ES.1 INTRODUCTION

The Powder River Basin (PRB) of Wyoming and Montana is a major coal-producing region in the United States (U.S.). It also has produced large quantities of natural gas and oil, and has experienced significant development of coal bed natural gas (CBNG) from its coal seams. The region has a diverse set of environmental values, including proximity to some of the most pristine areas in the U.S.

This update to the Task 3A Report for the PRB Coal Review evaluates the air quality-related environmental impacts of ongoing development in the region. The Task 1A Report for the PRB Coal Review, Current Air Quality Conditions (ENSR 2005a) documented the air quality impacts of operations during a base year (2002), using actual emissions and operations for that year. The base year analysis evaluated impacts both within the PRB itself and at selected sensitive areas surrounding the region. The analysis specifically quantified impacts of coal mines, power plants, CBNG development, and other activities. Results were provided for both Wyoming and Montana source groups and receptors.

The Task 2 Report for the PRB Coal Review, Past and Present and Reasonably Foreseeable Development Activities (ENSR 2005b) depicted the range of projected coal-related development in the PRB, for selected source groups. The report identified reasonably foreseeable development (RFD) activities for the years 2010, 2015, and 2020, and was separated into selected, partially overlapping source groups, including power plants, coal mine development, conventional oil and gas and CBNG activities, and other coal-related energy development scenarios. The results of that study were used to develop changes in air pollution emission rates for source groups in 2010, 2015, and 2020 which are the basis for modeled estimates of the projected cumulative air quality impacts. The 2020 RFD scenarios from the Task 2 report were updated with current information, as applicable, and revised emissions were included in this updated analysis.

The original Task 3A report (ENSR 2006) provided a modeled change in impacts on air quality and air quality-related values (AQRVs) resulting from the projected RFD activities in 2010. Impacts of coal and other resource development were evaluated for each source group and for the various receptor groups. The Task 2 projected development for 2010 was modeled using the same model and meteorological data that were used for the base year study in the Task 1A report. Impacts for 2015 and 2020 were qualitatively projected based on modeled impacts for 2010 and expected changes in source group emissions identified in the Task 2 study. As the uncertainty associated with predicted developments for 2015 and 2020 decreased, it became increasingly valuable to update the original Task 3A qualitative estimates for 2015 and 2020 with a quantitative evaluation. In 2008, the cumulative air quality effects for 2015 were modeled, and the Task 3A study correspondingly was updated (ENSR 2008a).

This current update to the Task 3A report quantitatively updates the original Task 3A qualitative analysis based on modeled changes in impacts on air quality and AQRVs resulting from the projected RFD activities in 2020. Similar to the original Task 3A report, impacts due to development of selected source types were evaluated at various receptor locations. Several important changes that occurred during the development of the 2015 update were carried through to this 2020 update. The changes that affect the comparison of this updated report with the original Task 3A report include:

- A new version of the dispersion model used to predict air quality and AQRVs;
- Initiation of the dispersion model with a different meteorological year;
- An improved base year emissions inventory; and
- Updated RFD emission sources and projected emissions activities to 2020.

ES.2 TECHNICAL APPROACH

Similar to the original Task 3A report, this updated analysis evaluates two levels of coal development: a lower production (or development) scenario and an upper production scenario. Existing and projected sources in the study area were analyzed using base year emissions and adjusting those emissions based on the projected development level. Emissions were evaluated for sources in the study area, which comprises several counties in the PRB in both states:

- Wyoming portion of the study area comprises all of Campbell County, all of Sheridan and Johnson counties except the Bighorn National Forest lands to the west of the PRB, and the northern portion of Converse County

- Montana portion of the study area comprises the area of relevant coal mines including portions of Rosebud, Custer, Powder River, Big Horn, and Treasure counties

The study evaluates impacts on air quality and AQRVs resulting from projected development of RFD activities (for 2020) in the study area. For the original Task 3A study, a quantitative modeling assessment was used to predict ambient air quality impacts for 2010, and qualitative evaluations were made for 2015 and 2020. For this current update to the Task 3A study, the original 2020 qualitative evaluations were quantitatively updated based on the same approach previously used to predict ambient air quality impacts for 2010 and 2015.

A state-of-the-art, guideline dispersion model was used to evaluate impacts at several locations:

- Near-field receptors in Wyoming (within the PRB study area);

- Near-field receptors in Montana (within the PRB study area);

- Receptors in nearby federally designated pristine or Class I areas; and

- Receptors at other sensitive areas (sensitive Class II areas).

The U.S. Environmental Protection Agency (USEPA) guideline CALPUFF model system version 5.8 (Scire et al. 2000a,b) was used for this study, which differs from the version used in the Task 1A and original Task 3A studies. The modeling domain is identical to the Task 1A, original Task 3A, and 2015 update to the Task 3A studies and extends over most of Wyoming, southeastern Montana, southwestern North Dakota, western South Dakota, and western Nebraska. A group of agency stakeholders participated in developing the modeling protocol and related methodology that were used for this analysis (ENSR 2008b).

This updated Task 3A report uses an identical model setup, meteorological input data, and base year emissions inventory as the 2015 update. Previously, the base year inventory was developed for actual emissions in 2002; for this update, the base year emissions inventory is for year 2004. Detailed information regarding the development of the emissions information is available in the 2015 update report (ENSR 2008a) and its corresponding Technical Support Document (ENSR 2008d). The base year emissions inventory is projected into future year 2020 for upper and lower production scenarios.

The meteorological data set for 2003 was selected as the worst-case meteorological year during the 2015 update based on an analysis of visibility impacts at the nearest Class I areas. The meteorological year 2003 was then used to model impacts for all emissions sources for the revised base year and the 2015 and 2020 development scenarios. Modeling data settings generally were set to default values. Base year ozone concentrations also were incorporated into the model using measured concentrations representative of the study area.

The objective of this updated study is to provide a quantitative evaluation of projected 2020 cumulative air quality impacts for comparison to both the base year impacts and the 2020 qualitative projections from the original Task 3A report. For this updated study, the base year (2004) and projected future year (2020) impacts are evaluated using the same receptor set and modeling domain used for the Task 1A and original Task 3A reports. The 2020 development scenarios were directly modeled for this study. The only difference between the base year and future year predicted impacts is due to the projected change in emissions as a result of RFD activities in the PRB study area. This report documents the modeled impacts for 2020 under both the upper and lower development scenarios. The changes in air quality and AQRVs due to projected development in the PRB are summarized and compared with the original Task 3A qualitative projections for 2020.

ES.3 CUMULATIVE IMPACTS

Generally, measured air quality conditions are good throughout the region. The base year (2004) modeling showed that there is reason for concern regarding the short-term impacts for some pollutants including particulate matter (PM) with an aerodynamic diameter of 10 microns or less (PM_{10}) and PM with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$). The base year modeling also predicted substantial visibility impacts at the nearby Class I and sensitive Class II areas. For regulatory purposes, the Class I evaluations are not directly comparable to the air quality permitting requirements, because the modeling effort does not segregate increment-consuming sources that would need to be evaluated under the Prevention of Significant Deterioration (PSD) program. The cumulative impact analysis focuses on changes in cumulative impacts versus a comparison to PSD-related evaluations, which would apply to specific sources. Changes in predicted impacts for air quality parameters (NO_2, sulfur dioxide [SO_2], PM_{10}, and $PM_{2.5}$) were evaluated, along with changes in AQRVs at Class I and sensitive Class II areas.

It is important to note that the effects of Best Available Retrofit Technology (BART) implementation are not incorporated into the results presented below, since the states are still developing their implementation plan. It is anticipated that air quality effects from large sources summarized below likely would be reduced as a result of BART regulations.

Table ES-1 presents the modeled impacts on ambient air quality at the near-field receptors in Montana and Wyoming. Results indicate the maximum impacts at any point in each receptor group. Results are summarized for both 2020 development scenarios, and results from the base year are included for comparison purposes. Peak impacts occur at isolated receptors and are likely due to unique source-receptor relationships. The model results should not be construed as predicting an actual exceedence of any standard, but are at best indicators of potential impacts.

The results of the modeling depict the anticipated changes under both development scenarios. For the Wyoming near-field receptors, the predicted impact of the 24-hour PM_{10} and $PM_{2.5}$ concentrations show localized exceedences of the National Ambient Air Quality Standard (NAAQS) for the base year (2004), as well as for both development scenarios for 2020. The 2020 development scenarios show the concentration increases by a factor of 2.5 relative to the base year for these parameters. Additionally, 2020 development scenarios show a 20 percent increase of annual PM_{10} and $PM_{2.5}$ concentrations at peak Wyoming near-field receptors. This level of increase indicated modeled exceedences of annual standards for $PM_{2.5}$.[1] Impacts of NO_2 and SO_2 emissions are predicted to be below the NAAQS and Wyoming State Ambient Air Quality Standard (SAAQS) at the Wyoming near-field receptors.

Based on the modeling results, impacts at Montana near-field receptors would be in compliance with the NAAQS and the Montana SAAQS for all pollutants and averaging periods. Importantly, the 1-hour NO_2 concentrations at Montana near-field receptors for 2015 were predicted to exceed the SAAQS at isolated locations due to CBNG development in Wyoming; however, with the anticipated southward progression of the CBNG wells, the 1-hour NO_2 concentrations in 2020 are predicted to remain below the SAAQS. The southward progression of the CBNG wells also contributes to a

[1] At the time of publication of this report, the annual PM_{10} NAAQS have been revoked by the USEPA. The state-specific annual PM_{10} standards are still in effect. Modeled impacts are compared to the annual PM_{10} threshold for consistency with the original Task 3A Report.

predicted decrease in impacts for annual NO_2, PM_{10} and $PM_{2.5}$ relative to the base year. Although large percentage increases were predicted in SO_2 impacts, the levels would be below the ambient standards for all pollutants in the Montana near-field.

Table ES-1
Projected Maximum Potential Near-field Impacts
(µg/m^3)

Pollutant	Averaging Time	Base Year (2004) Impacts	2020 Lower Development Scenario Impacts	2020 Upper Development Scenario Impacts	NAAQS	Wyoming SAAQS	Montana SAAQS	PSD Class II Increments
Wyoming Near-field								
NO_2	Annual	31.3	80.5	80.6	100	100	--	25
SO_2	Annual	15.3	16.4	16.5	80	60	--	20
	24-hour	112.3	144.3	144.3	365	260		91
	3-hour	462.0	936.7	936.7	1,300	1,300	--	512
$PM_{2.5}$	Annual	13.4	**16.3**	**16.3**	15	15	--	--
	24-hour	**87.6**	**218.4**	**218.5**	35	35	--	--
PM_{10}	Annual	38.4	46.6	46.6	--	50	--	17
	24-hour	**250.4**	**624.1**	**624.3**	150	150	--	30
Montana Near-field								
NO_2	Annual	3.3	2.5	2.6	100	--	100	25
	1-hour	409.0	440.1	442.7	--	--	564	--
SO_2	Annual	1.6	3.0	3.1	80	--	80	20
	24-hour	16.1	24.7	27.1	365	--	365	91
	3-hour	65.0	138.9	138.9	1,300	--	1,300	512
	1-hour	162.9	237.0	259.1	--	--	1,300	--
$PM_{2.5}$	Annual	1.0	0.9	0.9	15	--	15	--
	24-hour	10.2	10.2	10.2	35	--	35	--
PM_{10}	Annual	2.8	2.5	2.6	--	--	50	17
	24-hour	29.1	29.3	29.3	150	--	150	30

Note: -- = No standard or increment.
µg/m^3 = microgram per cubic meter.
Bold numbers indicate potential exceedences.

Table ES-2 provides modeled impacts at the three Class I areas and two Class II areas with the greatest impacts. A comparison to SAAQS and PSD increments is provided; however, the analysis did not separate PSD increment-consuming sources from those that did not consume increment. The PSD-increment comparison is provided for informational purposes only and cannot be directly related to a regulatory interpretation of PSD increment consumption.

None of the modeled Class I areas currently have, or are predicted to have, NAAQS or SAAQS exceedences. **Table ES-2** compares the modeled impacts to the PSD Class I and sensitive Class II increment levels. At the Northern Cheyenne Indian Reservation (IR), Badlands National Park (NP) and Wind Cave NP base year impacts are slightly above the Class I comparative levels for 24-hour PM_{10} in 2020. Additionally, the SO_2 impacts at the Northern Cheyenne IR for the 3-hour and 24-hour averaging period exceed the Class I PSD increment levels. In the other Class I areas, only the modeled 24-hour SO_2 impacts at Theodore Roosevelt NP and Fort Peck IR, and 3-hour SO_2 impacts at Theodore Roosevelt NP, are above the PSD increment levels for the 2020 development scenarios; the predicted exceedences for these areas are due to sources outside the PRB study area.

Table ES-2
Maximum Predicted PSD Class I and Sensitive Class II Area Impacts
(µg/m^3)

Location	Pollutant	Averaging Period	Base Year (2004) Impacts	2020 Lower Development Scenario	2020 Upper Development Scenario	PSD Class I and Class II Increments
Class I Areas						
Northern Cheyenne IR	NO_2	Annual	0.4	0.8	1.1	2.5
	SO_2	Annual	0.5	1.1	1.3	2
		24-hour	3.1	**7.1**	**12.8**	5
		3-hour	9.4	23.6	**39.7**	25
	$PM_{2.5}$	Annual	0.3	0.4	0.5	--
		24-hour	3.4	4.5	4.6	--
	PM_{10}	Annual	0.9	1.2	1.5	4
		24-hour	**9.6**	**12.9**	**13.2**	8
Badlands NP	NO_2	Annual	0.1	0.2	0.2	2.5
	SO_2	Annual	0.5	0.6	0.6	2
		24-hour	3.6	4.0	4.0	5
		3-hour	8.1	8.2	8.2	25
	$PM_{2.5}$	Annual	0.2	0.3	0.3	--
		24-hour	2.1	3.0	3.1	--
	PM_{10}	Annual	0.7	0.9	1.0	4
		24-hour	5.9	**8.5**	**8.8**	8
Wind Cave NP	NO_2	Annual	0.2	0.3	0.3	2.5
	SO_2	Annual	0.7	0.8	0.8	2
		24-hour	3.7	4.6	4.7	5
		3-hour	7.0	7.5	7.7	25
	$PM_{2.5}$	Annual	0.4	0.5	0.5	--
		24-hour	3.8	4.6	4.7	--
	PM_{10}	Annual	1.0	1.4	1.4	4
		24-hour	**10.9**	**13.0**	**13.3**	8
Sensitive Class II Areas						
Cloud Peak WA	NO_2	Annual	0.06	0.12	0.12	25
	SO_2	Annual	0.2	0.3	0.3	20
		24-hour	2.0	2.5	2.5	91
		3-hour	8.0	8.9	9.0	512
	$PM_{2.5}$	Annual	0.2	0.2	0.2	--
		24-hour	2.6	3.2	3.3	--
	PM_{10}	Annual	0.5	0.7	0.7	17
		24-hour	7.4	9.1	9.3	30
Crow IR	NO_2	Annual	0.9	3.6	4.2	25
	SO_2	Annual	2.3	2.4	2.4	20
		24-hour	14.4	14.8	14.8	91
		3-hour	76.8	77.0	77.0	512
	$PM_{2.5}$	Annual	0.8	0.8	0.8	--
		24-hour	7.2	7.2	7.2	--
	PM_{10}	Annual	2.2	2.3	2.4	17
		24-hour	20.5	20.6	20.6	30

Note: **Bold** numbers indicate potential exceedences.

In the sensitive Class II areas, there are no modeled exceedences of the Class II PSD Increments. The modeled annual NO_2 impacts at the Cloud Peak Wilderness Area (WA) and Crow IR are projected to increase by a factor of 2 to 4, respectively, in 2020 as a result of projected CBNG and coal hauling activities. For comparison purposes, modeling results for all sensitive Class II areas are below PSD increment levels for both 2020 development scenarios.

Table ES-3 provides a detailed listing of visibility impacts for all analyzed Class I and sensitive Class II areas. Modeled visibility impacts at the identified Class I areas continue to show a similar pattern as exhibited for the base year (2004), with a high number of days with a greater than 10 percent change in visibility at the most impacted Class I areas. Visibility impacts at Badlands NP, Northern Cheyenne IR, and Wind Cave NP all have greater than 10 percent change for more than 200 days a year during the base year. These Class I areas are the top three Class I areas with the highest predicted change in light extinction in 2020. All but four of the sensitive Class II areas have more than 100 days per year with greater than a 10 percent change during the base year. The most significant visibility change to sensitive Class II areas in 2020 is predicted for Black Elk WA and Mount Rushmore National Monument. Class II areas do not have any visibility protection under federal or state law.

Table ES-3
Modeled Change in Visibility Impacts at Class I and Sensitive Class II Areas

Location	Base Year (2004) No. of Days >10%	2020 Lower Development Scenario Change in No. of Days > 10%	2020 Upper Development Scenario Change in No. of Days > 10%
Class I Areas			
Badlands NP	218	44	44
Bob Marshall WA	8	0	0
Bridger WA	144	5	5
Fitzpatrick WA	91	6	6
Fort Peck IR	105	20	21
Gates of the Mountain WA	55	4	4
Grand Teton NP	70	6	6
North Absaorka WA	61	8	8
North Cheyenne IR	243	59	60
Red Rock Lakes	42	3	3
Scapegoat WA	27	2	2
Teton WA	57	8	8
Theodore Roosevelt NP	178	24	24
UL Bend WA	77	18	18
Washakie WA	83	8	8
Wind Cave NP	262	28	31
Yellowstone NP	84	5	5
Sensitive Class II Areas			
Absaorka Beartooth WA	101	10	10
Agate Fossil Beds National Monument	251	26	26
Big Horn Canyon NRA	331	1	1
Black Elk WA	236	47	47
Cloud Peak WA	126	29	30
Crow IR	360	3	3
Devils Tower National Monument	274	31	32
Fort Belknap IR	66	14	15
Fort Laramie National Historic Site	260	15	16
Jedediah Smith WA	79	3	3
Jewel Cave National Monument	261	36	37
Lee Metcalf WA	97	2	2
Mount Naomi WA	51	1	1
Mount Rushmore National Monument	222	49	52
Popo Agie WA	139	6	6
Soldier Creek WA	268	19	19
Wellsville Mountain WA	130	17	17
Wind River IR	217	9	10

For acid deposition, all predicted impacts are below the deposition threshold values for both nitrogen and sulfur compounds. There are substantial percentage increases in deposition under the lower and upper development scenarios; however, impacts remain well below the nitrogen and sulfur levels of concern (1.5 and 5.0 kilograms per hectare per year, respectively). The acid neutralizing capacity of sensitive lakes also was analyzed, and results are summarized in **Table ES-4**. The base year study indicated that none of the lakes had predicted significant impacts except Upper Frozen Lake; however, the lower and upper development scenarios for 2020 show an increased impact at Florence Lake, leading to an impact above the 10 percent change in acid neutralizing capacity (ANC). Impacts also are predicted to be above the 1 micro-equivalent per liter (µeq/L) for Upper Frozen Lake.

Table ES-4
Predicted Total Cumulative Change in Acid Neutralizing Capacity of Sensitive Lakes

Location	Lake	Background ANC (µeq/L)	Area (hectares)	Base Year (2004) Change (percent)	2020 Lower Development Scenario Change (percent)	2020 Upper Development Scenario Change (percent)	Thresholds (percent)
Bridger WA	Black Joe	67	890	4.00	4.26	4.27	10
	Deep	60	205	4.70	4.98	4.99	10
	Hobbs	70	293	3.95	4.14	4.15	10
	Upper Frozen	5	64.8	2.42	2.55	2.56	1[1]
Cloud Peak WA	Emerald	55.3	293	5.24	6.69	6.80	10
	Florence	32.7	417	9.09	11.79	11.99	10
Fitzpatrick WA	Ross	53.5	4,455	2.72	2.89	2.90	10
Popo Agie WA	Lower Saddlebag	55.5	155	6.28	6.65	6.67	10

[1]Data for Upper Frozen Lake presented in changes in µeq/L. (For lakes with less than 25 µeq/L background ANC.)

The study also modeled impacts of selected hazardous air pollutant emissions (benzene, ethyl benzene, formaldehyde, n-hexane, toluene, and xylene) on receptors with the highest ambient impacts. The near-field receptors in Wyoming and Montana were analyzed for annual (chronic) and 1-hour (acute) impacts. Model results for the base year (2004) and 2020 development scenarios show that impacts are predicted to be well below the acute Reference Exposure Levels, non-carcinogenic Reference Concentrations for Chronic Inhalation, and carcinogenic risk threshold for all hazardous air pollutants. The maximally exposed individual's carcinogenic risk factor due to benzene exposure is predicted to increase 50 percent as a result of projected development in the PRB; however, even with this substantial increase, the predicted risk is well below USEPA carcinogenic risk thresholds.

ES.4 COMPARISON TO ORIGINAL TASK 3A REPORT

With a few notable exceptions, the original Task 3A qualitative projections for 2020 are consistent with the findings of the current quantitative update. One important difference between this updated study and previous findings is the large increase in projected 2020 impacts due to CBNG development. While the original Task 3A study was based on preliminary Task 2 CBNG development production, this updated study used the final Task 2 projections for CBNG development, which were 15 to 30 percent greater than the earlier estimate. This increase suggests that while previously coal development was the most significant contributor to projected future year increases, based on this updated study, CBNG development may have a secondary, or even primary, contribution to air quality impacts. An additional change relative to the original Task 3A projections is the incorporation of new information on RFDs identified in the original Task 2 Report. Several coal-fired power plants had revised their permits since the original Task 2 and Task 3A reports, and expanded or reduced their power-generating capacity. Despite revisions to several of the tools used to analyze cumulative air quality, the overall findings and projected changes of this updated study generally are consistent with the original qualitative results for 2020.

Ambient impacts of PM_{10} continue to be a concern, as well as $PM_{2.5}$, at near-field locations and Class II areas located in proximity to the study area. While, generally, annual impacts are diminished relative to the original study, short-term impacts increased under some conditions. Essentially, coal mine operations and CBNG development would continue to dominate the PM_{10} impacts; the power plants would continue to dominate the SO_2 impacts (although they would continue to be below the standards); and the overall source groups would continue to contribute to NO_2 impacts, although impacts should remain below the national and state annual NO_2 standard.

Visibility impacts continue to be significant, and the predicted changes in the impact (number of days with greater than 10 percent change in extinction) for year 2010 are more than doubled in 2020 at some locations.

Based on modeling results, none of the acid deposition thresholds were exceeded at Class I areas for either the lower or upper development scenarios for 2020. However, there is a concern relating to the acid deposition into sensitive lakes. The model results showed that the increased deposition, largely from SO_2 emissions from power plants, exceeded the thresholds of significance for the ANC at two sensitive (high alpine) lakes. The results indicate that with increased growth in power plant operations, the reduced ANC of the sensitive lakes would become significant and would need to be addressed carefully for each proposed major development project.