6.0 STATE AND CLASS I AREA SUMMARIES

As described in Section 2.0, each state is required to submit progress reports at interim points between submittals of Regional Haze Rule (RHR) State Implementation Plans (SIPs), which assess progress towards visibility improvement goals in each state's mandatory Federal Class I areas (CIAs). Data summaries for each CIA in each Western Regional Air Partnership (WRAP) state, which address Regional Haze Rule (RHR) requirements for visibility measurements and emissions inventories are provided in this section. These summaries are intended to provide individual states with the technical information they need to determine if current RHR implementation plan elements and strategies are sufficient to meet all established reasonable progress goals, as defined in their respective initial RHR implementation plans.

6.15 WYOMING

The goal of the RHR is to ensure that visibility on the 20% most impaired, or worst, days continues to improve at each Federal Class I area (CIA), and that visibility on the 20% least impaired, or best, days does not get worse, as measured at representative Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring sites. Wyoming has 7 mandatory Federal CIAs, which are depicted in Figure 6.15-1 and listed in Table 6.15-1, along with the associated IMPROVE monitor locations.

This section addresses differences between the 2000-2004 baseline and 2005-2009 period, for both monitored data and emission inventory estimates. Monitored data are presented for the 20% most impaired, or worst, days and for the 20% least impaired, or best, days, as per Regional Haze Rule (RHR) requirements. Annual average trend statistics for the 2000-2009 10-year period are also presented here to support assessments of changes in each monitored species that contributes to visibility impairment. Some of the highlights regarding these comparisons are listed below, and more detailed state specific information is provided in monitoring and emissions sub-sections that follow.

- For both the best and worst days, the 5-year average deciview metric decreased at all Wyoming Federal CIA IMPROVE sites.
- All sites measured lower 5-year averages of ammonium nitrate. This was consistent with emission inventory comparison results that showed net decreases in NO_X emissions, with large decreases in mobile sources partially offset by smaller increases in point and area sources.
- Particulate organic mass was the largest contributor to aerosol extinction for the most impaired days at the Wyoming sites. The current period showed increases in particulate organic mass for the BRID1 and YELL2 sites, but not at the NOAB1 site. The year 2007 was a high fire impact year at these sites, but this year was incomplete for the NOAB1 site and not included in the average, which may have influenced decreases there.
- The 5-year averages showed slightly increased ammonium sulfate measurements for the worst days at the BRID1 and YELL2 sites, but neither site showed statistically significant increasing trends. Also, state totals for SO_2 emissions showed decreases for all categories except for a slight increase in area oil and gas emissions. For oil and gas sources, methodology differences that occurred between the development of the baseline and progress period inventories have likely influenced results, so inventory comparison results are not necessarily reflective of actual changes in emissions.
- Coarse mass decreased at BRID1 and YELL2, but increased at the NOAB1 site. Coarse mass emission inventories showed increases in fugitive and road dust, but the sites did not show any significant increasing annual trends in measured coarse mass. At the NOAB1 site, the higher 5-year average coarse mass was influenced by an anomalously high sample day in 2006.

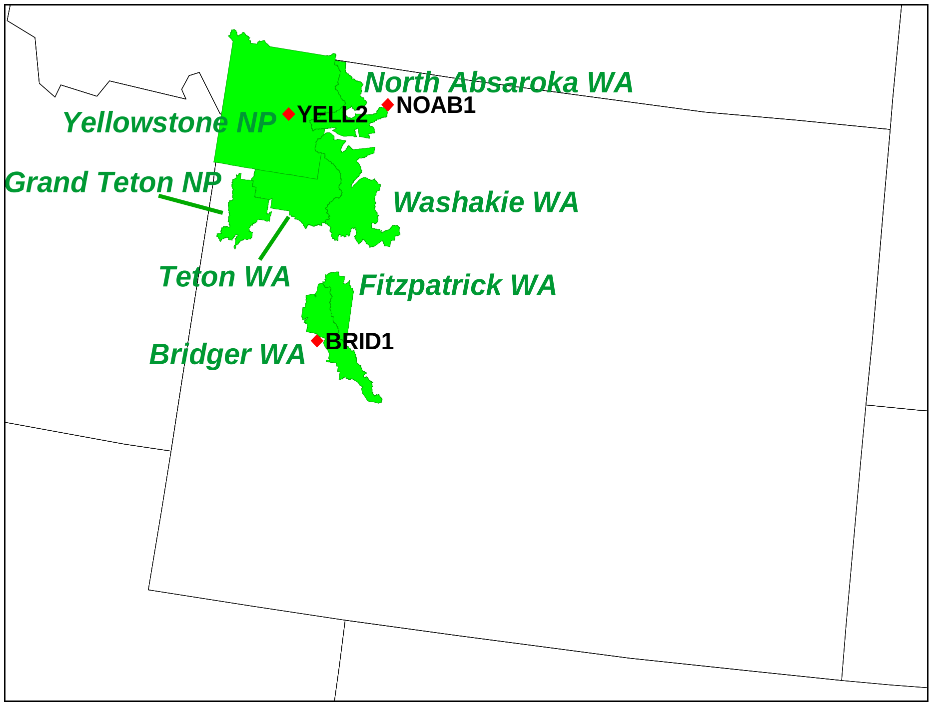

Figure 6.15-1. Map Depicting Federal CIAs and Representative IMPROVE Monitors in Wyoming.

Table 6.15-1
Wyoming CIAs and Representative IMPROVE Monitors

Class I Area	Representative IMPROVE Site	Latitude	Longitude	Elevation (m)
Bridger WA Fitzpatrick WA	BRID1	42.97	-109.76	2626
North Absaroka WA Washakie WA	NOAB1	44.74	-109.38	2482
Yellowstone NP Teton WA Grand Teton NP	YELL2	44.57	-110.40	2425

6.15.1 Monitoring Data

This section addresses RHR regulatory requirements for monitored data as measured by IMPROVE monitors representing Federal CIAs in Wyoming. These summaries are supported by regional data presented in Section 4.0 and by more detailed site specific tables and charts in Appendix M.

As described in Section 3.1, regional haze progress in Federal CIAs is tracked using calculations based on speciated aerosol mass as collected by IMPROVE monitors. The RHR calls for tracking haze in units of deciviews (dv), where the deciview metric was designed to be linearly associated with human perception of visibility. In a pristine atmosphere, the deciview metric is near zero, and a one deciview change is approximately equivalent to a 10% change in cumulative species extinction. To better understand visibility conditions, summaries here include both the deciview metric, and the apportionment of haze into extinction due to the various measured species in units of inverse megameters (Mm^{-1}).

6.15.1.1 Current Conditions

This section addresses the regulatory question, ***what are the current visibility conditions for the most impaired and least impaired days (40 CFR 51.309(d)(10)(i)(C))?*** RHR guidance specifies that 5-year averages be calculated over successive 5-year periods, i.e. 2000-2004, 2005-2009, 2010-2014, etc.[1] Current visibility conditions are represented here as the most recent successive 5-year average period available, or the 2005-2009 period average, although the most recent IMPROVE monitoring data currently available includes 2010 data.

Tables 6.15-2 and 6.15-3 present the calculated deciview values for current conditions at each site, along with the percent contribution to extinction from each aerosol species for the 20% most impaired, or worst, and 20% least impaired, or best, days for each of the Federal CIA IMPROVE monitors in Wyoming. Figure 6.15-2 presents 5-year average extinction for the current progress period for both the 20% most impaired and 20% least impaired days. Note that the percentages in the tables consider only the aerosol species which contribute to extinction, while the charts also show Rayleigh, or scattering due to background gases in the atmosphere.

Specific observations for the current visibility conditions on the 20% most impaired days are as follows:

- The largest contributors to aerosol extinction at Wyoming sites were particulate organic mass, ammonium sulfate and coarse mass.
- The highest aerosol extinction (11.5 dv) was measured at the YELL2 site, where particulate organic mass was the largest contributor to aerosol extinction, followed by ammonium sulfate and coarse mass. The lowest aerosol extinction (10.7 dv) was measured at the BRID1 site.

[1] EPA's September 2003 *Guidance for Tracking Progress Under the Regional Haze Rule* specifies that progress is tracked against the 2000-2004 baseline period using corresponding averages over successive 5-year periods, i.e. 2005-2009, 2010-2014, etc. (See page 4-2 in the Guidance document.)

Specific observations for the current visibility conditions on the 20% least impaired days are as follows:

- The aerosol contribution to total extinction on the best days was less than Rayleigh, or the background scattering that would occur in clear air. Average extinction (including Rayleigh) ranged from 1.2 dv (NOAB1) t 2.0 dv (YELL2).
- For all sites, ammonium sulfate was the largest non-Rayleigh contributor to the aerosol species of extinction

Table 6.15-2
Wyoming Class I Area IMPROVE Sites
Current Visibility Conditions
2005-2009 Progress Period, 20% Most Impaired Days

Site	**Deciviews (dv)**	**Percent Contribution to Aerosol Extinction by Species (Excludes Rayleigh) (% of Mm^{-1}) and Rank***						
		Ammonium Sulfate	**Ammonium Nitrate**	**Particulate Organic Mass**	**Elemental Carbon**	**Soil**	**Coarse Mass**	**Sea Salt**
BRID1	10.7	23% (2)	5% (5)	**49% (1)**	8% (4)	5% (6)	10% (3)	0% (7)
NOAB1	11.0	21% (2)	6% (5)	**45% (1)**	8% (4)	4% (6)	15% (3)	0% (7)
YELL2	11.5	17% (2)	6% (5)	**57% (1)**	8% (4)	3% (6)	9% (3)	0% (7)

*Highest aerosol species contribution per site is highlighted in bold.

Table 6.15-3
Wyoming Class I Area IMPROVE Sites
Current Visibility Conditions
2005-2009 Progress Period, 20% Least Impaired Days

Site	**Deciviews (dv)**	**Percent Contribution to Aerosol Extinction by Species (Excludes Rayleigh) (% of Mm^{-1}) and Rank**						
		Ammonium Sulfate	**Ammonium Nitrate**	**Particulate Organic Mass**	**Elemental Carbon**	**Soil**	**Coarse Mass**	**Sea Salt**
BRID1	1.5	**45% (1)**	13% (3)	23% (2)	8% (5)	3% (6)	8% (4)	1% (7)
NOAB1	1.2	**44% (1)**	10% (4)	16% (3)	7% (5)	4% (6)	18% (2)	0% (7)
YELL2	2.0	**42% (1)**	16% (3)	25% (2)	8% (4)	2% (6)	7% (5)	1% (7)

*Highest aerosol species contribution per site is highlighted in bold.

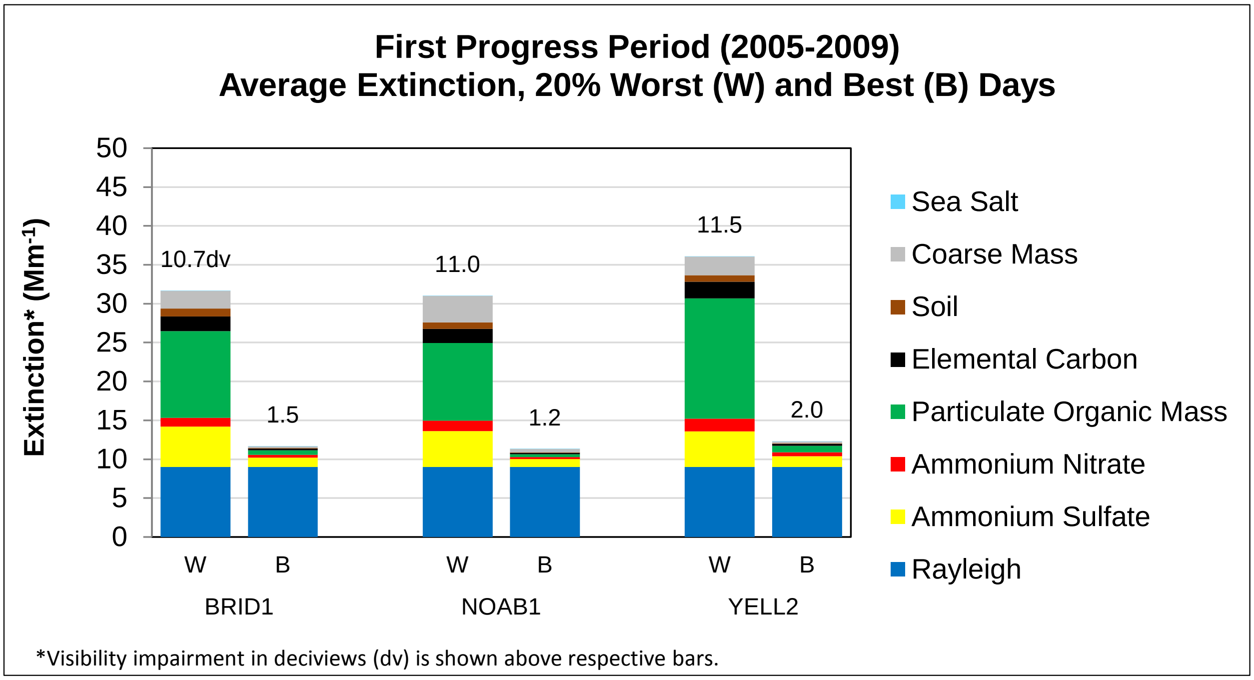

Figure 6.15-2. Average Extinction for Current Progress Period (2005-2009) for the Worst (Most Impaired) and Best (Least Impaired) Days Measured at Wyoming Class I Area IMPROVE Sites.

6.15.1.2 Differences between Current and Baseline Conditions

This section addresses the regulatory question, ***what is the difference between current visibility conditions for the most impaired and least impaired days and baseline visibility conditions (40 CFR 51.309(d)(10)(i)(C))?*** Included here are comparisons between the 5-year average baseline conditions (2000-2004) and current progress period extinction (2005-2009).

Table 6.15-4 presents the differences between the 2000-2004 baseline period average extinction and the 2005-2009 progress period average for each site in Wyoming for the 20% most impaired days, and Table 6.15-5 presents similar data for the least impaired days. Averages that increased are depicted in red text and averages that decreased in blue.

Figure 6.15-3 presents the 5-year average extinction for the baseline and current progress period averages for the worst days and Figure 6.15-4 presents the differences in averages by aerosol species, with increases represented above the zero line and decreases below the zero line. Figures 6.15-5 and 6.15-6 present similar plots for the best days.

For the 20% most impaired days, the 5-year average deciview metric decreased between the 2000-2004 and 2005-2009 periods at all three Wyoming sites. Notable differences for individual species averages were as follows:

- Ammonium nitrate averages decreased at all sites.

- Particulate organic mass and ammonium sulfate increased at the BRID1 and YELL2 sites, but decreased at the NOAB1 site.
- Coarse mass decreased at the BRID1 and YELL2 sites, but increased at the NOAB1 site.

For the 20% least impaired days, the 5-year average deciview metric decreased at all sites. Notable differences for individual species averages on the 20% least impaired days were as follows:

- Ammonium nitrate, ammonium sulfate, and particulate organic mass decreased at all sites.
- Elemental carbon decreased at the BRID1 and YELL2 sites, and coarse mass decreased at the NOAB1 site.

Table 6.15-4
Wyoming Class I Area IMPROVE Sites
Difference in Aerosol Extinction by Species
2000-2004 Baseline Period to 2005-2009 Progress Period
20% Most Impaired Days

Site	Deciview (dv)			Change in Extinction by Species (Mm^{-1})*						
	2000-04 Baseline Period	2005-09 Progress Period	Change in dv*	Amm. Sulfate	Amm. Nitrate	POM	EC	Soil	CM	Sea Salt
BRID1	11.1	10.7	-0.4	+0.2	-0.3	+0.6	-0.1	-0.1	-0.2	0.0
NOAB1	11.5	11.0	-0.5	-0.3	-0.3	-1.7	0.0	0.0	+0.5	0.0
YELL2	11.8	11.5	-0.3	+0.3	-0.1	+2.0	-0.3	-0.1	-0.2	0.0

*Change is calculated as progress period average minus baseline period average. Values in red indicate increases in extinction and values in blue indicate decreases.

Table 6.15-5
Wyoming Class I Area IMPROVE Sites
Difference in Aerosol Extinction by Species
2000-2004 Baseline Period to 2005-2009 Progress Period
20% Least Impaired Days

Site	Deciview (dv)			Change in Extinction by Species (Mm^{-1})*						
	2000-04 Baseline Period	2005-09 Progress Period	Change in dv*	Amm. Sulfate	Amm. Nitrate	POM	EC	Soil	CM	Sea Salt
BRID1	2.1	1.5	-0.6	-0.2	-0.1	-0.2	-0.2	0.0	0.0	0.0
NOAB1	2.0	1.2	-0.8	-0.1	-0.1	-0.4	0.0	0.0	-0.3	0.0
YELL2	2.6	2.0	-0.6	-0.1	-0.2	-0.3	-0.1	0.0	0.0	0.0

*Change is calculated as progress period average minus baseline period average. Values in red indicate increases in extinction and values in blue indicate decreases.

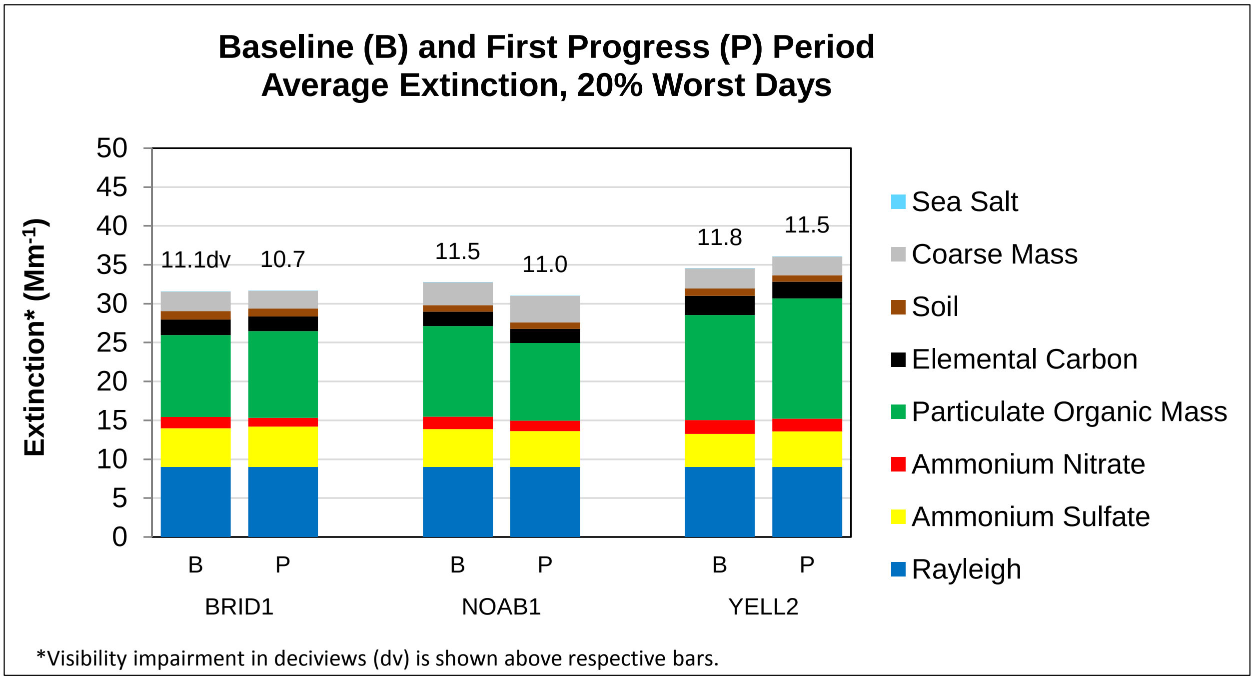

Figure 6.15-3. Average Extinction for Baseline and Progress Period Extinction for Worst (Most Impaired) Days Measured at Wyoming Class I Area IMPROVE Sites.

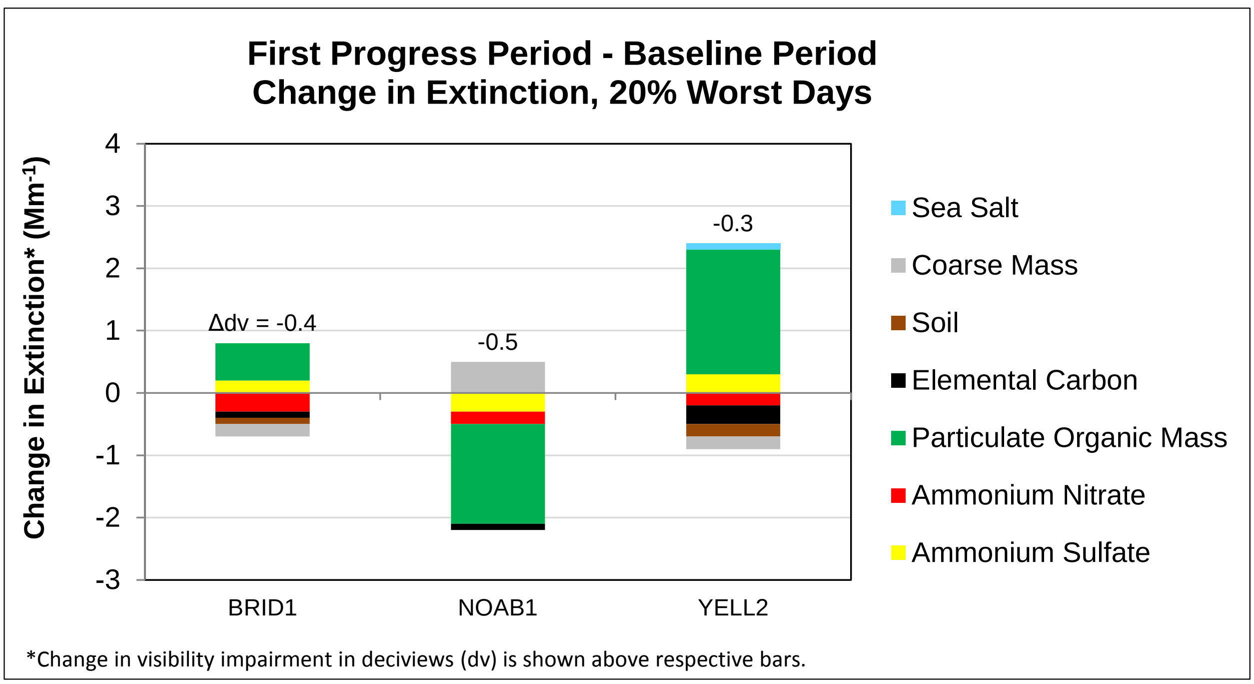

Figure 6.15-4. Difference Between Average Extinction for Current Progress Period (2005-2009) and Baseline Period (2000-2004) for the Worst (Most Impaired) Days Measured at Wyoming Class I Area IMPROVE Sites.

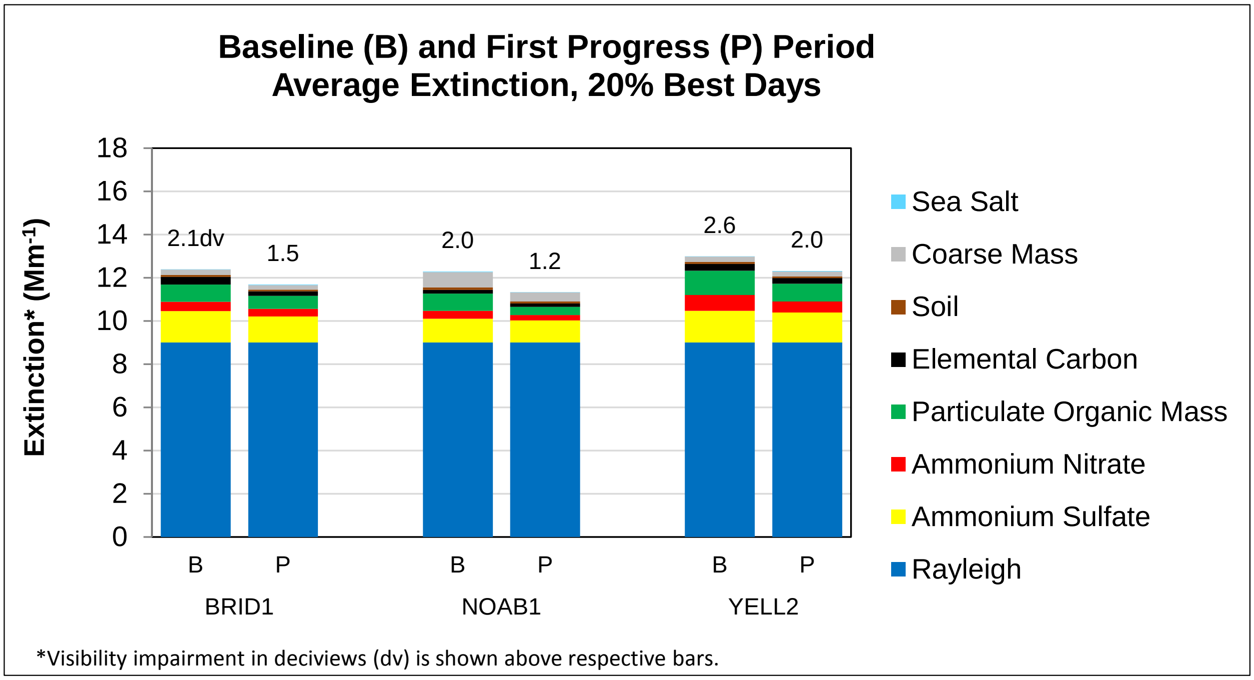

Figure 6.15-5. Average Extinction for Baseline and Progress Period Extinction for Best (Least Impaired) Days Measured at Wyoming Class I Area IMPROVE Sites.

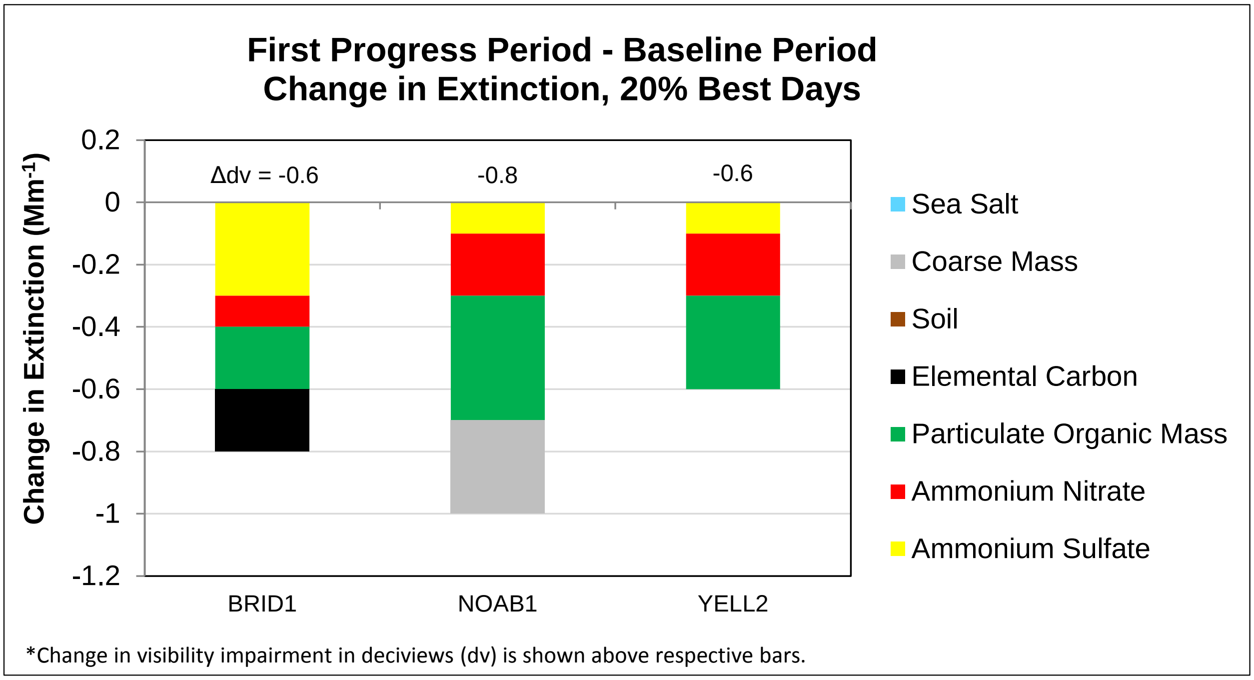

Figure 6.15-6. Difference between Average Extinction for Current Progress Period (2005-2009) and Baseline Period (2000-2004) for the Best (Least Impaired) Days Measured at Wyoming Class I Area IMPROVE Sites.

6.15.1.3 Changes in Visibility Impairment

This section addresses the regulatory question, ***what is the change in visibility impairment for the most impaired and least impaired days over the past 5 years (40 CFR 51.309(d)(10)(i)(C))?*** Included here are changes in visibility impairment as characterized by annual average trend statistics, and some general observations regarding local and regional events and outliers on a daily and annual basis that affected the current 5-year progress period. The regulatory requirement asks for a description of changes over the past 5-year period, but trend analysis is better suited to longer periods of time, so trends for the entire 10-year planning period are presented here.

Trend statistics for the years 2000-2009 for each species at each site in Wyoming are summarized in Table 6.15-6, and regional trends were presented earlier in Section 4.1.1.[2] Only trends for aerosol species trends with p-value statistics less than 0.15 (85% confidence level) are presented in the table here, with increasing slopes in red and decreasing slopes in blue.[3] In some cases, trends may show decreasing tendencies while the difference between the 5-year averages do not (or vice versa), as discussed in Section 3.1.2.2. In these cases, the 5-year average for the best and worst days is the important metric for RHR regulatory purposes, but trend statistics may be of value to understand and address visibility impairment issues for planning purposes.

For each site, a more comprehensive list of all trends for all species, including the associated p-values, is provided in Appendix O. Additionally, the appendix includes plots depicting 5-year, annual, monthly and daily average extinction for each site. These plots are intended to provide a fairly comprehensive compilation of reference information for individual states to investigate local and regional events and outliers that may have influenced changes in visibility impairment as tracked using the 5-year deciview metrics. Note that similar summary products are also available from the WRAP TSS website (http://vista.cira.colostate.edu/tss/). Some general observations regarding changes in visibility impairment at sites in Wyoming are as follows:

- Particulate organic mass was the largest contributor to aerosol extinction for the worst days at all sites, and the largest events generally occurred between June and September, consistent with wildland fire activity.
- The NOAB1 site showed a decrease in 5-year average particulate organic mass on the worst days, while the YELL2 and BRID1 sites showed an increase. This may be due to the fact that 2007 and 2009 were incomplete years and not included in the NOAB1

[2] Annual trends were calculated for the years 2000-2009, with a trend defined as the slope derived using Theil statistics. Trends derived from Theil statistics are useful in analyzing changes in air quality data because these statistics can show the overall tendency of measurements over long periods of time, while minimizing the effects of year-to-year fluctuations which are common in air quality data. Theil statistics are also used in EPA's National Air EPA's National Air Quality Trends Reports (http://www.epa.gov/airtrends/) and the IMPROVE program trend reports (http://vista.cira.colostate.edu/improve/Publications/improve_reports.htm)

[3] The significance of the trend is represented with p-values calculated using Mann-Kendall trend statistics. Determining a significance level helps to distinguish random variability in data from a real tendency to increase or decrease over time, where lower p-values indicate higher confidence levels in the computed slopes.

averages. The daily data that were collected for NOAB1 indicated that 2007 was one of the highest particulate organic mass years measured at the site.

- Trend statistics did not indicate any increasing annual trends for any of the aerosol species. Slightly decreasing annual trends were measured for the best days for ammonium sulfate at the BRID1 site, particulate organic mass at all sites, and coarse mass at the NOAB1 site.
- The NOAB1 site indicated a slight increase in 5-year average coarse mass for the 20% worst days. The higher coarse mass average was influenced by a relatively high coarse mass measurements on October 29, 2006.

Table 6.15-6
Wyoming Class I Area IMPROVE Sites
Change in Aerosol Extinction by Species
2000-2009 Annual Average Trends

Site	Group	Annual Trend* (Mm^{-1}/year)						
		Ammonium Sulfate	Ammonium Nitrate	Particulate Organic Mass	Elemental Carbon	Soil	Coarse Mass	Sea Salt
BRID1	20% Best	-0.1	--	-0.1	0.0	0.0	0.0	--
	20% Worst	--	--	--	0.0	--	--	0.0
	All Days	--	0.0	--	0.0	--	0.0	0.0
NOAB1	20% Best	--	0.0	-0.1	--	0.0	-0.1	--
	20% Worst	--	--	--	--	--	--	0.0
	All Days	--	0.0	--	--	0.0	--	--
YELL2	20% Best	--	0.0	-0.1	--	0.0	--	0.0
	20% Worst	--	--	--	--	--	0.0	0.0
	All Days	--	--	--	0.0	--	--	0.0

*(--) Indicates statistically insignificant trend (<85% confidence level). Annual averages and complete trend statistics for all significance levels are included for each site in Appendix O.

6.15.2 Emissions Data

Included here are summaries depicting differences between two emission inventory years that are used to represent the 5-year baseline and current progress periods. The baseline period is represented using a 2002 inventory developed by the WRAP for use in the initial WRAP state SIPs, and the progress period is represented by a 2008 inventory which leverages recent WRAP inventory work for modeling efforts, as referenced in Section 3.2.1. For reference, Table 6.15-7 lists the major emitted pollutants inventoried, the related aerosol species, some of the major sources for each pollutant, and some notes regarding implications of these pollutants. Differences between these baseline and progress period inventories, and a separate summary of annual emissions from electrical generating units (EGUs), are presented in this section.

Table 6.15-7
Wyoming
Pollutants, Aerosol Species, and Major Sources

Emitted Pollutant	Related Aerosol	Major Sources	Notes
Sulfur Dioxide (SO_2)	Ammonium Sulfate	Point Sources; On- and Off-Road Mobile Sources	SO_2 emissions are generally associated with anthropogenic sources such as coal-burning power plants, other industrial sources such and refineries and cement plants, and both on- and off-road diesel engines.
Oxides of Nitrogen (NO_X)	Ammonium Nitrate	On- and Off-Road Mobile Sources; Point Sources; Area Sources	NO_X emissions are generally associated with anthropogenic sources. Common sources include virtually all combustion activities, especially those involving cars, trucks, power plants, and other industrial processes.
Ammonia (NH_3)	Ammonium Sulfate and Ammonium Nitrate	Area Sources; On-Road Mobile Sources	Gaseous NH_3 has implications in particle formation because it can form particulate ammonium. Ammonium is not directly measured by the IMPROVE program, but affects formation potential of ammonium sulfate and ammonium nitrate. All measured nitrate and sulfate is assumed to be associated with ammonium for IMPROVE reporting purposes.
Volatile Organic Compounds (VOCs)	Particulate Organic Mass (POM)	Biogenic Emissions; Vehicle Emissions; Area Sources	VOCs are gaseous emissions of carbon compounds, which are often converted to POM through chemical reactions in the atmosphere. Estimates for biogenic emissions of VOCs have undergone significant updates since 2002, so changes reported here are more reflective of methodology changes than actual changes in emissions (see Section 3.2.1).
Primary Organic Aerosol (POA)	POM	Wildfires; Area Sources	POA represents organic aerosols that are emitted directly as particles, as opposed to gases. Wildfires in the west generally dominate POA emissions, and large wildfire events are generally sporadic and highly variable from year-to-year.
Elemental Carbon (EC)	EC	Wildfires; On- and Off-Road Mobile Sources	Large EC events are often associated with large POM events during wildfires. Other sources include both on- and off-road diesel engines.
Fine Soil	Soil	Windblown Dust; Fugitive Dust; Road Dust; Area Sources	Fine soil is reported here as the crustal or soil components of $PM_{2.5}$.
Coarse Mass (PMC)	Coarse Mass	Windblown Dust; Fugitive Dust	Coarse mass is reported by the IMPROVE Network as the difference between PM_{10} and $PM_{2.5}$ mass measurements. Coarse mass is not separated by species in the same way that $PM_{2.5}$ is speciated, but these measurements are generally associated with crustal components. Similar to crustal $PM_{2.5}$, natural windblown dust is often the largest contributor to PMC.

6.15.2.1 Changes in Emissions

This section addresses the regulatory question, ***what is the change over the past 5 years in emissions of pollutants contributing to visibility impairment from all sources and activities within the State (40 CFR 51.309(d)(10)(i)(D))?*** For these summaries, emissions during the baseline years are represented using a 2002 inventory, which was developed with support from the WRAP for use in the original RHR SIP strategy development (termed plan02d). Differences between inventories are represented as the difference between the 2002 inventory, and a 2008 inventory which leverages recent inventory development work performed by the WRAP for the WestJumpAQMS and DEASCO$_3$ modeling projects (termed WestJump2008). Note that the comparisons of differences between inventories does not necessarily reflect a change in emissions, as a number of methodology changes and enhancements have occurred between development of the individual inventories, as referenced in Section 3.2.1. Inventories for all major visibility impairing pollutants are presented for major source categories, and categorized as either anthropogenic or natural emissions. State-wide inventories totals and differences are presented here, and inventory totals on a county level basis are available on the WRAP Technical Support System website (http://vista.cira.colostate.edu/tss/).

Table 6.15-8 and Figure 6.15-7 present the differences between the 2002 and 2008 sulfur dioxide (SO_2) inventories by source category. Tables 6.15-9 and Figure 6.15-8 present data for oxides of nitrogen (NO_X), and subsequent tables and figures (Tables 6.15-10 through 6.15-15 and Figures 6.15-9 through 6.15-14) present data for ammonia (NH_3), volatile organic compounds (VOCs), primary organic aerosol (POA), elemental carbon (EC), fine soil, and coarse mass. General observations regarding emissions inventory comparisons are listed below.

- Largest differences for point source inventories were decreases in SO_2, fine soil and coarse mass and increases in NO_X and VOCs.
- Area source inventories showed decreases in SO_2 NH_3, and VOCs and increases in NO_X. These changes may be due to a combination of population changes and differences in methodologies used to estimate these emissions, as referenced in Section 3.2.1. One methodology change was the reclassification of some off-road mobile sources (such as some types of marine vessels and locomotives) into the area source category in 2008, which may have contributed to increases in area source inventory totals, but decreases in off-road mobile totals.
- On-road mobile source inventory comparisons showed decreases in most parameters, especially NO_X and VOCs, with slight increases in POA, EC, and coarse mass. Reductions in NO_X and VOC are likely influenced by federal and state emissions standards that have already been implemented. The increases in POA, EC, and coarse mass occurred in all of the WRAP states for on-road mobile inventories, regardless of reductions in NO_X and VOCs, indicating that these increases were likely due use of different on-road models, as referenced in Section 3.2.1.
- Off-road mobile source inventories showed decreases in NO_X, SO_2, and VOCs, and increases in fine soil and coarse mass, which was consistent with most contiguous WRAP states. These differences were likely due to a combination of actual changes in source contributions and methodology differences, as referenced in Section 3.2.1.

As noted previously, one major methodology difference was the reclassification of some off-road mobile sources (such as some types of marine vessels and locomotives) into the area source category in 2008, which may have contributed to decreases in the off-road inventory totals, but increases in area source totals.

- Inventory comparison results for area oil and gas sources showed an increase in NO_X and a decrease in VOCs, but note that inventory methodologies for these sources may have evolved substantially between the baseline and 2008 inventories as referenced in Section 3.2.1.
- For most parameters, especially POAs, VOCs, and EC, natural fire emission inventory estimates decreased (except for an increase in fine soil), and anthropogenic fire estimates increased (except for a slight decrease in VOCs). Note that these differences are not necessarily reflective of changes in monitored data, as the baseline period is represented by an average of 2000-2004 fire emissions, and the progress period is represented only by the fires that occurred in 2008, as referenced in Section 3.2.1. Also, methodology differences likely contributed to fine soil (for natural fire) and VOCs (for anthropogenic fire) not tracking with the other parameters.
- Comparisons between VOC inventories showed large decreases in biogenic emissions, which was consistent with other contiguous WRAP states. Estimates for biogenic emissions of VOCs have undergone significant updates since 2002, so changes reported here are more reflective of methodology changes than actual changes in emissions, as referenced in Section 3.2.1.
- Fine soil and coarse mass increased for the fugitive/road dust inventories. These changes may be due to a combination of population changes and differences in methodologies used to estimate these emissions, as referenced in Section 3.2.1.

Table 6.15-8

Wyoming
Sulfur Dioxide Emissions by Category

Source Category	Sulfur Dioxide Emissions (tons/year)		
	2002 (Plan02d)	2008 (WestJump2008)	Difference (Percent Change)
Anthropogenic Sources			
Point	119,717	108,729	-10,988
Area	16,689	501	-16,188
On-Road Mobile	959	190	-768
Off-Road Mobile	5,866	95	-5,771
Area Oil and Gas	150	1,822	1,672
Fugitive and Road Dust	0	0	0
Anthropogenic Fire	173	266	93
Total Anthropogenic	**143,554**	**111,604**	**-31,950 (-22%)**
Natural Sources			
Natural Fire	2,286	1,051	-1,235
Biogenic	0	0	0
Wind Blown Dust	0	0	0
Total Natural	**2,286**	**1,051**	**-1,235 (-54%)**
All Sources			
Total Emissions	**145,840**	**112,655**	**-33,186 (-23%)**

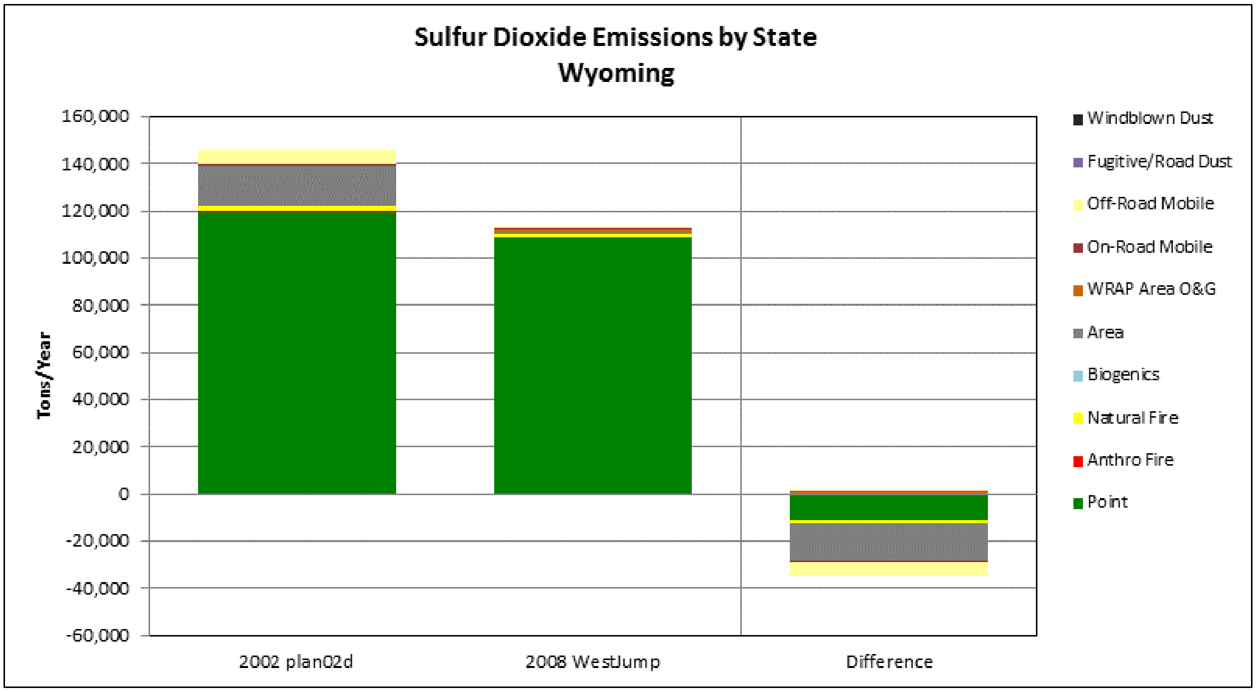

Figure 6.15-7. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Sulfur Dioxide by Source Category for Wyoming.

Table 6.15-9
Wyoming
Oxides of Nitrogen Emissions by Category

Source Category	Oxides of Nitrogen Emissions (tons/year)		
	2002 (Plan02d)	2008 (WestJump2008)	Difference (Percent Change)
Anthropogenic Sources			
Point	117,806	122,169	4,362
Area	15,192	37,685	22,493
On-Road Mobile	38,535	27,211	-11,324
Off-Road Mobile	76,637	4,848	-71,789
Area Oil and Gas	14,725	22,526	7,801
Fugitive and Road Dust	0	0	0
Anthropogenic Fire	782	1,883	1,101
Total Anthropogenic	**263,677**	**216,321**	**-47,356 (-18%)**
Natural Sources			
Natural Fire	8,372	7,429	-943
Biogenic	15,925	6,928	-8,997
Wind Blown Dust	0	0	0
Total Natural	**24,297**	**14,357**	**-9,940 (-41%)**
All Sources			
Total Emissions	**287,974**	**230,678**	**-57,296 (-20%)**

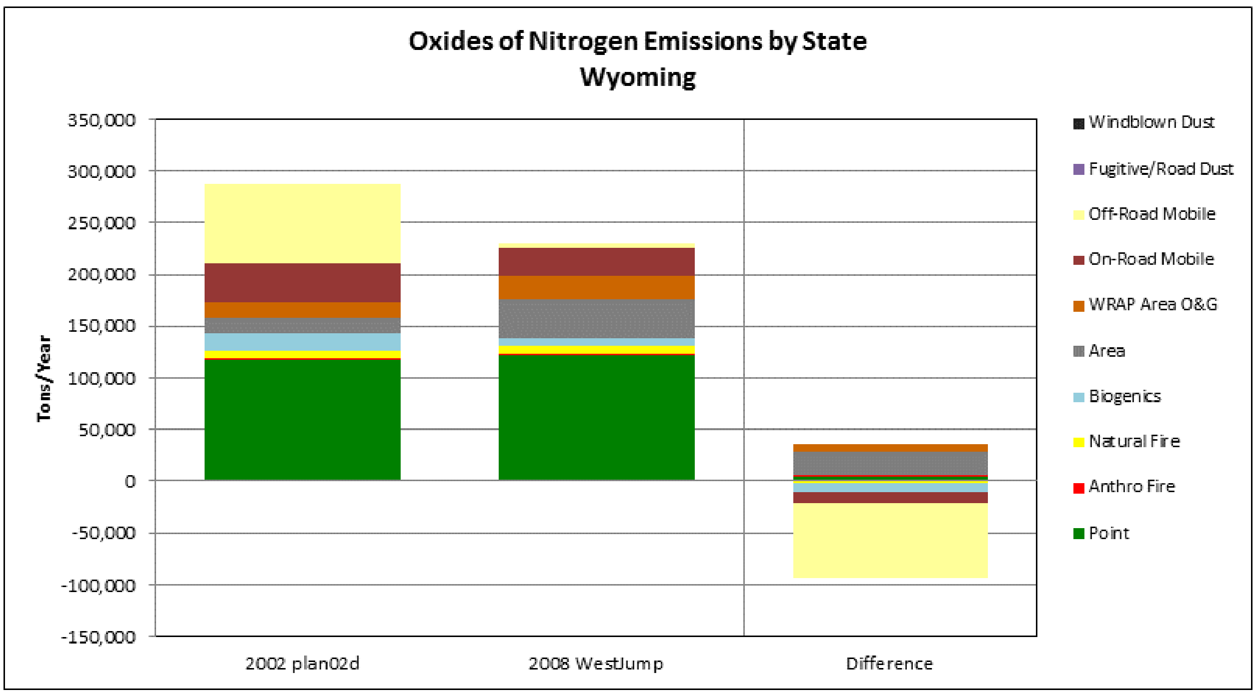

Figure 6.15-8. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Oxides of nitrogen by Source Category for Wyoming.

Table 6.15-10
Wyoming
Ammonia Emissions by Category

Source Category	Ammonia Emissions (tons/year)		
	2002 (Plan02d)	**2008 (WestJump2008)**	**Difference (Percent Change)**
Anthropogenic Sources			
Point	685	717	32
Area	29,776	19,446	-10,330
On-Road Mobile	538	374	-164
Off-Road Mobile	41	6	-35
Area Oil and Gas	0	0	0
Fugitive and Road Dust	0	0	0
Anthropogenic Fire	218	1,306	1,088
Total Anthropogenic	**31,257**	**21,848**	**-9,409 (-30%)**
Natural Sources			
Natural Fire	1,775	5,177	3,402
Biogenic	0	0	0
Wind Blown Dust	0	0	0
Total Natural	**1,775**	**5,177**	**3,402 (>100%)**
All Sources			
Total Emissions	**33,032**	**27,024**	**-6,007 (-18%)**

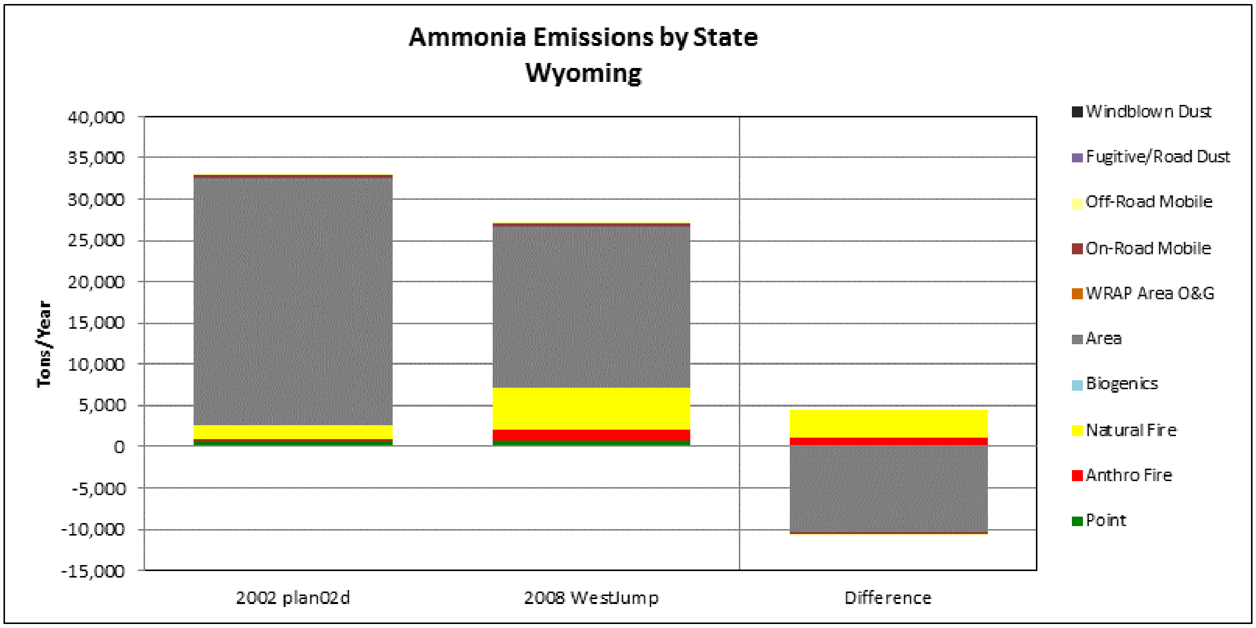

Figure 6.15-9. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Ammonia by Source Category for Wyoming.

Table 6.15-11
Wyoming
Volatile Organic Compound Emissions by Category

Source Category	Volatile Organic Compound Emissions (tons/year)		
	2002 (Plan02d)	**2008 (WestJump2008)**	**Difference (Percent Change)**
Anthropogenic Sources			
Point	19,602	20,765	1,163
Area	24,310	11,719	-12,591
On-Road Mobile	14,252	10,760	-3,491
Off-Road Mobile	13,805	9,081	-4,725
Area Oil and Gas	119,447	103,208	-16,239
Fugitive and Road Dust	0	0	0
Anthropogenic Fire	1,742	1,600	-142
Total Anthropogenic	**193,158**	**157,134**	**-36,024 (-19%)**
Natural Sources			
Natural Fire	18,376	5,357	-13,018
Biogenic	605,371	177,044	-428,328
Wind Blown Dust			
Total Natural	**623,747**	**182,401**	**-441,346 (-71%)**
All Sources			
Total Emissions	**816,904**	**339,534**	**-477,370 (-58%)**

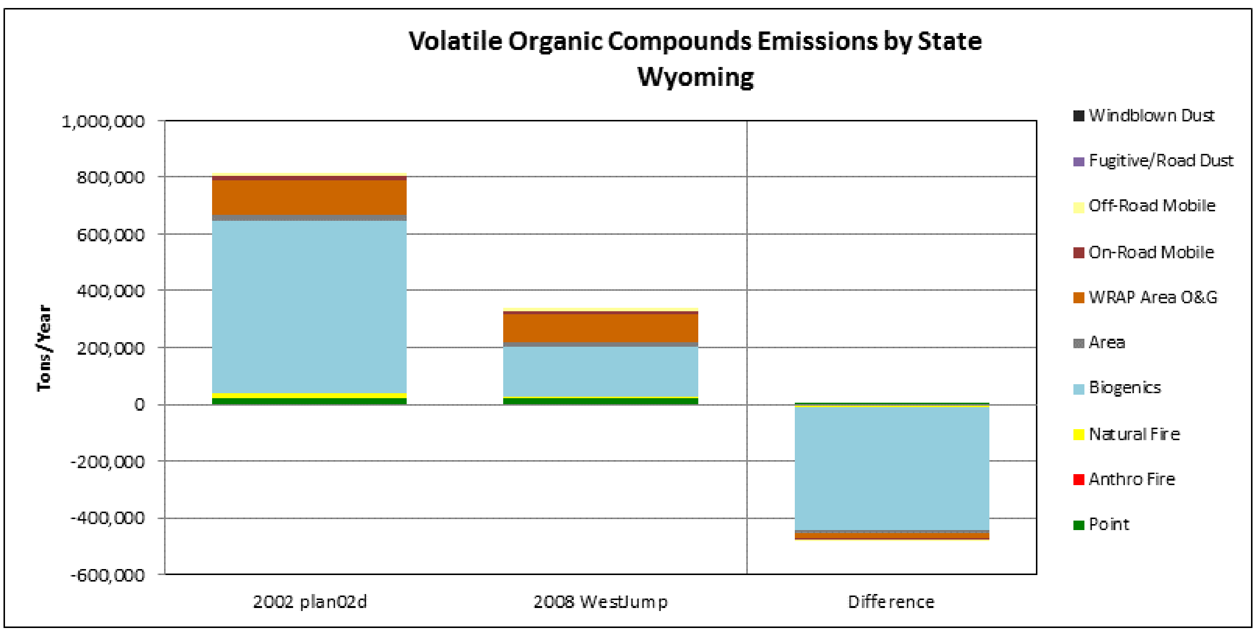

Figure 6.15-10. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Volatile Organic Compounds by Source Category for Wyoming.

Table 6.15-12
Wyoming
Primary Organic Aerosol Emissions by Category

Source Category	Primary Organic Aerosol Emissions (tons/year)		
	2002 (Plan02d)	2008 (WestJump2008)	Difference (Percent Change)
Anthropogenic Sources			
Point*	646	647	1
Area	2,000	1,107	-893
On-Road Mobile	304	698	394
Off-Road Mobile	625	246	-378
Area Oil and Gas	0	51	51
Fugitive and Road Dust	117	1,551	1,434
Anthropogenic Fire	1,709	4,386	2,677
Total Anthropogenic	**5,401**	**8,686**	**3,285 (61%)**
Natural Sources			
Natural Fire	23,793	16,341	-7,452
Biogenic	0	0	0
Wind Blown Dust	0	0	0
Total Natural	**23,793**	**16,341**	**-7,452 (-31%)**
All Sources			
Total Emissions	**29,194**	**25,027**	**-4,167 (-14%)**

*Point source data includes only oil and gas and regulated CEM sources. More comprehensive point source data were not available at the time this report was prepared but will be made available through the WRAP TSS (http://vista.cira.colostate.edu/tss/).

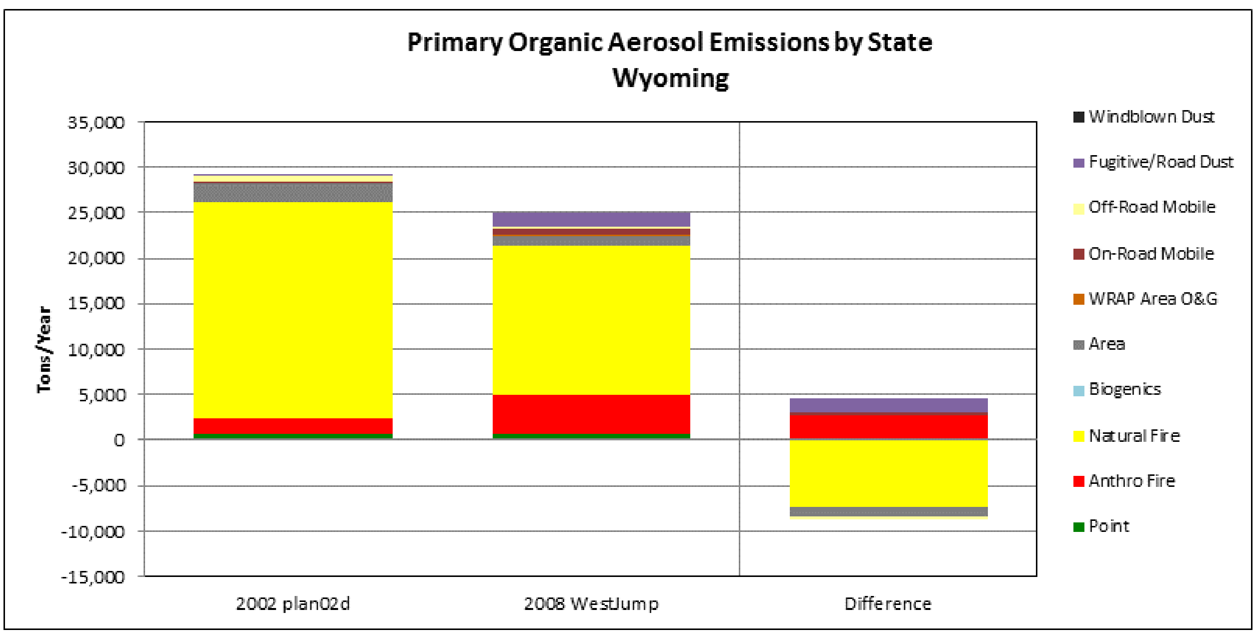

Figure 6.15-11. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Primary Organic Aerosol by Source Category for Wyoming.

Table 6.15-13
Wyoming
Elemental Carbon Emissions by Category

Source Category	Elemental Carbon Emissions (tons/year)		
	2002 (Plan02d)	2008 (WestJump2008)	Difference (Percent Change)
Anthropogenic Sources			
Point*	104	492	388
Area	304	991	687
On-Road Mobile	443	1,226	783
Off-Road Mobile	1,986	284	-1,703
Area Oil and Gas	0	0	0
Fugitive and Road Dust	8	31	22
Anthropogenic Fire	298	749	451
Total Anthropogenic	**3,144**	**3,772**	**628 (20%)**
Natural Sources			
Natural Fire	4,922	2,333	-2,589
Biogenic	0	0	0
Wind Blown Dust	0	0	0
Total Natural	**4,922**	**2,333**	**-2,589 (-53%)**
All Sources			
Total Emissions	**8,066**	**6,105**	**-1,961 (-24%)**

*Point source data includes only oil and gas and regulated CEM sources. More comprehensive point source data were not available at the time this report was prepared but will be made available through the WRAP TSS (http://vista.cira.colostate.edu/tss/).

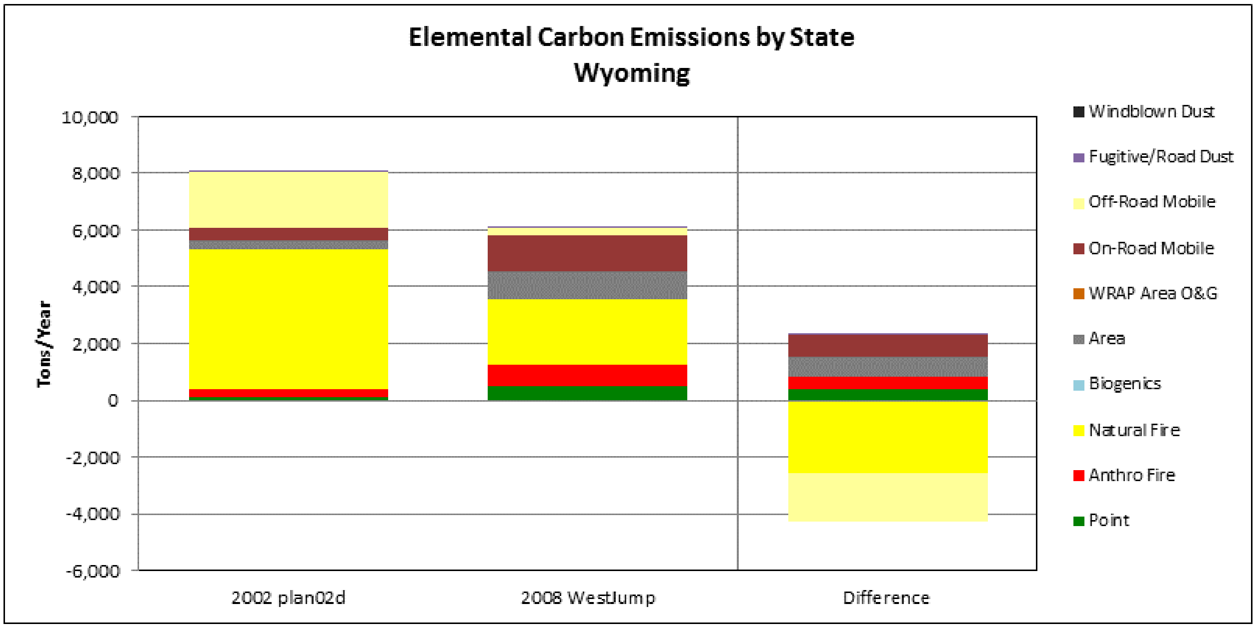

Figure 6.15-12. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Elemental Carbon by Source Category for Wyoming.

Table 6.15-14
Wyoming
Fine Soil Emissions by Category

Source Category	Fine Soil Emissions (tons/year)		
	2002 (Plan02d)	**2008 (WestJump2008)**	**Difference (Percent Change)**
Anthropogenic Sources			
Point*	11,375	5,503	-5,871
Area	1,601	467	-1,133
On-Road Mobile	187	103	-84
Off-Road Mobile	0	17	17
Area Oil and Gas	0	791	791
Fugitive and Road Dust	2,241	35,883	33,642
Anthropogenic Fire	242	1,616	1,374
Total Anthropogenic	**15,646**	**44,382**	**28,736 (>100%)**
Natural Sources			
Natural Fire	1,535	5,947	4,411
Biogenic	0	0	0
Wind Blown Dust	5,838	5,631	-208
Total Natural	**7,374**	**11,577**	**4,204 (57%)**
All Sources			
Total Emissions	**23,020**	**55,959**	**32,940 (>100%)**

*Point source data includes only oil and gas and regulated CEM sources. More comprehensive point source data were not available at the time this report was prepared but will be made available through the WRAP TSS (http://vista.cira.colostate.edu/tss/).

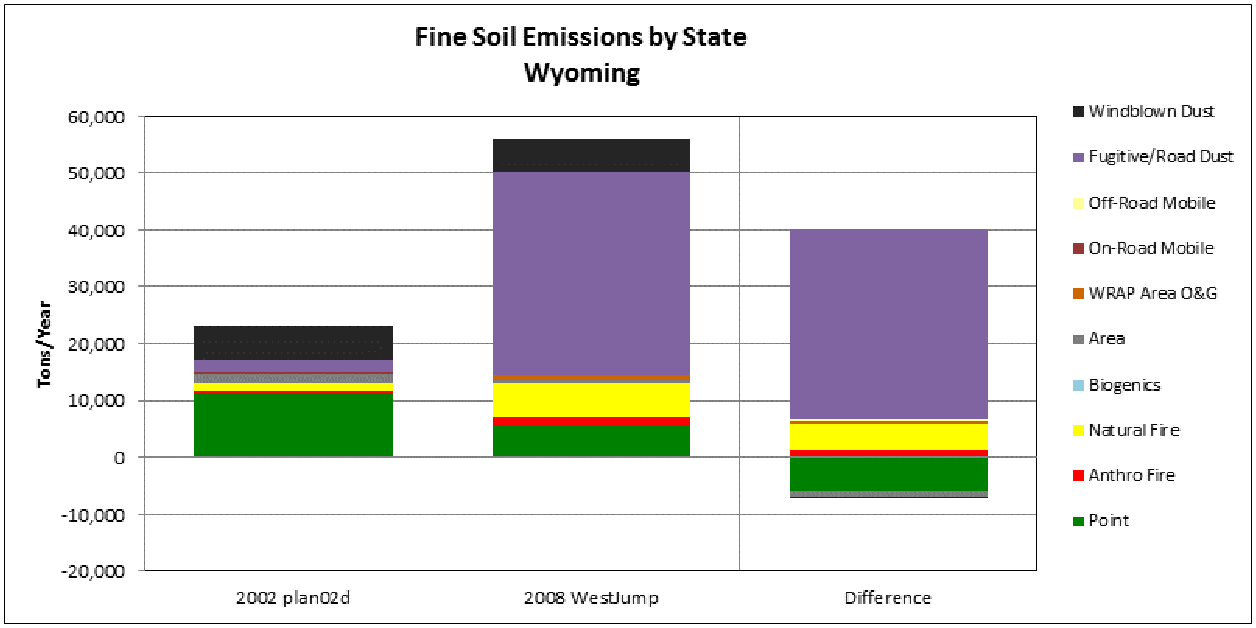

Figure 6.15-13. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Fine Soil by Source Category for Wyoming.

Table 6.15-15
Wyoming
Coarse Mass Emissions by Category

Source Category	Coarse Mass Emissions (tons/year)		
	2002 (Plan02d)	2008 (WestJump2008)	Difference (Percent Change)
Anthropogenic Sources			
Point*	24,751	12,872	-11,878
Area	409	203	-206
On-Road Mobile	171	1,251	1,080
Off-Road Mobile	0	29	29
Area Oil and Gas	0	9	9
Fugitive and Road Dust	19,155	297,663	278,508
Anthropogenic Fire	259	840	581
Total Anthropogenic	**44,745**	**312,867**	**268,122 (>100%)**
Natural Sources			
Natural Fire	5,369	3,131	-2,238
Biogenic	0	0	0
Wind Blown Dust	52,546	50,675	-1,870
Total Natural	**57,915**	**53,806**	**-4,108 (-7%)**
All Sources			
Total Emissions	**102,660**	**366,673**	**264,014 (>100%)**

*Point source data includes only oil and gas and regulated CEM sources. More comprehensive point source data were not available at the time this report was prepared but will be made available through the WRAP TSS (http://vista.cira.colostate.edu/tss/).

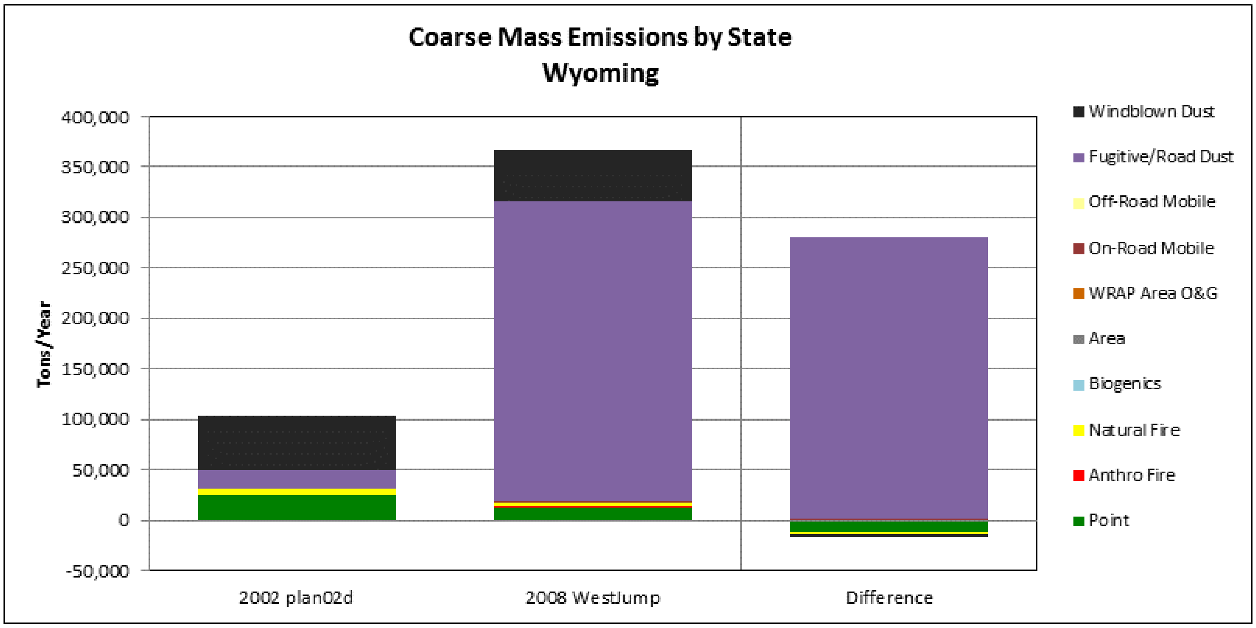

Figure 6.15-14. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Coarse Mass by Source Category for Wyoming.

6.15.2.2 EGU Summary

As described in previous sections, differences between the baseline and progress period inventories presented here do not necessarily represent changes in actual emissions because numerous updates in inventory methodologies have occurred between the development of the separate inventories. Also, the 2002 baseline and 2008 progress period inventories represent only annual snapshots of emissions estimates, which may not be representative of entire 5-year monitoring periods compared. To better account for year-to-year changes in emissions, annual emission totals for Wyoming electrical generating units (EGU) are presented here. EGU emissions are some of the more consistently reported emissions, as tracked in EPA's Air Markets Program Database for permitted Title V facilities in the state (http://ampd.epa.gov/ampd/). RHR implementation plans are required to pay specific attention to certain major stationary sources, including EGUs, built between 1962 and 1977.

Figure 6.15-17 presents a sum of annual NO_X and SO_2 emissions as reported for Wyoming EGU sources between 1996 and 2010. While these types of facilities are targeted for controls in state regional haze SIPs, it should be noted that many of the controls planned for EGUs in the WRAP states had not taken place yet in 2010, while other controls separate from the RHR may have been implemented. The chart shows periods of steady decline for both SO_2 and NO_X.

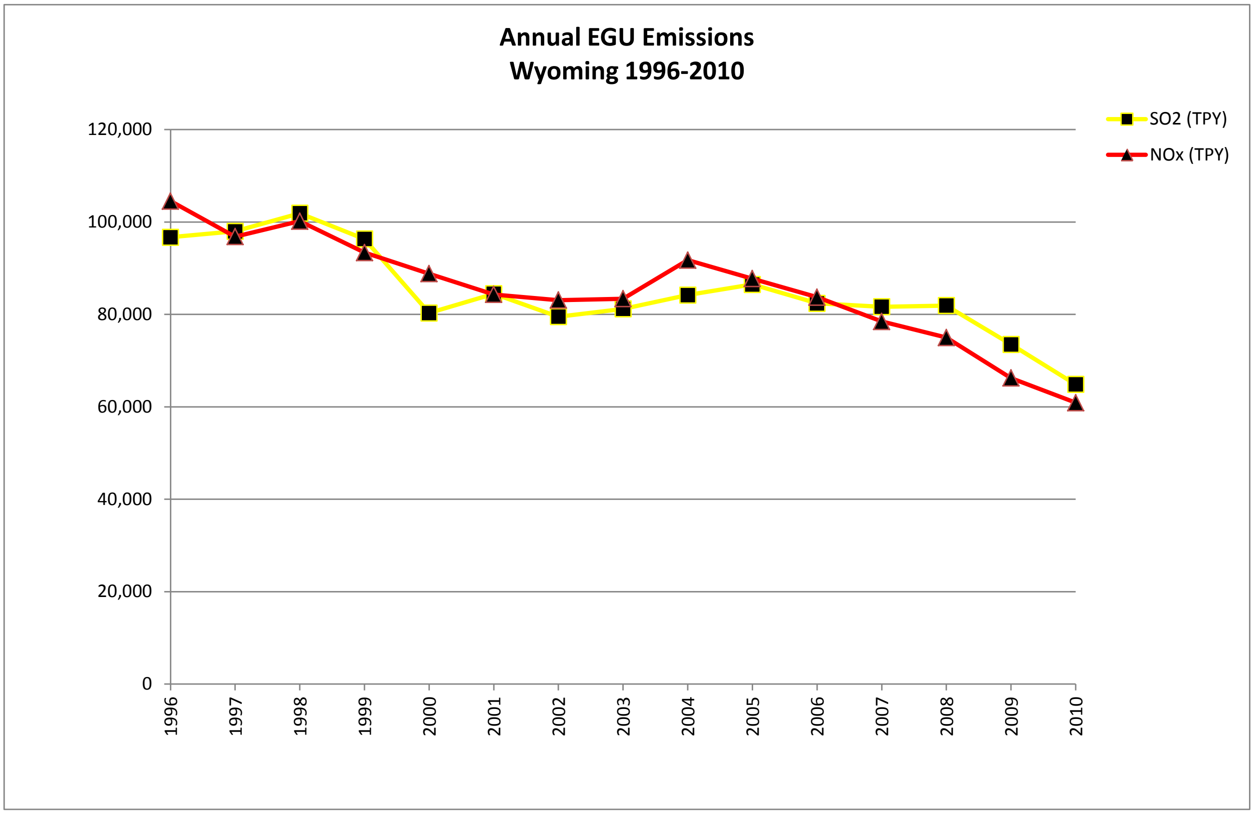

Figure 6.15-8. Sum of EGU Emissions of SO_2 and NO_X reported between 1996 and 2010 for Wyoming.