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.

6.10 NORTH DAKOTA

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. North Dakota has 2 mandatory Federal CIAs, which are depicted in Figure 6.10-1 and listed in Table 6.10-1, 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 the best days, the 5-year average deciview metric decreased at both the THRO1 and LOST1 sites.
- For the worst days, the 5-year average deciview metric decreased at the THRO1 site and remained the same at the LOST1 site.
- Both sites showed decreases in ammonium nitrate, which is consistent with emission inventories showing decreases in mobile and point source NO_X emissions.
- Both sites showed increases in 5-year average ammonium sulfate, and the LOST1 showed a statistically significant increasing annual trend. This was not consistent with a comparison of emissions inventories and summaries of annual EGU emissions which showed decreased SO_2 due to point and area sources. Increases in ammonium sulfate were also observed at the nearby MELA1 site in Montana. Both of these sites are near the Canadian border, so it is possible that international emissions affected these measurements.
- Both sites showed decreases in particulate organic mass, and emission inventories indicated that these measurements are largely due to fire impacts, which are highly variable from year-to-year.

Figure 6.10-1. Map Depicting Federal CIAs and Representative IMPROVE Monitors in North Dakota.

Table 6.10-1
North Dakota CIAs and Representative IMPROVE Monitors

Class I Area	Representative IMPROVE Site	Latitude	Longitude	Elevation (m)
Lostwood WA	LOST1	48.64	-102.40	696
Theodore Roosevelt NP	THRO1	46.89	-103.38	852

6.10.1 Monitoring Data

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

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}).

6.10.1.1 Current Conditions

This section addresses the regulatory question, ***what are the current visibility conditions for the most impaired and least impaired days (40 CFR 51.308 (g)(3)(i))?*** 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 6.10-2 and 6.10-3 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 North Dakota. Figure 6.10-2 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 North Dakota sites were ammonium sulfate, ammonium nitrate and particulate organic mass.

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.
- For both North Dakota sites, ammonium sulfate was the largest contributor to the non-Rayleigh aerosol species of extinction

---

[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.)

Table 6.10-2
North Dakota 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**
LOST1	19.6	**37% (1)**	35% (2)	16% (3)	4% (5)	1% (6)	6% (4)	1% (7)
THRO1	17.6	**37% (1)**	25% (2)	21% (3)	5% (5)	2% (6)	9% (4)	1% (7)

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

Table 6.10-3
North Dakota 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**
LOST1	8.1	**40% (1)**	13% (4)	16% (3)	6% (5)	3% (6)	21% (2)	1% (7)
THRO1	6.7	**39% (1)**	11% (4)	17% (3)	10% (5)	3% (6)	20% (2)	1% (7)

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

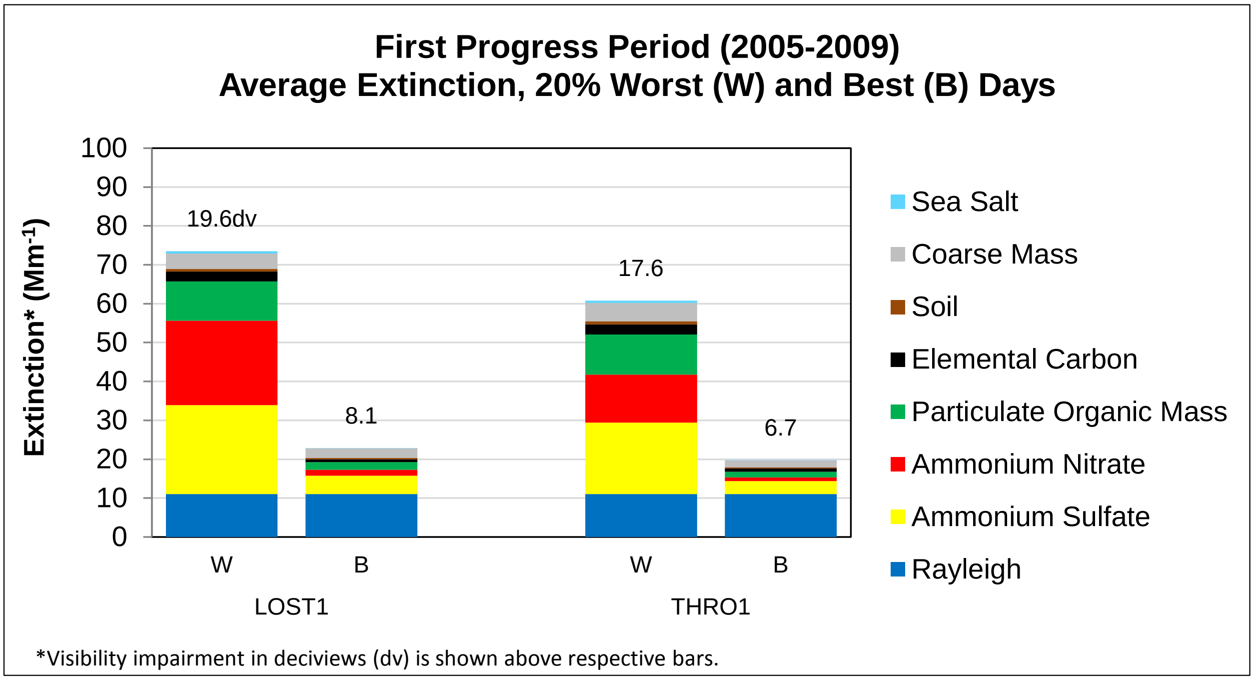

Figure 6.10-2. Average Extinction for Current Progress Period (2005-2009) for the Worst (Most Impaired) and Best (Least Impaired) Days Measured at North Dakota Class I Area IMPROVE Sites.

6.10.1.2 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 51.308 (g)(3)(ii))?*** Included here are comparisons between the 5-year average baseline conditions (2000-2004) and current progress period extinction (2005-2009).

Table 6.10-4 presents the differences between the 2000-2004 baseline period average extinction and the 2005-2009 progress period average for each site in North Dakota for the 20% most impaired days, and Table 6.10-5 presents similar data for the least impaired days. Averages that increased are depicted in red text and averages that decreased in blue.

Figure 6.10-3 presents the 5-year average extinction for the baseline and current progress period averages for the worst days and Figure 6.10-4 presents the differences in averages by aerosol species, with increases represented above the zero line and decreases below the zero line. Figures 6.10-5 and 6.10-6 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 the THRO1 site and remained the same at the LOST1 site. Notable differences for individual species averages were as follows:

- Ammonium nitrate, particulate organic mass, and elemental carbon averages decreased at both sites.
- Ammonium sulfate and sea salt averages increased at both sites.

Table 6.10-4
North Dakota 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
LOST1	19.6	19.6	0.0	+1.5	-1.2	-0.9	-0.3	0.0	+0.1	+0.3
THRO1	17.8	17.6	-0.2	+0.9	-1.4	-0.5	-0.1	-0.1	-0.1	+0.5

*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 6.10-5
North Dakota 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
LOST1	8.2	8.1	-0.1	+0.4	-0.3	-0.3	0.0	0.0	+0.2	+0.1
THRO1	7.8	6.7	-1.1	-0.4	-0.6	-0.5	-0.1	-0.1	-0.5	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.

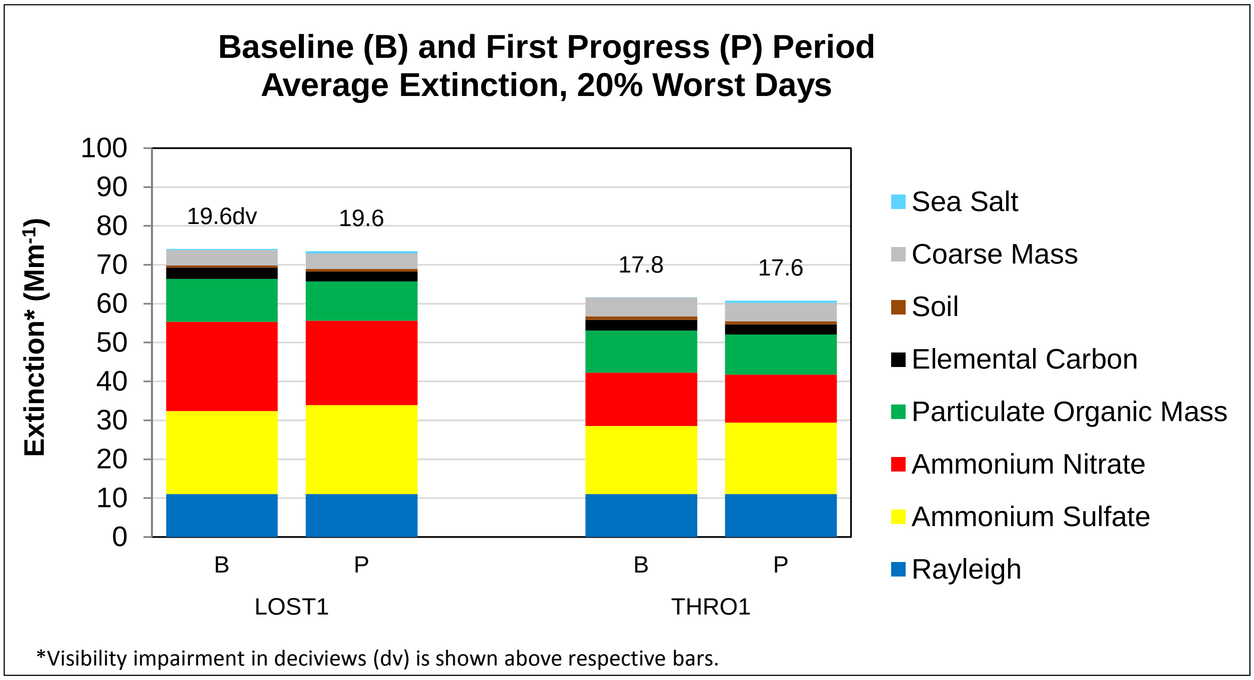

Figure 6.10-3. Average Extinction for Baseline and Progress Period Extinction for Worst (Most Impaired) Days Measured at North Dakota Class I Area IMPROVE Sites.

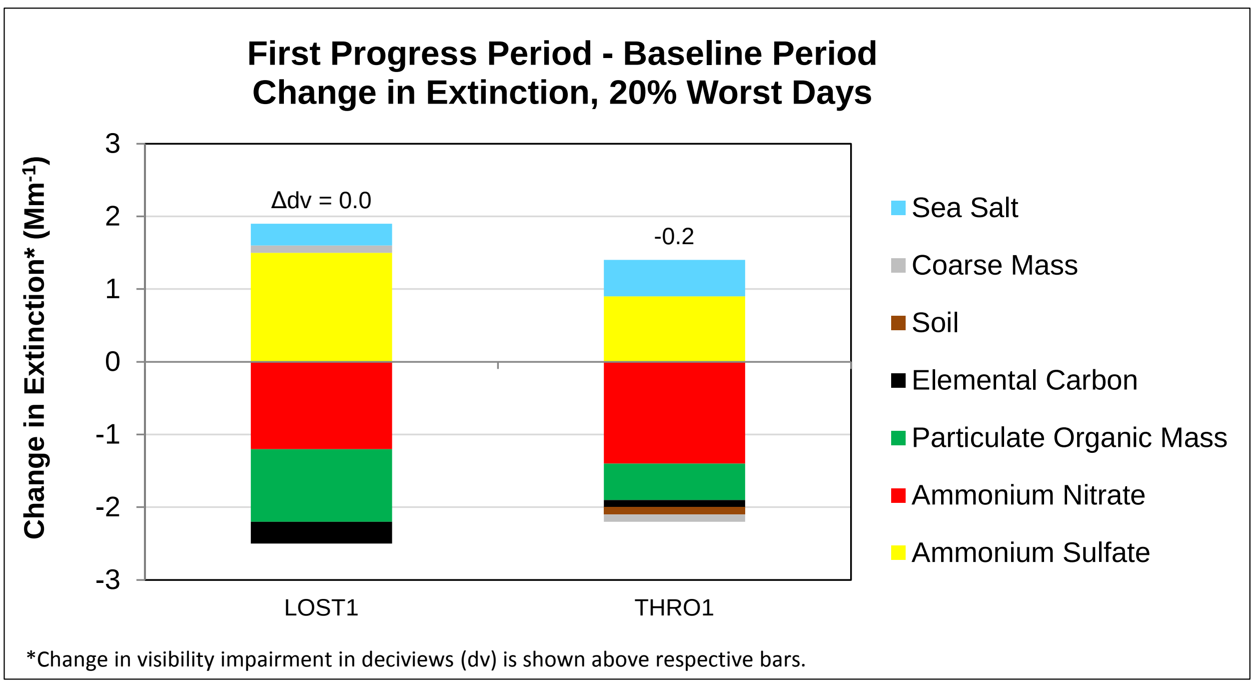

Figure 6.10-4. Difference between Average Extinction for Current Progress Period (2005-2009) and Baseline Period (2000-2004) for the Worst (Most Impaired) Days Measured at North Dakota Class I Area IMPROVE Sites.

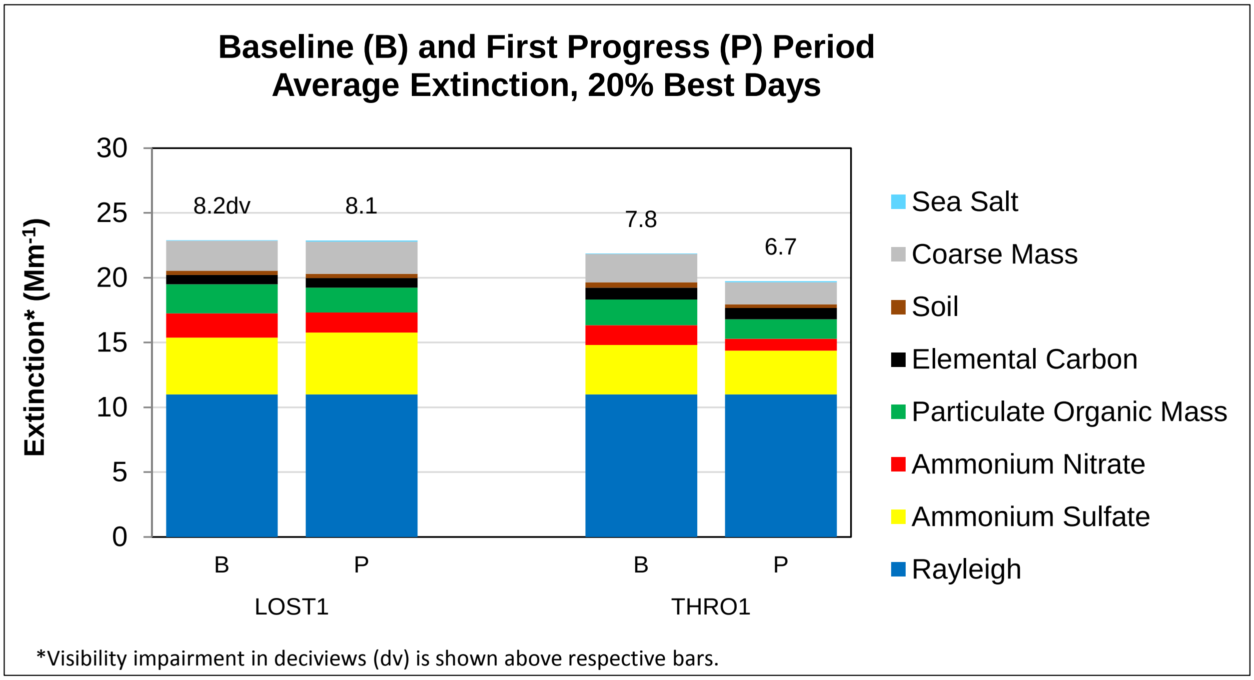

Figure 6.10-5. Average Extinction for Baseline and Progress Period Extinction for Best (Least Impaired) Days Measured at North Dakota Class I Area IMPROVE Sites.

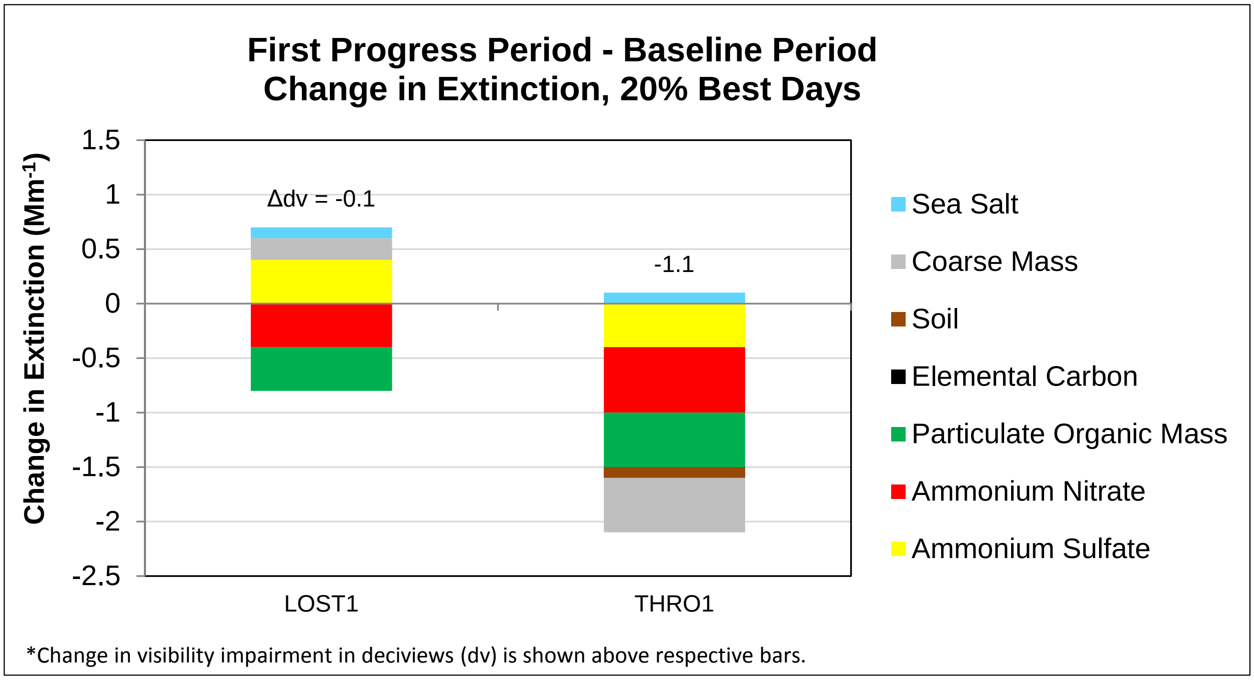

Figure 6.10-6. Difference between Average Extinction for Current Progress Period (2005-2009) and Baseline Period (2000-2004) for the Best (Least Impaired) Days Measured at North Dakota Class I Area IMPROVE Sites.

6.10.1.3 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 51.308 (g)(3)(iii))?*** 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 North Dakota are summarized in Table 6.10-6, 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 J. Additionally, this 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 North Dakota are as follows:

- For ammonium sulfate, the 5-year average for the worst days increased at both North Dakota sites, and showed an increasing annual average trend at the LOST1 site.
- For ammonium nitrate, the 5-year average for the worst days decreased at both North Dakota sites, and showed a decreasing annual average trend at the THRO1 site.
- Elemental carbon and particulate organic mass showed decreasing annual average trends at both sites.

---

[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.

Table 6.10-6
North Dakota 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**
LOST1	20% Best	--	0.0	--	--	--	--	0.0
	20% Worst	--	--	--	**-0.1**	--	**-0.1**	--
	All Days	**0.1**	--	**-0.2**	**-0.1**	--	--	0.0
THRO1	20% Best	**-0.1**	**-0.1**	**-0.1**	--	0.0	0.0	0.0
	20% Worst	--	--	--	--	0.0	**-0.1**	0.0
	All Days	--	**-0.1**	--	**-0.1**	--	--	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 J.

6.10.2 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 6.10-7 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 6.10-7
North Dakota
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 Source	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.

6.10.2.1 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 51.308 (g)(4))?*** 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 6.10-8 and Figure 6.10-7 present the differences between the 2002 and 2008 sulfur dioxide (SO_2) inventories by source category. Tables 6.10-9 and Figure 6.10-8 present data for oxides of nitrogen (NO_X), and subsequent tables and figures (Tables 6.10-10 through 6.10-15 and Figures 6.10-9 through 6.10-14) present data for ammonia (NH_3), volatile organic compounds (VOCs), primary organic aerosol (POA), elemental carbon (EC), fine soil, and coarse mass. Inventory totals on a county level basis will be made available on the WRAP TSS website (http://vista.cira.colostate.edu/tss/). General observations regarding emissions inventory comparisons are listed below.

- Largest differences for point source inventories were decreases in SO_2 and NO_X, and increases in NH_3 and VOCs. Note that decreases in SO_2 and NO_X for point sources are consistent with the summary of annual EGU emissions as included in Section 6.10.2.2.
- Area source inventories showed decreases in SO_2, NH_3, and VOCs, with 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_2 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.
- For most parameters, especially POAs, VOCs, and EC, fire emission inventory estimates decreased. 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.
- 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 decreased for the windblown dust inventory comparisons, and increased for the combined fugitive/road dust inventories. Large variability in changes in windblown dust was observed for the contiguous WRAP states, which was likely due in large part to enhancements in dust inventory methodology, as referenced in Section 3.2.1, rather than changes in actual emissions.

Table 6.10-8
North Dakota
Sulfur Dioxide Emissions by Category

Source Category	Sulfur Dioxide Emissions (tons/year)		
	2002 (Plan02d)	**2008 (WestJump2008)**	**Difference (Percent Change)**
Anthropogenic Sources			
Point	156,668	142,121	-14,547
Area	5,389	729	-4,660
On-Road Mobile	771	156	-615
Off-Road Mobile	6,828	683	-6,144
Area Oil and Gas	358	0	-358
Fugitive and Road Dust	0	0	0
Anthropogenic Fire	268	107	-162
Total Anthropogenic	**170,283**	**143,796**	**-26,486 (-16%)**
Natural Sources			
Natural Fire	195	7	-188
Biogenic	0	0	0
Wind Blown Dust	0	0	0
Total Natural	**195**	**7**	**-188 (-97%)**
All Sources			
Total Emissions	**170,477**	**143,803**	**-26,675 (-16%)**

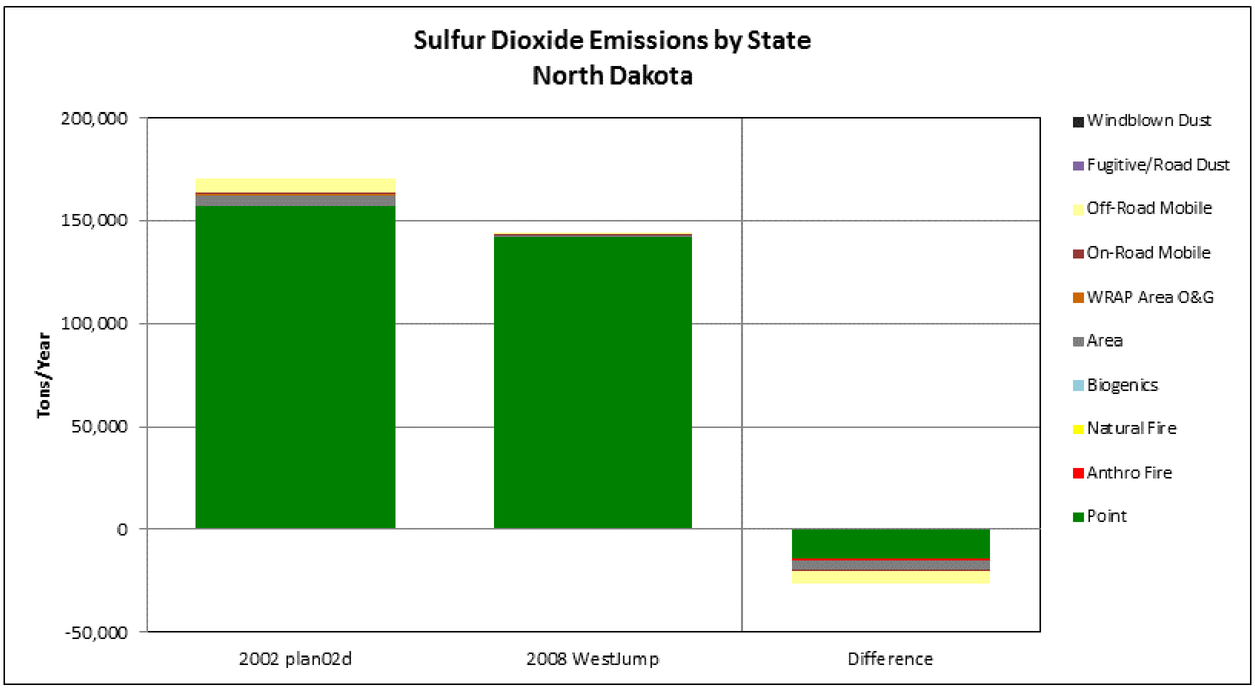

Figure 6.10-7. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Sulfur Dioxide by Source Category for North Dakota.

Table 6.10-9
North Dakota
Nitrogen Oxide Emissions by Category

Source Category	Oxides of Nitrogen Emissions (tons/year)		
	2002 (Plan02d)	2008 (WestJump2008)	Difference (Percent Change)
Anthropogenic Sources			
Point	87,425	78,252	-9,173
Area	10,826	16,719	5,892
On-Road Mobile	24,746	23,180	-1,566
Off-Road Mobile	55,502	34,572	-20,930
Area Oil and Gas	4,631	0	-4,631
Fugitive and Road Dust	0	0	0
Anthropogenic Fire	995	854	-140
Total Anthropogenic	**184,125**	**153,577**	**-30,548 (-17%)**
Natural Sources			
Natural Fire	766	47	-720
Biogenic	44,569	9,133	-35,436
Wind Blown Dust	0	0	0
Total Natural	**45,335**	**9,179**	**-36,156 (-80%)**
All Sources			
Total Emissions	**229,460**	**162,756**	**-66,704 (-29%)**

*Natural fire totals for the 2008 inventory include both anthropogenic and natural sources. Updated data distinguishing these sources are expected.

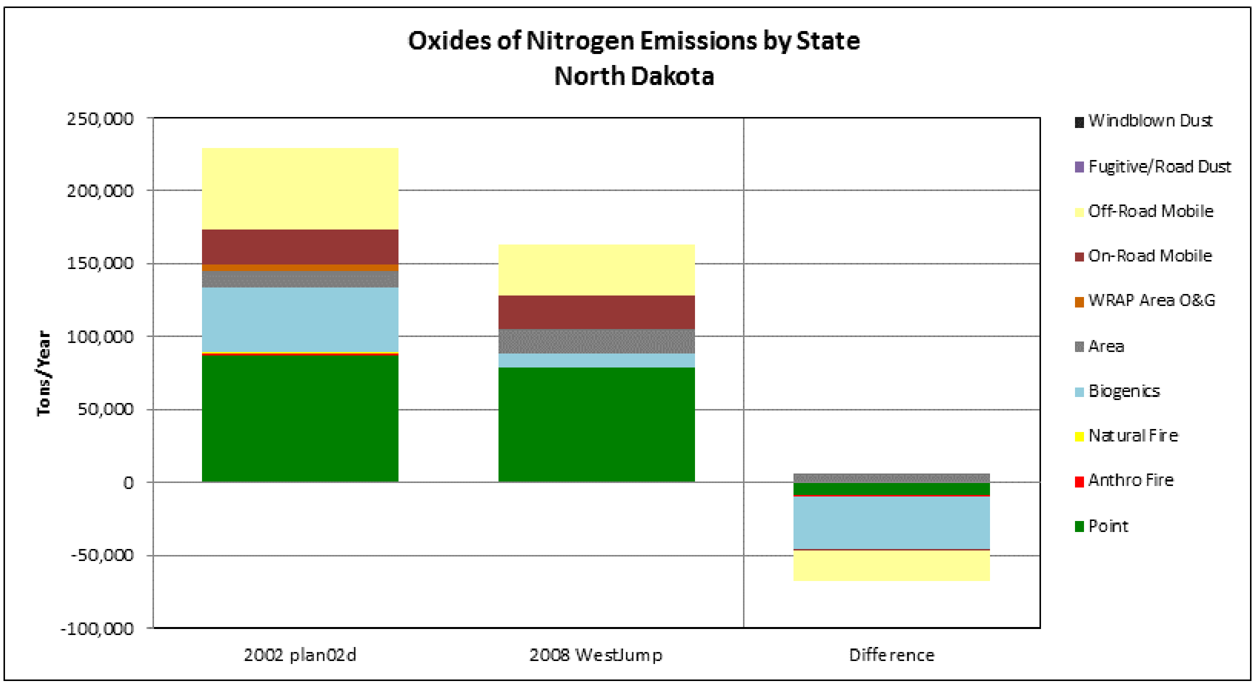

Figure 6.10-8. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Oxides of Nitrogen by Source Category for North Dakota.

Table 6.10-10
North Dakota
Ammonia Emissions by Category

Source Category	Ammonia Emissions (tons/year)		
	2002 (Plan02d)	**2008 (WestJump2008)**	**Difference (Percent Change)**
Anthropogenic Sources			
Point	518	6,372	5,854
Area	118,398	78,857	-39,542
On-Road Mobile	732	345	-387
Off-Road Mobile	33	29	-4
Area Oil and Gas	0	0	0
Fugitive and Road Dust	0	0	0
Anthropogenic Fire	619	529	-90
Total Anthropogenic	**120,300**	**86,131**	**-34,169 (-28%)**
Natural Sources			
Natural Fire	193	33	-160
Biogenic	0	0	0
Wind Blown Dust	0	0	0
Total Natural	**193**	**33**	**-160 (-83%)**
All Sources			
Total Emissions	**120,493**	**86,164**	**-34,329 (-28%)**

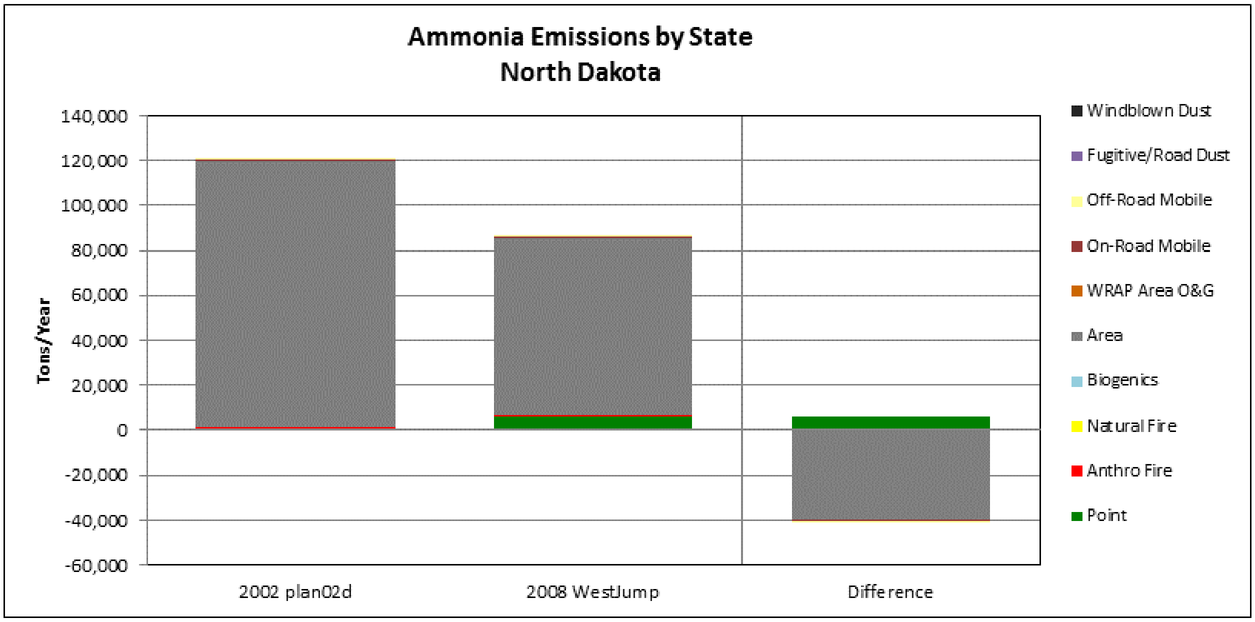

Figure 6.10-9. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Ammonia by Source Category for North Dakota.

Table 6.10-11
North Dakota
Volatile Organic Compound Emissions by Category

Source Category	Volatile Organic Compound Emissions (tons/year)		
	2002 (Plan02d)	**2008 (WestJump2008)**	**Difference (Percent Change)**
Anthropogenic Sources			
Point	2,086	3,877	1,791
Area	60,455	21,194	-39,262
On-Road Mobile	12,814	10,928	-1,885
Off-Road Mobile	13,515	11,892	-1,623
Area Oil and Gas	7,740	0	-7,740
Fugitive and Road Dust	0	0	0
Anthropogenic Fire	2,148	1,674	-474
Total Anthropogenic	**98,758**	**49,566**	**-49,192 (-50%)**
Natural Sources			
Natural Fire	1,701	52	-1,649
Biogenic	233,561	118,195	-115,366
Wind Blown Dust	0	0	0
Total Natural	**235,262**	**118,247**	**-117,015 (-50%)**
All Sources			
Total Emissions	**334,020**	**167,813**	**-166,207 (-50%)**

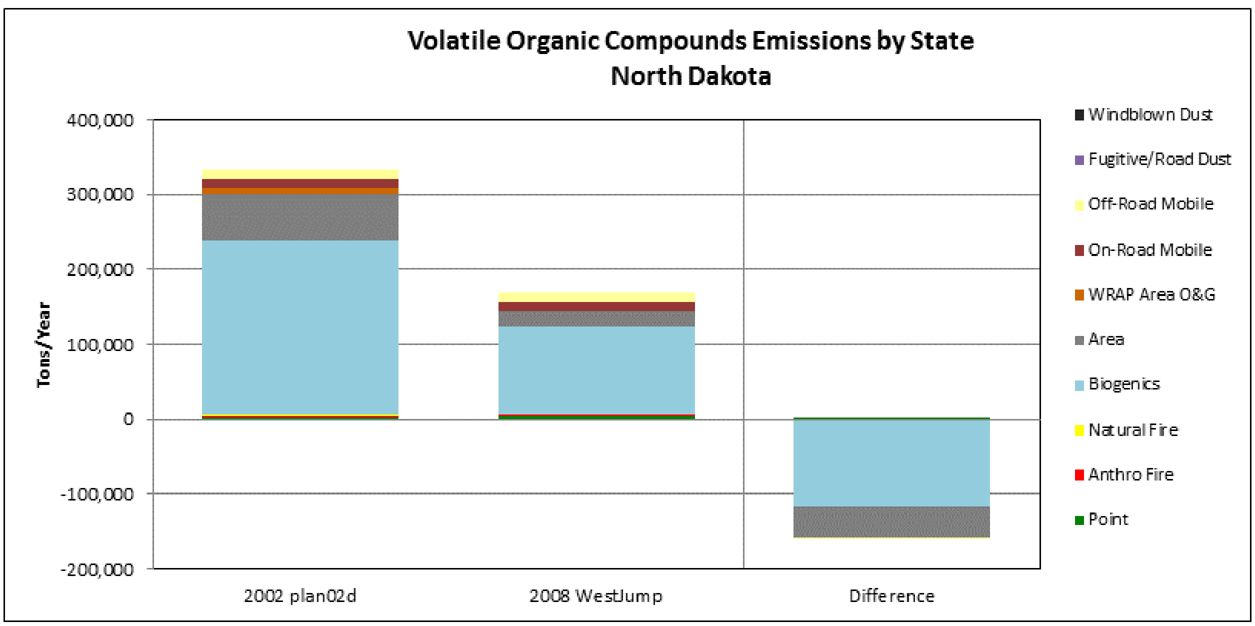

Figure 6.10-10. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Volatile Organic Compounds by Source Category for North Dakota.

Table 6.10-12
North Dakota
Primary Organic Aerosol Emissions by Category

Source Category	Primary Organic Aerosol Emissions (tons/year)		
	2002 (Plan02d)	**2008 (WestJump2008)**	**Difference (Percent Change)**
Anthropogenic Sources			
Point*	262	144	-118
Area	1,466	920	-546
On-Road Mobile	231	680	449
Off-Road Mobile	1,034	794	-240
Area Oil and Gas	0	0	0
Fugitive and Road Dust	2,190	1,874	-316
Anthropogenic Fire	1,443	990	-452
Total Anthropogenic	**6,626**	**5,402**	**-1,223 (-18%)**
Natural Sources			
Natural Fire	2,214	82	-2,132
Biogenic	0	0	0
Wind Blown Dust	0	0	0
Total Natural	**2,214**	**82**	**-2,132 (-96%)**
All Sources			
Total Emissions	**8,840**	**5,485**	**-3,355 (-38%)**

*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/).

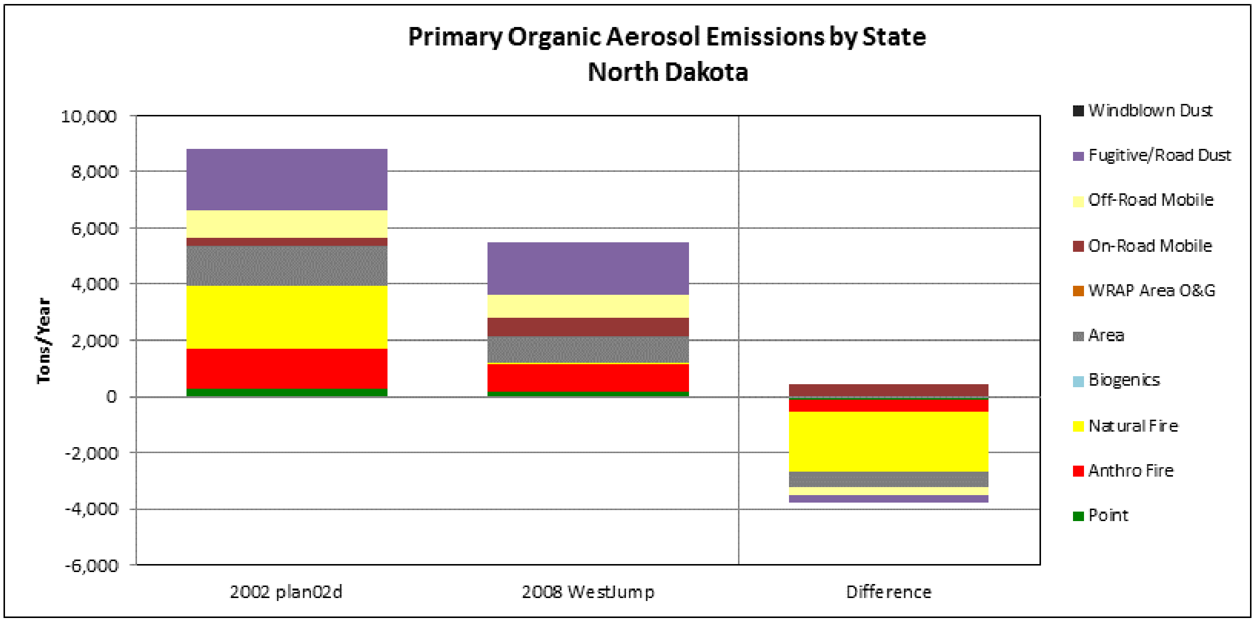

Figure 6.10-11. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Primary Organic Aerosol by Source Category for North Dakota.

Table 6.10-13
North Dakota
Elemental Carbon Emissions by Category

Source Category	Elemental Carbon Emissions (tons/year)		
	2002 (Plan02d)	**2008 (WestJump2008)**	**Difference (Percent Change)**
Anthropogenic Sources			
Point*	29	6	-23
Area	262	454	192
On-Road Mobile	272	994	722
Off-Road Mobile	3,625	2,337	-1,288
Area Oil and Gas	0	0	0
Fugitive and Road Dust	150	25	-124
Anthropogenic Fire	86	307	221
Total Anthropogenic	**4,423**	**4,124**	**-299 (-7%)**
Natural Sources			
Natural Fire	423	37	-387
Biogenic	0	0	0
Wind Blown Dust	0	0	0
Total Natural	**423**	**37**	**-387 (-91%)**
All Sources			
Total Emissions	**4,847**	**4,161**	**-686 (-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/).

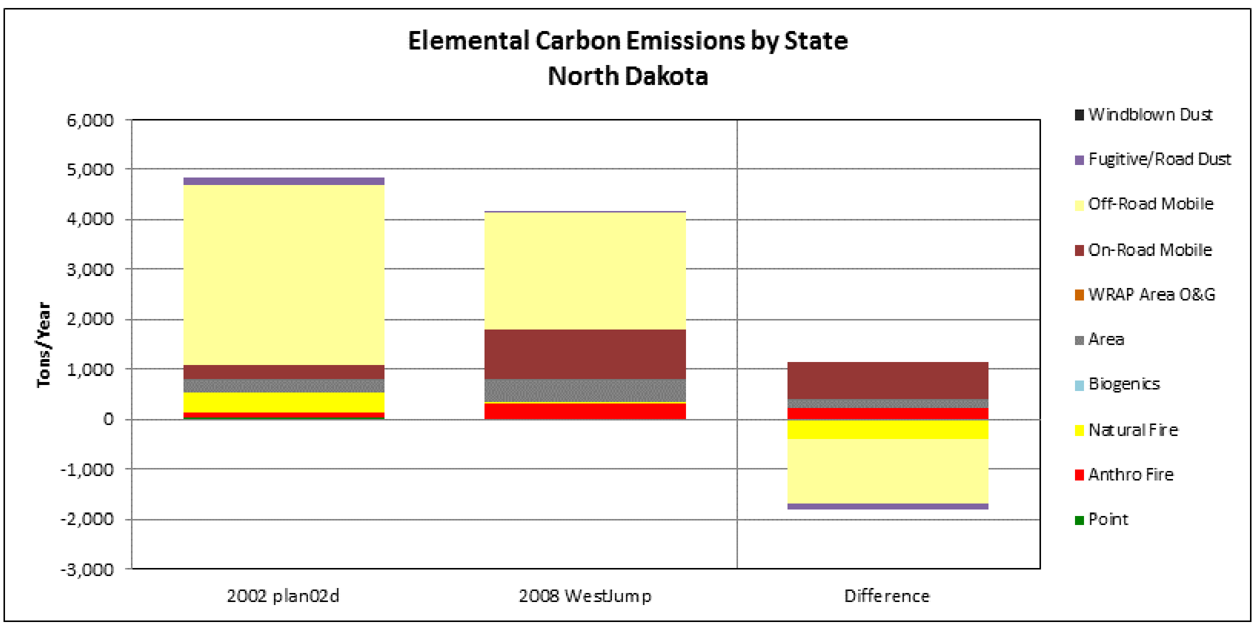

Figure 6.10-12. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Elemental Carbon by Source Category for North Dakota.

Table 6.10-14
North Dakota
Fine Soil Emissions by Category

Source Category	Fine Soil Emissions (tons/year)		
	2002 (Plan02d)	**2008 (WestJump2008)**	**Difference (Percent Change)**
Anthropogenic Sources			
Point*	2,002	122	-1,880
Area	1,617	413	-1,204
On-Road Mobile	149	98	-52
Off-Road Mobile	0	54	54
Area Oil and Gas	0	0	0
Fugitive and Road Dust	39,440	42,148	2,708
Anthropogenic Fire	596	403	-194
Total Anthropogenic	**43,805**	**43,237**	**-567 (-1%)**
Natural Sources			
Natural Fire	225	31	-194
Biogenic	0	0	0
Wind Blown Dust	17,639	15,784	-1,855
Total Natural	**17,864**	**15,815**	**-2,049 (-11%)**
All Sources			
Total Emissions	**61,669**	**59,052**	**-2,616 (-4%)**

*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/).

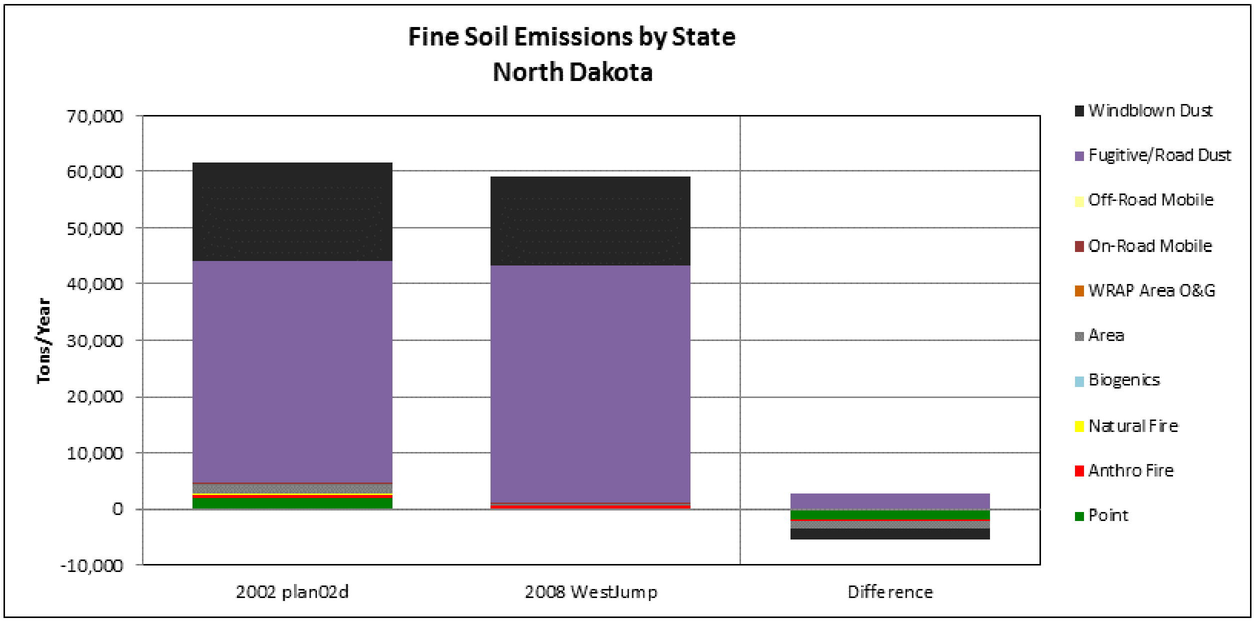

Figure 6.10-13. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Fine Soil by Source Category for North Dakota.

Table 6.10-15
North Dakota
Coarse Mass Emissions by Category

Source Category	Coarse Mass Emissions (tons/year)		
	2002 (Plan02d)	**2008 (WestJump2008)**	**Difference (Percent Change)**
Anthropogenic Sources			
Point*	565	651	86
Area	199	99	-100
On-Road Mobile	141	1,102	961
Off-Road Mobile	0	109	109
Area Oil and Gas	0	0	0
Fugitive and Road Dust	200,777	208,858	8,081
Anthropogenic Fire	62	191	129
Total Anthropogenic	**201,743**	**211,010**	**9,267 (5%)**
Natural Sources			
Natural Fire	441	16	-425
Biogenic	0	0	0
Wind Blown Dust	158,752	142,061	-16,691
Total Natural	**159,193**	**142,077**	**-17,116 (-11%)**
All Sources			
Total Emissions	**360,936**	**353,087**	**-7,849 (-2%)**

*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/).

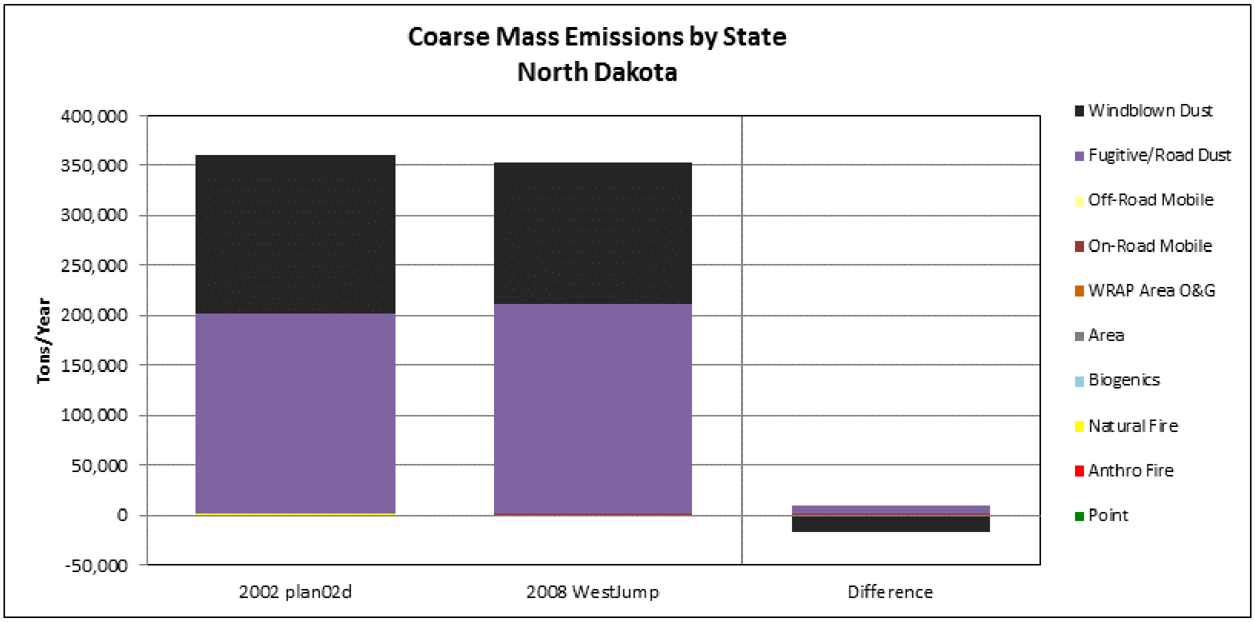

Figure 6.10-14. 2002 and 2008 Emission and Difference between Emissions Inventory Totals, for Coarse Mass by Source Category for North Dakota.

6.10.2.2 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 North Dakota 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 6.10-17 presents a sum of annual NO_X and SO_2 emissions as reported for North Dakota 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 decline for both SO_2 and NO_X. The chart shows a fairly steady decline for both SO_2 and NO_X emissions in recent years.

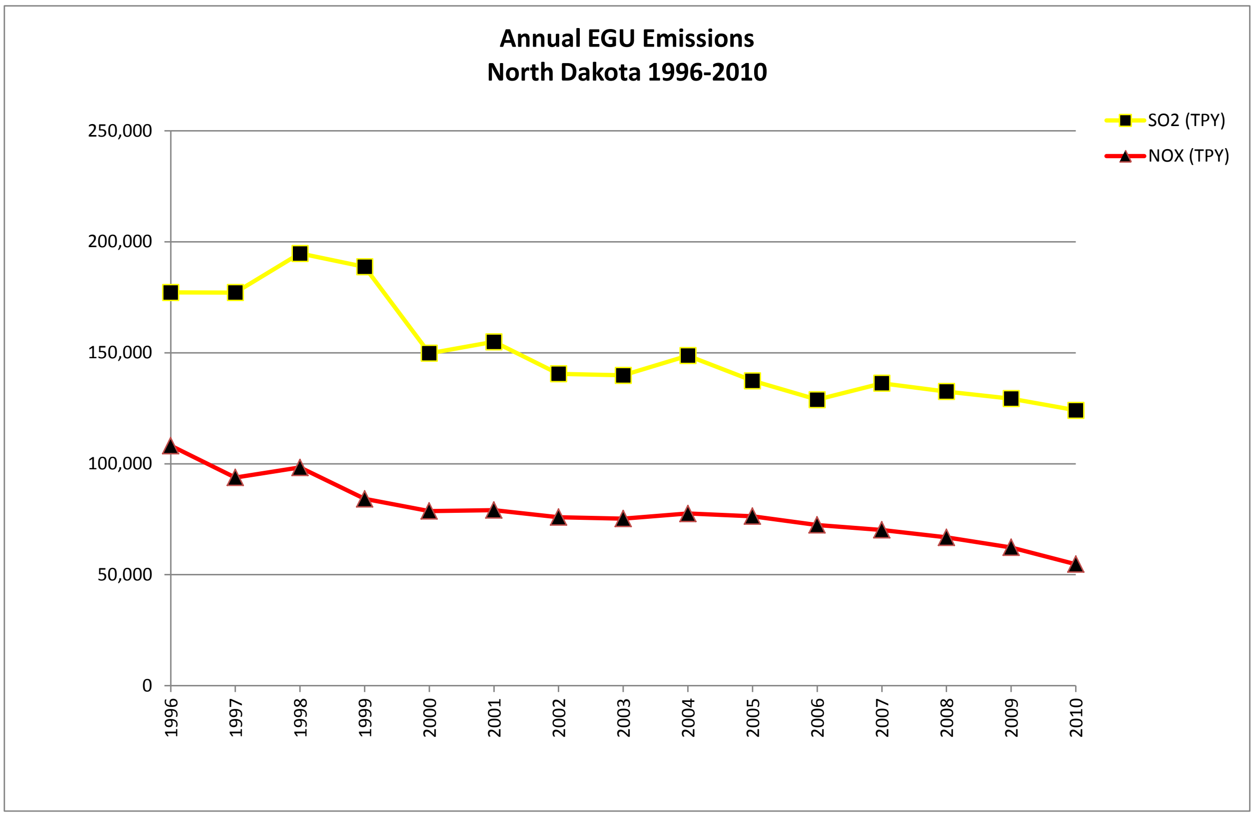

Figure 6.10-17. Sum of EGU Emissions of SO_2 and NO_X reported between 1996 and 2010 for North Dakota.