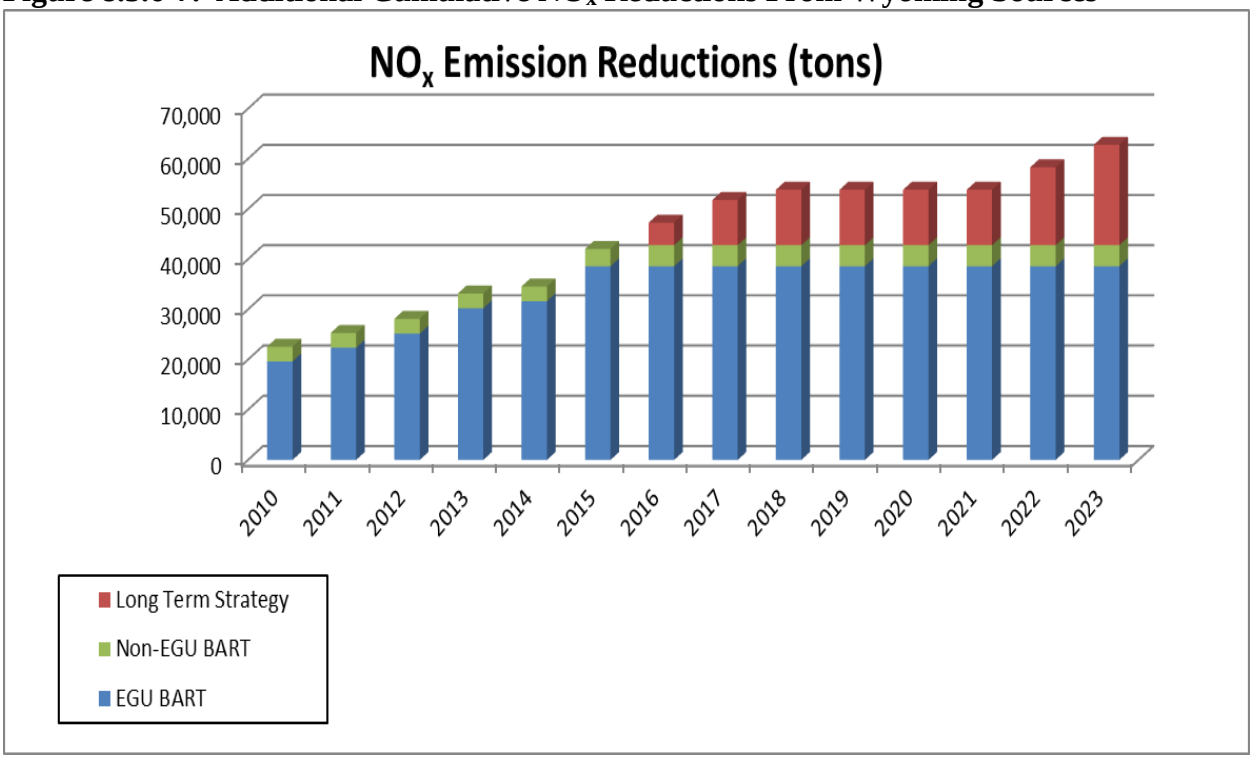
	Class I Area Visibility Summary: Bridger W, WY: Fitzpatrick W, WY **Visibility Conditions:** Best 20% Days **RRF Calculation Method:** Specific Days (EPA) **Emissions Scenarios:** 2000-04 Baseline (plan02d) & 2018 PRPb (prp18b)						
	Monitored	**Estimated**		**Projected**			
	2000-04 Baseline Conditions (Mm-1)	2064 Natural Conditions (Mm-1)	2018 Uniform Rate of Progress Target (Mm-1)[1]	2018 Projected Visibility Conditions (Mm-1)	Baseline to 2018 Change In Statewide Emissions (tons / %)	Baseline to 2018 Change In Upwind Weighted Emissions[2] (%)	Baseline to 2018 Change In Anthropogenic Upwind Weighted Emissions[2] (%)
Sulfate	1.45	0.28	Not Applicable	1.35	-22,794 -15%	-31%	-33%
Nitrate	0.43	0.25	Not Applicable	0.41	-39,861 -14%	-21%	-25%
Organic Carbon	0.8	0.41	Not Applicable	0.8	-730 -3%	-5%	-23%
Elemental Carbon	0.36	0.08	Not Applicable	0.29	-1,217 -15%	-20%	-53%
Fine Soil	0.09	0.07	Not Applicable	0.12	5,223 31%	13%	23%
Coarse Material[3]	0.25	0.2	Not Applicable	Not Applicable	13,394 27%	16%	42%
Sea Salt[3]	0.01	0.01	Not Applicable		Not Applicable		
Total Light Extinction	12.38	10.3	Not Applicable	12.22			
Deciview	2.1	0.28	Not Applicable	1.97			

1) 2018 Uniform Rate of Progress Target for Best 20% Days is not defined.
2) Results based on Weighted Emissions Potential analysis using the 2000-04 Baseline (plan02d) & 2018 PRPb (prp18b) emissions scenarios.
3) Visibility projections not available due to model performance issues.

(WRAP TSS - http://vista.cira.colostate.edu/tss/)

Since the Regional Haze process has proved to be much more complicated than the rule writers ever imagined, the entire process has taken longer than originally estimated. While most east coast states accepted EPA's determination that CAIR satisfied BART for electric generating units, some western states are still going through the difficult case-by-case BART determinations for each EGU. As a result, the WRAP was not able to model all of the emission reductions from BART and State long-term strategies in the most recent modeling effort. In the State of Wyoming, significant additional NO_x reductions will be made at the completion of the BART and long-term strategy. The overall cumulative NO_x reductions from Wyoming sources over time are demonstrated in the figure below. Any additional future modeling will most likely demonstrate additional progress towards the 2018 visibility goals.

Figure 8.3.6-7. Additional Cumulative NO_x Reductions From Wyoming Sources



CHAPTER 9
ONGOING MONITORING AND EMISSION INVENTORY STRATEGY

The State of Wyoming will rely upon a Regional Planning Organization's provision of adequate technical support to meet its commitment to conduct the analyses necessary to meet the requirements of 51.308(d)(4).

The State of Wyoming will depend on the Inter-Agency Monitoring of PROtected Visual Environments (IMPROVE) monitoring program to collect and report aerosol monitoring data for long-term reasonable progress tracking as specified in 40 CFR 51.308(d)(4) of the Regional Haze Rule (RHR). Because the RHR is a long-term tracking program with an implementation period nominally set for 60 years, the Division expects that the IMPROVE program 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 at each site of all visibility-impairing species;
3) Comply with EPA quality control and assurance requirements; and
4) Prepare and disseminate periodic reports on IMPROVE program operations.

The State of Wyoming is relying on the IMPROVE program 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 program during the 2000-2004 RHR baseline period. Technical analyses and reasonable progress goals in this Implementation Plan for Regional Haze are based on data from these sites. As such, the State asks that the IMPROVE program identify potential issues affecting RHR implementation trends and/or notify the State before changes in the IMPROVE program affecting a RHR tracking site are made.

Further, the State of Wyoming notes that the human resources to operate these monitors are provided by Federal Land Management agencies. Beyond that in-kind contribution, resources for operation and sample analysis of a complete and representative monitoring network of these long-term reasonable progress tracking sites by the IMPROVE program are a collaborative responsibility of EPA, states, tribes, and FLMs and the IMPROVE program steering committee. The State of Wyoming will collaborate with the EPA, FLMs, other states, tribes, and the IMPROVE committee to assure adequate and representative data collection and reporting by the IMPROVE program.

Figure 9-1. Links to Site Locations and Monitors

Site Name	Site Location	Link
BRID1	VIEWS WRAP TSS IMPROVE	http://vista.cira.colostate.edu/views/Web/SiteBrowser/SiteBrowser.aspx http://vista.cira.colostate.edu/TSS/Tools/AOI.aspx http://vista.cira.colostate.edu/Datawarehouse/IMPROVE/Data/Photos/BRID/start.htm
NOAB1	VIEWS WRAP TSS	http://vista.cira.colostate.edu/views/Web/SiteBrowser/SiteBrowser.aspx http://vista.cira.colostate.edu/TSS/Tools/AOI.aspx
YELL2	VIEWS WRAP TSS IMPROVE	http://vista.cira.colostate.edu/views/Web/SiteBrowser/SiteBrowser.aspx http://vista.cira.colostate.edu/TSS/Tools/AOI.aspx http://vista.cira.colostate.edu/Datawarehouse/IMPROVE/Data/Photos/YELL/start.htm

Pursuant to 40 CFR 51.308(d)(4)(i), the State of Wyoming depends on the following IMPROVE program-operated monitors at the following sites for tracking RHR reasonable progress:

Table 9-1. The Wyoming IMPROVE Monitoring Network

Site Code	Class I Area	Sponsor	Elevation (MSL)	Start Date
BRID1	Bridger Wilderness Fitzpatrick Wilderness	USFS	2627 m 8619 ft	3/2/1988
NOAB1	North Absaroka Wilderness Washakie Wilderness	USFS	2483 m 8146 ft	1/25/2000
YELL2	Grand Teton National Park Teton Wilderness Yellowstone National Park	NPS	2425 m 7956 ft	7/1/1996

In accordance with provisions of 40 CFR 51.308(d)(4)(ii), the State of Wyoming 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) and the Technical Support System (TSS), as well as other analysis tools and efforts sponsored by a Regional Planning Organization. Wyoming will participate in the ongoing regional analysis activities of a Regional Planning Organization to collectively assess and verify the progress toward reasonable progress goals, also supporting interstate consultation as the RHR is implemented, and collaborate with members of a Regional Planning Organization to ensure the continued operation of these technical support analysis tools and systems.

Wyoming may conduct additional analyses as needed.

The State of Wyoming 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 systems, VIEWS and TSS as set forth in 40 CFR 51.308(d)(4)(iv). The State of Wyoming will collaborate with members of a Regional Planning Organization to ensure the continued operation of these technical support analysis tools and systems.

Per requirements of 40 CFR 51.308(d)(4)(v), the State of Wyoming has prepared a statewide inventory of emissions that can reasonably be expected to cause or contribute to visibility impairment in Federal Class I areas. Chapter 4 of this Plan summarizes the emissions by pollutant and source category.

The State of Wyoming commits to updating statewide emissions periodically. The updates will be used for state tracking of emission changes, trends, and input into a Regional Planning Organization's evaluation of whether reasonable progress goals are being achieved and other regional analyses. The inventories will be updated every three years on the same schedule as the every three-year reporting required by EPA's Consolidated Emissions Reporting Rule.

As a member of a Regional Planning Organization, the State of Wyoming will use the Regional Planning Organization-sponsored data system(s) to store and access emission inventory data for the region. The State of Wyoming will also depend upon and participate in additional periodic collective emissions inventory efforts by a Regional Planning Organization. Further, the State of Wyoming will depend on and use the capabilities of a Regional Planning Organization-sponsored modeling center to simulate the air quality impacts of emissions for haze and other related air quality planning purposes. The State of Wyoming will collaborate with members of a Regional Planning Organization to ensure the continued operation of these technical support analysis tools and systems.

The State of Wyoming, in accordance with provisions of 40 CFR 51.308(d)(4)(vi), will track data related to RHR haze plan implementation for sources for which the State has regulatory authority, and will depend on the IMPROVE program and a Regional Planning Organization-sponsored collection and analysis efforts and data support systems for monitoring and emissions inventory data, respectively. To ensure the availability of data and analyses to report on visibility conditions and progress toward Class I area visibility goals, the State of Wyoming will collaborate with members of a Regional Planning Organization to ensure the continued operation of the IMPROVE program and Regional Planning Organization-sponsored technical support analysis tools and systems.

CHAPTER 10
COMPREHENSIVE PERIODIC IMPLEMENTATION PLAN REVISIONS

40 CFR 51.308(f) requires the Division to revise its Regional Haze Implementation Plan and submit a Plan revision to the USEPA by July 31, 2018 and every ten years thereafter. In accordance with the requirements listed in Section 51.308(f) of the Federal rule for regional haze, Wyoming commits to revising and submitting this Regional Haze Implementation Plan by July 31, 2018 and every ten years thereafter.

In addition, 51.308(g) requires periodic reports evaluating progress towards the reasonable progress goals established for each mandatory Class I area. In accordance with the requirements listed in 51.308(g) of the Federal rule for regional haze, the Division commits to submitting a report on reasonable progress to the USEPA every five years following the initial submittal of the SIP. The report will be in the form of a SIP revision. The reasonable progress report will evaluate the progress made towards the reasonable progress goal for each mandatory Class I area located within Wyoming and in each mandatory Class I area located outside Wyoming which may be affected by emissions from within Wyoming.

The requirements listed in 51.308(g) include the following:

1. 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;

2. Summary of emission reductions achieved thus far;

3. Assessment of changes in visibility conditions at each Class I area (current vs. baseline), expressed as 5-year averages of annual values for least impaired and most impaired days;

4. Analysis of emissions changes over the 5-year period, identified by source or activity, using the most recent updated emissions inventory;

5. Analysis of any significant changes in anthropogenic emissions in or out of the state which have impeded progress;

6. Assessment of the sufficiency of the implementation plan to meet reasonable progress goals;

7. Review of the State's visibility monitoring strategy and any modifications to the strategy as necessary.

CHAPTER 11
WYOMING REGIONAL HAZE SIP DEVELOPMENT AND CONSULTATION PROCESS

11.1 State to State Consultation

Pursuant to 40 CFR Section 51.308(d)(iv), the State of Wyoming consulted with other states through a regional planning organization, the Western Regional Air Partnership (WRAP), in developing reasonable progress goals. The WRAP is a collaborative effort of tribal governments, State governments and various Federal agencies to implement the Grand Canyon Visibility Transport Commission's recommendations and to develop the technical and policy tools needed by western states and tribes to comply with the U.S. EPA's regional haze regulations. The WRAP is administered jointly by the Western Governors' Association and the National Tribal Environmental Council. WRAP activities are conducted by a network of committees and forums composed of WRAP members and stakeholders who represent a wide range of viewpoints. The WRAP recognizes that residents have the most to gain from improved visibility and that many solutions are best implemented at the local, state, tribal or regional level with public participation. The following states: Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming have agreed to work together to address regional haze in the Western United States. The goals, objectives, management and decision making structure of the WRAP are described in Work Plans and a Strategic Plan provided in Chapter 1 of the Wyoming TSD.

This consultation effort began with all states in the WRAP region contributing information to a technical support system (TSS) which allows all states to better understand the causes of haze and the levels of contribution from all sources to each Class I area. This project has involved many hours of consultation between states on regional emission inventories, monitoring and modeling to determine the causes of visibility impairment in each mandatory Class I Federal area in the regional planning area. WRAP forums involved in the technical consultation between states are as follows:

Air Pollution Prevention Forum
Dust Emissions Forum
Economic Analysis Forum
Emissions Forum
Fire Emissions Forum
Mobile Sources Forum
Sources In and Near Class I Areas Forum
Stationary Sources Forum
Technical Analysis Forum

The next step in state consultation in the development of reasonable progress goals was through the Implementation Work Group (IWG) of the WRAP. The State of Wyoming participated in the IWG which took the products of the technical consultation process discussed above and developed a process for establishing reasonable progress goals in the Western Class I areas. A description of that process and the determination of reasonable progress goals for each of the Class I areas in the State of Wyoming is described in Chapter 7. The following states have agreed to work together through the IWG in the development of reasonable progress goals: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming.

Opportunities for consultation on development of reasonable progress goals provided through the WRAP Implementation Work Group have been documented in calls listed on the Implementation Work Group section of the WRAP website at: http://www.wrapair.org/forums/iwg/meetings.html.

Pursuant to 40 CFR Section 51.308(d)(iv), the State of Wyoming also gave opportunity for neighboring states to comment on the State of Wyoming's reasonable progress goals for each Class I area located within the state. Opportunity for comment from other states was offered through a public hearing on the State Implementation Plan (SIP), held in accordance with 40 CFR Section 51.102. The following states in the WRAP region were notified of the SIP public hearing: Alaska, Arizona, California, Colorado, Idaho, Montana, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Nevada, and Hawaii. The following states in the neighboring Central States Regional Planning Organization (CENRAP) were notified of the SIP public hearing: Iowa, Kansas, Minnesota, Missouri, Nebraska, Oklahoma, and Texas. Consultation correspondence between Wyoming and other states will be included in Chapter 11 of the Wyoming TSD. Comments were received from the following states, on the State of Wyoming's reasonable progress goals for Class I areas located within the State of Wyoming.

The State of Wyoming took the following actions to resolve the disagreement:

The State of Wyoming did not receive any comments from other states indicating disagreement on the reasonable progress goals established for the following Class I areas: Bridger Wilderness, Fitzpatrick Wilderness, Grand Teton National Park, North Absaroka Wilderness, Teton Wilderness, Washakie Wilderness, and Yellowstone National Park.

Pursuant to 40 CFR 51.308(d)(3)(i), the State of Wyoming has participated in regional planning and coordination with other states in developing emission management strategies if emissions from within the state contribute to visibility impairment in a mandatory Class I Federal area outside the state, or if emissions from another state, regional planning organization, country, tribal area, or offshore location contribute to visibility impairment in any Class I Federal area within the state. This participation was through the Western Regional Air Partnership (WRAP). A more detailed description of the goals, objectives, management, and decision-making structure of the WRAP has been included in Work Plans and a Strategic Plan provided in Chapter 1 of the Wyoming TSD. The following WRAP forums have provided consultation opportunities between states on emission management strategies:

Air Pollution Prevention Forum
Dust Emissions Forum
Economic Analysis Forum
Emissions Forum
Fire Emissions Forum
Mobile Sources Forum
Sources In and Near Class I Areas Forum
Stationary Sources Forum
Technical Analysis Forum

Opportunities for consultation on emission strategies provided through the WRAP have been documented in calls and meetings on the WRAP website at: http://www.wrapair.org/cal/calendar.php.

A description of the selected emission management strategies for the State of Wyoming is described in Chapter 8 of this Plan. The State of Wyoming views the development of coordinated emission management strategies to be a long-term commitment, and therefore, the State of Wyoming agrees to continue to participate in the WRAP or an alternative Regional Planning Organization in developing coordinated emission management strategies for SIP revisions in 2013 and 2018.

Pursuant to 40 CFR 51.308(h)(2), the State of Wyoming has determined this first State Implementation Plan is adequate to ensure reasonable progress for the first planning period of the regional haze long-term planning effort which extends out to the year 2064. While emissions from sources outside of the State of Wyoming have resulted in a slower rate of improvement in visibility than the rate that would be needed to attain natural conditions by 2064, most of these emissions are beyond the control of any state in the regional planning area of the WRAP. The emission sources include: emissions from outside the WRAP domain; emissions from Canada and Mexico; emissions from wildfires and windblown dust; and emissions from offshore shipping. A more detailed description and quantification of these uncontrolled emissions is included in the Source Apportionment and Regional Haze Modeling chapter of this SIP. Additional strategies to address emissions beyond the control of any state in the WRAP under the jurisdiction of EPA are discussed in the Long-Term Strategy chapter of this SIP.

Through the WRAP consultation process the State of Wyoming has reviewed and analyzed the contributions from other states that reasonably may cause or contribute to visibility impairment in Wyoming's Class I areas. Wyoming acknowledges that the long-term strategies adopted by Colorado, South Dakota, and Idaho in their SIPs and approved by EPA will include emission reductions from a variety of sources that will reduce visibility impairment in Wyoming's Class I areas.

Figure 11.1-1. Regional Planning Organizations

11.2 State and Federal Land Manager Coordination

40 CFR Section 51.308(i) of the Regional Haze Rule requires coordination between states and the Federal Land Managers (FLMs). Wyoming has provided agency contacts to the FLMs as required under 51.308(i)(1). During the development of this Plan, the FLMs were consulted in accordance with the provisions of 51.308(i)(2).

Numerous opportunities were provided by the Western Regional Air Partnership for FLMs to participate fully in the development of technical documents developed by the WRAP and included in this Plan. This included the ability to review and comment on these analyses, reports, and policies. A summary of WRAP-sponsored meetings and conference calls is provided on the WRAP website at: http://www.wrapair.org/cal/calendar.php.

The State of Wyoming has provided an opportunity for consultation, in person and at least 60 days prior to holding any public hearing on the SIP. As required by 40 CFR Section 51.308(i)(3), the FLM comments and State responses, as well as email exchanges from the FLM community to the Division explaining their review preferences of the SIP, will be included in Chapter 11 of the Wyoming TSD.

40 CFR Sections 51.308(f-h) establish requirements and timeframes for states to submit periodic SIP revisions and progress reports that evaluate progress toward the reasonable progress goal for each Class I area. As required by 40 CFR Section 51.308(i)(4), Wyoming will continue to

coordinate and consult with the FLMs during the development of these future progress reports and Plan revisions, as well as during the implementation of programs having the potential to contribute to visibility impairment in mandatory Class I areas. The progress and Plan reviews are to occur at five-year intervals, with a progress report between each required Plan revision. This consultation process shall provide on-going and timely opportunities to address the status of the control programs identified in this SIP, the development of future assessments of sources and impacts, and the development of additional control programs. The consultation will include the status of the following specific implementation items:

1. Implementation of emissions strategies identified in the SIP as contributing to achieving improvement in the worst-day visibility.
2. Summary of major new permits issued.
3. Status of State actions to meet commitments for completing any future assessments or rulemakings on sources identified as likely contributors to visibility impairment, but not directly addressed in the most recent SIP revision.
4. Any changes to the monitoring strategy or monitoring stations status that may affect tracking of reasonable progress.
5. Work underway for preparing the 5-year review and/or 10-year revision.
6. Items for FLMs to consider or provide support for in preparation for any visibility protection SIP revisions (based on a 5-year review or the 10-year revision schedule under EPA's RHR).
7. Summary of topics discussion (meetings, emails, other records) covered in ongoing communications between the State and FLMs regarding implementation of the visibility program.

The consultation will be coordinated with the designated visibility protection program coordinators for the National Park Service, U.S. Fish and Wildlife Service, Bureau of Land Management, and the U.S. Forest Service. At a minimum, the State of Wyoming will meet with the Federal Land Managers on an annual basis through the Western Regional Air Partnership or an alternative Regional Planning Organization.

11.3 Tribal Consultation

Although tribal consultation is not required under the Regional Haze Rule, the Division views this as an important part of the consultation process, and actively pursued this during the development of the Regional Haze Plan. Not unlike the state consultation process, consultation with tribes involved reviewing major emission sources and regional haze strategies to address visibility issues. Consultation correspondence between Wyoming and tribal contacts will be included in Chapter 11 of the Wyoming TSD.

CHAPTER 12
DETERMINATION OF THE ADEQUACY OF THE EXISTING PLAN

Depending on the findings of the five-year progress report, Wyoming commits to taking one of the actions listed in 40 CFR 51.308(h). The findings of the five-year progress report will determine which action is appropriate and necessary.

List of Possible Actions (40 CFR 51.308(h))

1. The Division determines that the existing SIP requires no further substantive revision in order to achieve established goals. The Division provides to the EPA Administrator a negative declaration that further revision of the SIP is not needed at this time.

2. The Division determines that the existing SIP may be inadequate to ensure reasonable progress due to emissions from other states, which participated in the regional planning process. The Division provides notification to the EPA Administrator and the states that participated in regional planning. The Division collaborates with states and FLMs through the regional planning process to address the SIP's deficiencies.

3. The Division determines that the current SIP may be inadequate to ensure reasonable progress due to emissions from another country. The Division provides notification, along with available information, to the EPA Administrator.

4. The Division determines that the existing SIP is inadequate to ensure reasonable progress due to emissions within the state. The Division will consult with FLMs and revise its SIP to address the Plan's deficiencies within one year.

CHAPTER 13
TECHNICAL INFORMATION AND DATA RELIED UPON IN THIS PLAN

This chapter describes the information relied upon by the Division in developing this Regional Haze Plan. The first portion of this chapter describes the Western Regional Air Partnership (WRAP) and the work products of this organization which have been utilized by the Division.

13.1 The WRAP and Technical Support

The WRAP is a voluntary organization of western states, tribes and Federal agencies which was formed in 1997 as the successor to the Grand Canyon Visibility Transport Commission (GCVTC). It is a regional planning organization that provides assistance to western states like Wyoming in the preparation and implementation of Regional Haze Plans. The WRAP is also instigating regional planning processes to improve visibility in all Western Class I areas by providing the technical and policy tools needed by states and tribes to implement the Federal Regional Haze Rule. The WRAP is administered jointly by the Western Governors' Association (WGA) and the National Tribal Environmental Council (NTEC).

The WRAP is comprised of western states, tribes and Federal agencies. The states include Alaska, Arizona, California, Colorado, Idaho, Montana, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming. Tribal board members include Campo Band of Kumeyaay Indians, Confederated Salish and Kootenai Tribes, Cortina Indian Rancheria, Hopi Tribe, Hualapai Nation of the Grand Canyon, Native Village of Shungnak, Nez Perce Tribe, Northern Cheyenne Tribe, Orutsararmiut Native Council, Pueblo of Acoma, Pueblo of San Felipe, Pueblo of Zuni, and Shoshone-Bannock Tribes of Fort Hall. Representatives of other tribes participate on WRAP forums and committees. Participation is encouraged throughout the western states and tribes. Federal participants include the Department of Interior (National Park Service and Fish & Wildlife Service), the Department of Agriculture (Forest Service), and the Environmental Protection Agency.

13.2 WRAP Committees and Work Groups

- Air Managers Committee

The Air Managers Committee (formerly the Northern Air Managers Committee) is made up of state and tribal caucuses, each representing the interests of state and tribal air managers. The committee is expected to provide air managers with a forum for discussing WRAP related matters of concern to them. These matters may cover a spectrum of air quality issues. The committee also provides a mechanism for communication and guidance to the technical and policy forums as to what air managers believe is needed to support their regional planning efforts.

- Communications Committee

The WRAP Communications Committee facilitates the exchange of information between the standing committees and forums of the WRAP, and is also charged with developing materials

that help the general public understand the WRAP process and take part in its decision making. Some of the products of the Communications Committee have included outreach materials to encourage direct participation, the development of internal and external communications plans and the construction of the WRAP website.

- Planning Team

The Planning Team is convened as needed to address long-term planning and administrative issues, such as annual WRAP work plans and the WRAP strategic plan. Some of the functions performed by the Planning Team were previously performed by the Coordinating Group, which no longer exists.

- Initiatives Oversight Committee

The Initiatives Oversight Committee (IOC) provides general oversight for the coordination and development of air quality strategies necessary to promote the implementation of the Grand Canyon Visibility Transport Commission's recommendations. The IOC oversees the development of other air quality policies and strategies at the direction of the WRAP, refers issues to forums, reviews recommendations from forums and makes recommendations to the WRAP.

- Technical Oversight Committee

The Technical Oversight Committee (TOC) provides general oversight to the technical activities of the WRAP. The TOC identifies technical issues and tasks necessary to support the activities of the WRAP and refers these issues to the technical forums. The TOC identifies issues to be addressed by the forums, based on input, priorities, and directions from the WRAP. The TOC reviews any recommendations made by the forums and subsequently makes its own recommendations to the WRAP.

- Implementation Work Group

The purpose of the WRAP Air Managers Committee Implementation Work Group is to help states and tribes prepare their Regional Haze Implementation Plans to meet the requirements of 40 CFR 51.308 and 401 CFR 51.309(g). The work group is comprised of state and tribal representatives to accommodate the needs of states and tribes by recognizing the variety of regulatory and statutory authorities and range of technical and policy expertise.

- Oil and Gas Emissions Work Group

Significant air pollutant emissions come from production of oil and gas from wells located on state-regulated and tribal lands, as well as from the interconnected gathering networks interlacing the WRAP region. These emissions result from operation of an extensive fleet of field equipment and an array of processing plants, operating continuously across the West. These field operations include exploration, production, and gathering activities.

Historically, emissions from large stationary point sources processing this energy for the oil and gas fuels markets were pretty well quantified through existing regulatory agency permitting programs, but quite a number of pieces of smaller oil and gas field equipment (compressor engines, drill rigs, heaters, dehydrators, flares, etc.) traditionally fell below agency permitting thresholds. Although individual emissions from this field equipment could be considered minor, with increasing energy demand and continuing oil and gas field development the cumulative totals for oil and gas basins, producing states and the WRAP region as a whole were thought to present an entirely different picture. But prior to WRAP involvement, present and future area source emissions from western field oil and gas production operations were generally incompletely quantified.

The WRAP recognized this deficiency and formed the Oil and Gas Emissions Work Group to look more closely at this industry and take steps to address the deficiencies. In late 2005 the WRAP completed the Phase I oil and gas emission inventory project to estimate for the first time, regional emission totals from these field operations. As a "first cut" Phase I had a number of uncertainties identified, thus the work group subsequently initiated the Phase II project, completed in fall 2007, to more fully characterize the oil and gas field operations emissions. These WRAP inventories identified over 100,000 TPY of NO_x emissions in the WRAP region which had not previously been included in regional air quality assessments, as well as significant totals of other air pollutant species (VOC's primarily) critical in the evaluation of regional haze and other air quality management issues.

Members of the Independent Petroleum Association of Mountain States (IPAMS) felt that still more improvement in the accuracy of these emission estimates was needed and available. So in late 2007 IPAMS initiated a Phase III regional oil and gas emission inventory project funded by their organization. The project was undertaken in conjunction with the WRAP to assure that the products from Phase III were widely distributed among non-industry stakeholders (state/local agencies, tribal air programs, Federal Land Managers, environmental groups and EPA). This wider participation was viewed as necessary to assure review and feedback such that the final inventories were understood and more universally accepted by those parties interested in and affected by oil and gas development in the Intermountain West.

- Tribal Data Development Work Group

The mission of this work group is to assist and advise WRAP on gathering tribal air quality data and other air quality issues related to the WRAP mission from tribes in the WRAP area. They work with the other WRAP forum and non-tribal communities to improve understanding communities of protocols and processes for obtaining and using tribal data. In addition to assisting in gathering existing air quality and air emissions data, this work group aids in devising plans for filling the gaps in the tribal data.

13.3 WRAP Forums

- Air Pollution Prevention Forum

The Air Pollution Prevention Forum (AP2) was created by the WRAP to examine barriers to use of renewable energy and energy efficient technologies, identify actions to overcome such barriers, and recommend potential renewable energy and energy efficiency programs and policies that could result in a reduction of air pollution emissions from energy production and energy end-use sectors in the Grand Canyon Visibility Transport Region.

- Dust Emissions Joint Forum

In the summer of 2002, the WRAP Oversight Committees established a Dust Emissions Joint Forum to consolidate the WRAP's efforts involving dust. Previously, three forums had worked on dust issues: the Mobile Sources Forum, the Research and Development Forum, and the Emissions Forum. The new DEJF concentrates on improving how dust emissions are estimated and subsequently treated by air quality models. The forum also examines strategies to effectively reduce the impact of dust emissions on visibility in Class I areas.

- Economic Analysis Forum

The mission of the Economic Analysis Forum (EAF) is to provide the WRAP and WRAP forums with projections of econometric parameters needed to forecast changes in emissions, and assessments of the economic effects of pollution controls on the region and sub-regions, including Indian Country. Specifically, the EAF is seeking to: develop a better definition of what states, tribes and stakeholders expect from the economic analyses provided with WRAP products; develop a common economic analysis framework, which will include incorporating existing studies' economic analyses; assist states and tribes as they prepare their Implementation Plans; and provide overall analytical support and analysis as states and tribes gage the economic components of their Regional Haze Plans.

- Emissions Forum

The Emissions Forum oversees the development of a comprehensive emissions tracking and forecasting system which can be utilized by the WRAP, or its member entities, monitors the trends in actual emissions, and forecasts the anticipated emissions which will result from current regulatory requirements and alternative control strategies. In addition, this forum is responsible for the oversight of the assembly and quality assurance of the emissions inventories and forecasts to be utilized by the WRAP forums.

- Fire Emissions Joint Forum

The Fire Emissions Joint Forum (FEJF) was formed to assist the WRAP in addressing the Grand Canyon Visibility Transport Commission's (GCVTC) Recommendations on fire. The term fire refers inclusively to wildfire, prescribed natural fire/wildland fire managed for resource benefits, prescribed fire, and agricultural fire. The forum addresses a broad definition of smoke effects

which includes consideration of public nuisance, public health and visibility/regional haze. The FEJF follows its consensus based Work Plan which addresses four major topics.

Criteria for implementation of different stringencies of smoke management programs are being developed as well as specific smoke management program elements. Fire emissions are being directly assessed in terms of pollutant estimation methods, emission projections and tracking. An assessment is being done of the potential applicability and utility of non-burning alternatives to fire. The use of alternatives and other emission reduction methods relates directly to the potential application of annual emission goals.

A public education and outreach program related to fire and smoke effects is being developed. All recommendations to the WRAP and methods developed by the forum are intended for Western U.S. application and represent a consensus of FEJF members. Collaboration and cooperation with other entities addressing smoke management issues in the West have been included in the Work Plan of the FEJF.

- Mobile Sources Forum

The Mobile Sources Forum (MSF) investigates and recommends mobile source emission control measures. Mobile sources includes both on-road sources (e.g., cars, trucks, buses, and motorcycles) and off-road sources (e.g., aircraft and its support equipment, locomotives, commercial marine and pleasure craft, and equipment used for construction, logging, mining, agriculture, and lawn and garden care). Since emission standards for new on-road and off-road sources can only be set by the U.S. EPA (on-road standards can also be set by California), the MSF focuses more on the impact and treatment of existing sources, especially off-road sources. The MSF also participates in technical activities related to mobile sources. During its first couple of years (2000-02), the MSF led the development of a WRAP-wide mobile source emission inventory and worked with the Air Quality Modeling Forum to define and analyze the significance of mobile sources with respect to the requirements of §309 of the Regional Haze Rule.

- Sources In and Near Class I Areas Forum

The Grand Canyon Visibility Transportation Commission (GCVTC) developed recommendations to address emissions from sources in and near Class I areas on the Colorado Plateau. The Sources In and Near Class I Areas Forum (In and Near Forum) helps implement those recommendations by working with parks and local communities to develop and implement strategies to minimize emissions and the resulting visibility impacts.

- Stationary Sources Joint Forum

The Stationary Sources Joint Forum (SSJF) was established in January 2004 and replaces the Market Trading Forum (MTF). The SSJF focuses more broadly on stationary source issues throughout the WRAP and their relationship to Section 308 SIP requirements. Major topics for the SSJF include BART, reasonable progress for stationary sources, technical analyses, and

evaluating the effect of and integration with other regulatory and legislative developments at the national level.

- Technical Analysis Forum

The TAF coordinates and manages the processing, display, delivery, and explanation of technical data for regional haze planning activities. The TAF assumes responsibility for combining the participants and maintaining the activities and ongoing projects of the Ambient Air Monitoring & Reporting Forum, the Air Quality Modeling Forum, and the Attribution of Haze Workgroup.

13.4 WRAP TSS

The primary purpose of the TSS is to provide key summary analytical results and methods documentation for the required technical elements of the Regional Haze Rule, to support the preparation, completion, evaluation, and implementation of the Regional Haze Implementation Plans to improve visibility in Class I areas. The TSS provides technical results prepared using a regional approach, to include summaries and analysis of the comprehensive datasets used to identify the sources and regions contributing to regional haze in the Western Regional Air Partnership (WRAP) region.

The secondary purpose of the TSS is to be the one-stop-shop for access, visualization, analysis, and retrieval of the technical data and regional analytical results prepared by WRAP Forums and Workgroups in support of regional haze planning in the West. The TSS specifically summarizes results and consolidates information about air quality monitoring, meteorological and receptor modeling data analyses, emissions inventories and models, and gridded air quality/visibility regional modeling simulations. These copious and diverse data are integrated for application to air quality planning purposes by prioritizing and refining key information and results into explanatory tools. A detailed description of the TSS website, "WRAP Technical Support System Web Site Description (November 16, 2009 Draft)", can be found in Chapter 13 of the Wyoming TSD.

13.5 IMPROVE Monitoring

13.5.1 Background on IMPROVE Monitoring

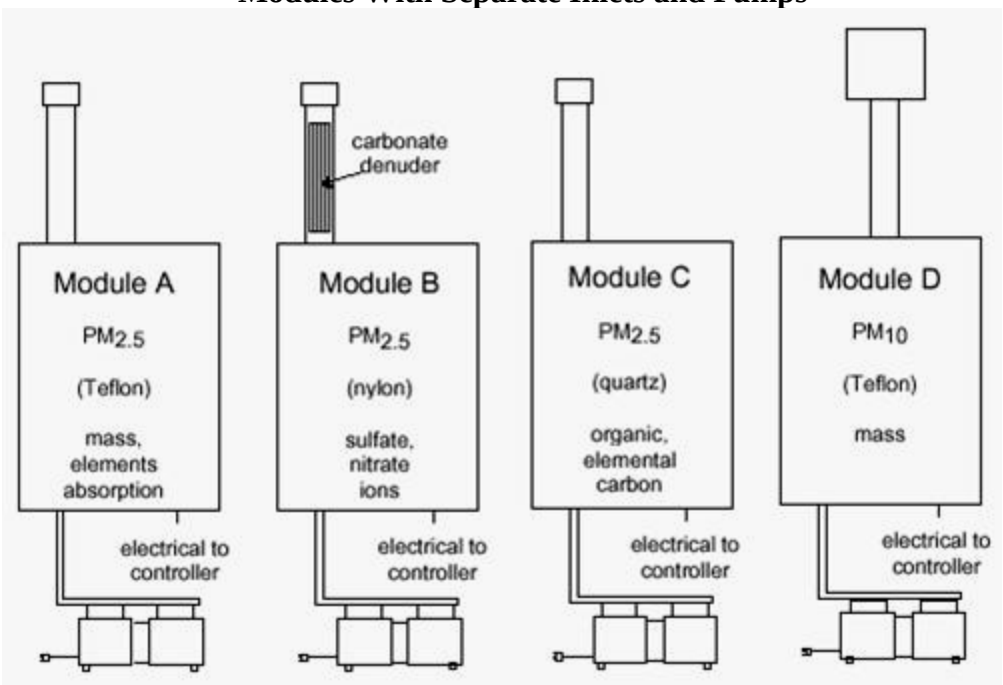
The Interagency Monitoring of Protected Visual Environments (IMPROVE) program is a cooperative measurement effort governed by a steering committee composed of representatives from Federal and regional-state organizations. The IMPROVE monitoring program was established in 1985 to aid the creation of Federal and State Implementation Plans for the protection of visibility in Class I areas (156 national parks and wilderness areas) as stipulated in the 1977 amendments to the Clean Air Act.

The objectives of IMPROVE are: (1) to establish current visibility and aerosol conditions in mandatory Class I areas; (2) to identify chemical species and emission sources responsible for existing man-made visibility impairment; (3) to document long-term trends for assessing progress towards the national visibility goal; (4) and with the enactment of the Regional Haze

Rule, to provide regional haze monitoring representing all visibility-protected Federal Class I areas where practical. IMPROVE has also been a key participant in visibility-related research, including the advancement of monitoring instrumentation, analysis techniques, visibility modeling, policy formulation and source attribution field studies.

An IMPROVE sampler, depicted below, consists of four separate modules used for collecting the various pollutant species.

Figure 13.5.1-1. Schematic of the IMPROVE Sampler Showing the Four Modules With Separate Inlets and Pumps



(http://vista.cira.colostate.edu/improve/Overview/IMPROVEProgram_files/frame.htm)

The IMPROVE monitoring network consists of aerosol and optical samplers. The network began operating in 1988 with 20 monitoring sites in Class I areas. By 1999 the network expanded to 30 monitoring sites in Class I areas and 40 sites using IMPROVE site and sampling protocols operated by Federal and State agencies. With the enactment of the Regional Haze Rules the IMPROVE network has been expanded by 80 new sites. Photographs of Wyoming Class I area IMPROVE monitoring sites are provided in Chapter 2.

13.6 Formula for Reconstructed Light Extinction

The IMPROVE program has developed methods for estimating light extinction from speciated aerosol and relative humidity data. The three most common metrics used to describe visibility impairment are:

- **Extinction (b_{ext}) -** Extinction is a measure of the fraction of light lost per unit length along a sight path due to scattering and absorption by gases and particles, expressed in inverse Megameters (Mm^{-1}). This metric is useful for representing the contribution of

each aerosol species to visibility impairment and can be practically thought of as the units of light lost in a million meter distance.

- **Visual Range (VR)** - Visual range is the greatest distance a large black object can be seen on the horizon, expressed in kilometers (km) or miles (mi).

- **Deciview (dv)** - This is the metric used for tracking regional haze in the Regional Haze Rule. The deciview index was designed to be linear with respect to human perception of visibility. A one deciview change is approximately equivalent to a 10% change in extinction, whether visibility is good or poor. A one deciview change in visibility is generally considered to be the minimum change the average person can detect with the naked eye.

The IMPROVE network estimates light extinction based upon the measured mass of various contributing aerosol species. EPA's 2003 guidance for calculating light extinction is based on the original protocol defined by the IMPROVE program in 1988. (For further information, see http://vista.cira.colostate.edu/improve/Publications/GuidanceDocs/guidancedocs.htm.) In December 2005, the IMPROVE Steering Committee voted to adopt a revised algorithm for use by IMPROVE as an alternative to the original approach.

The revised algorithm for estimating light extinction is calculated as recommended for use by the IMPROVE steering committee using the following equations:

$$
\begin{aligned}
b_{ext} \approx\ & 2.2 \times f_s(RH) \times [\text{Small Amm. Sulfate}] + 4.8 \times f_L(RH) \times [\text{Large Amm. Sulfate}] \\
& + 2.4 \times f_s(RH) \times [\text{Small Amm. Nitrate}] + 5.1 \times f_L(RH) \times [\text{Large Amm. Nitrate}] \\
& + 2.8 \times [\text{Small POM}] + 6.1 \times [\text{Large POM}] \\
& + 10 \times [\text{EC}] \\
& + 1 \times [\text{Soil}] \\
& + 1.7 \times f_{ss}(RH) \times [\text{Sea Salt}] \\
& + 0.6 \times [\text{CM}] \\
& + 0.33 \times [NO_2(\text{ppb})] \\
& + \text{Rayleigh Scattering (Site Specific)}
\end{aligned}
$$

The revised algorithm splits ammonium sulfate, ammonium nitrate, and POM concentrations into small and large size fractions as follows:

$$
\text{For } [\text{Total}] < 20\mu g/m^3 \begin{cases} [\text{Large}] = \dfrac{[\text{Total}]}{20} \times [\text{Total}] \\ [\text{Small}] = [\text{Total}] - [\text{Large}] \end{cases}
$$

$$
\text{For } [\text{Total}] \geq 20\mu g/m^3, [\text{Large}] = [\text{Total}]
$$

13.7 Wyoming IMPROVE Monitoring Network

In Wyoming there are three IMPROVE monitors which are described in the table below. There are seven Class I areas in Wyoming; therefore, some monitors serve multiple Class I areas. Although it is desirable to have one monitor for each Class I area, in most cases one monitor is "representative" of haze conditions in nearby Class I areas. Locations and descriptions of the IMPROVE monitors were presented in Chapter 2.

Table 13.7-1. The Wyoming IMPROVE Monitoring Network

Site Code	Class I Area	Sponsor	Elevation (MSL)	Start Date
BRID1	Bridger Wilderness Fitzpatrick Wilderness	USFS	2627 m 8619 ft	3/2/1988
NOAB1	North Absaroka Wilderness Washakie Wilderness	USFS	2483 m 8146 ft	1/25/2000
YELL2	Grand Teton National Park Teton Wilderness Yellowstone National Park	NPS	2425 m 7956 ft	7/1/1996