JONAH INFILL DRILLING PROJECT
DRAFT AIR QUALITY TECHNICAL SUPPORT DOCUMENT SUPPLEMENT

Prepared for

Bureau of Land Management
Wyoming State Office
Cheyenne, Wyoming

Pinedale Field Office
Pinedale, Wyoming

and

Wyoming Department of Environmental Quality
Air Quality Division
Cheyenne, Wyoming

Prepared by

TRC Environmental Corporation
Laramie, Wyoming

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TRC Project 35982

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EXECUTIVE SUMMARY

This Draft Air Quality Technical Support Document Supplement was prepared to document additional air quality analyses that have been performed for the Bureau of Land Management (BLM) in support of the proposed Jonah Infill Drilling Project (JIDP). The additional air quality modeling analyses supplement the air quality analyses that were performed and presented for a range of project alternatives in the *Draft Environmental Impact Statement, Jonah Infill Drilling Project, Sublette County, Wyoming* (DEIS) (BLM 2005) and summarized in detail in the *Draft Air Quality Technical Support Document for the Jonah Infill Drilling Project Environmental Impact Statement* (AQTSD) (TRC 2004). The additional air quality analyses quantify project-specific and cumulative air quality impacts from additional configurations of the proposed JIDP Preferred Alternative, and quantify project-specific and cumulative impacts from project and regional sources during the early-project-development stage of the JIDP. The additional analyses were deemed necessary by the BLM to 1) evaluate alternative potential mitigation strategies for the Preferred Alternative and 2) identify potential early-project-development stage impacts from JIDP and regional emissions (i.e., drilling) to determine if they would produce impacts greater than those projected for peak production within the JIDPA.

These analyses utilized the CALMET and CALPUFF models to assess impacts from project and non-project cumulative air emissions of PM_{10}, $PM_{2.5}$, NO_x, and SO_2 on air quality and air quality related values (AQRVs) at far-field and mid-field locations and within the JIDPA. Far-field pollutant impacts were assessed at Prevention of Significant Deterioration (PSD) Class I areas (Bridger, Fitzpatrick, Teton, and Washakie Wilderness Areas and Grand Teton and Yellowstone National Parks), and at sensitive PSD Class II areas (Popo Agie Wilderness Area and Wind River Roadless Area). Far-field analyses included impact assessments of concentration, visibility (regional haze), atmospheric deposition, and lake acidity at sensitive lakes within the Wilderness Areas (Black Joe, Deep, Hobbs, Lazy Boy, and Upper Frozen lakes within the Bridger Wilderness Area, Ross Lake in the Fitzpatrick Wilderness Area, and Lower Saddlebag Lake in the Popo Agie Wilderness Area). Mid-field visibility (regional haze) impact analyses were performed for the Wyoming regional community locations of Big Piney, Big Sandy, Boulder, Bronx, Cora, Daniel, Farson, LaBarge, Merna, and Pinedale, although these communities are classified as PSD Class II areas where no visibility protection exists under local, State, or Federal law. In-field analyses included assessments of concentration impacts within the JIDPA.

Preferred Alternative

Configurations of the Preferred Alternative that are different from those analyzed in the DEIS were modeled to provide a representation of a range of impacts possible under the Preferred Alternative. A low emissions scenario and a high emissions scenario were modeled, as were four potential levels of air pollution mitigation of proposed project sources through emission reductions within the JIDPA (emission reductions of 20%, 40%, 60%, and 80%). The modeling analyses for these additional configurations of the Preferred Alternative follow the methodologies described in the AQTSD, and are directly comparable to the analyses conducted for the DEIS. As in the DEIS modeling, the modeling scenarios were based upon anticipated field characteristics in year 2017, the presumed year of peak emissions. Only project emissions differed in this analysis from those modeled for the DEIS; non-project emissions remained the same.

The findings of the Preferred Alternative analyses are summarized in Tables ES-1 and ES-2. These tables summarize the impacts that could occur for the range of Preferred Alternative scenarios. Table ES-1 provides a summary of the potential concentration and deposition impacts from the Preferred Alternative high emissions case, low emissions case, and the high emissions mitigation case with an 80 percent emission reduction (maximum reduction). Table ES-2 provides a summary of the potential impacts to visibility (regional haze) for these scenarios. Results summaries shown in green (normal text) in these tables indicate that potential impacts are below ambient air quality standards, PSD increments, and BLM-recognized significant threshold values and levels of concern. Results summaries shown in red (**bold text**) indicate that potential impacts are above these levels. A complete disclosure of all modeled impacts from the Preferred Alternative analyses with comparisons to ambient air quality standards, PSD increments, and to BLM and other Federal Land Manager (FLM) significance threshold values and levels of concern is presented in the text of this document.

Table ES-1 Preferred Alternative Air Quality Concentrations and Deposition Impacts Summary

Air Quality Component	Criteria	Source Group & Impact Area	Preferred Alternative: WDR250 High Emissions Case	Preferred Alternative: WDR250 Low Emissions Case	Preferred Alternative: WDR250 80% Mitigation Case
Concentrations	Air Quality Standards	Project: In-Field	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS
		Cumulative: In-Field	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS
		Project: Far-Field	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS
		Cumulative: Far-Field	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS
	PSD Class I Increments[1]	Cumulative: Far-Field	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment
	PSD Class II Increments[1]	Cumulative: Far-Field	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment	PM_{10} < increment NO_2 < increment SO_2 < increment
Atmospheric Deposition	N Deposition	Project: Far-Field	**Bridger WA, N > DAT** **Fitzpatrick WA, N > DAT** **Popo Agie WA, N > DAT** **Wind River RA, N > DAT** Grand Teton NP, N < DAT Teton WA, N < DAT Yellowstone NP, N < DAT Washakie WA, N < DAT	**Bridger WA, N > DAT** Fitzpatrick WA, N < DAT **Popo Agie WA, N > DAT** **Wind River RA, N > DAT** Grand Teton NP, N < DAT Teton WA, N < DAT Yellowstone NP, N < DAT Washakie WA, N < DAT	**Bridger WA, N > DAT** Fitzpatrick WA, N < DAT **Popo Agie WA, N > DAT** Wind River RA, N < DAT Grand Teton NP, N < DAT Teton WA, N < DAT Yellowstone NP, N < DAT Washakie WA, N < DAT
		Total: Far-Field	N < LOC, All Areas	N < LOC, All Areas	N < LOC, All Areas
	S Deposition	Project: Far Field	**Bridger WA, S > DAT** Fitzpatrick WA, S < DAT Popo Agie WA, S < DAT Wind River RA, S < DAT Grand Teton NP, S < DAT Teton WA, S < DAT Yellowstone NP, S < DAT Washakie WA, S < DAT	Bridger WA, S < DAT Fitzpatrick WA, S < DAT Popo Agie WA, S < DAT Wind River RA, S < DAT Grand Teton NP, S < DAT Teton WA, S < DAT Yellowstone NP, S < DAT Washakie WA, S < DAT	Bridger WA, S < DAT Fitzpatrick WA, S < DAT Popo Agie WA, S < DAT Wind River RA, S < DAT Grand Teton NP, S < DAT Teton WA, S < DAT Yellowstone NP, S < DAT Washakie WA, S < DAT
		Total: Far-Field	S < LOC, All Areas	S < LOC, All Areas	S < LOC, All Areas
	Sensitive Lakes	Project: Far-Field	ANC Change < LAC, All Lakes	ANC Change < LAC, All Lakes	ANC Change < LAC, All Lakes
		Cumulative: Far-Field	ANC Change < LAC, All Lakes	ANC Change < LAC, All Lakes	ANC Change < LAC, All Lakes

[1] The PSD demonstrations serve information purposes only and do not constitute a regulatory PSD Increment consumption analysis.

Table ES-2 Preferred Alternative Visibility (Regional Haze) Impacts Summary

Air Quality Component	Impact Area	Source Group	Preferred Alternative: WDR250 High Emissions Case	Preferred Alternative: WDR250 Low Emissions Case	Preferred Alternative: WDR250 80% Mitigation Case
Visibility (Regional Haze)	PSD Class I and Sensitive Class II Areas	Project	**Bridger WA, >1.0-dv 31 days, max dv = 6.44**	**Bridger WA, >1.0-dv 9 days, max dv = 3.26**	**Bridger WA, >1.0-dv 3 days, max dv = 1.66**
			Fitzpatrick WA, >1.0-dv 3 days, max dv = 1.54	Fitzpatrick WA, >1.0-dv 0 days, max dv = 0.61	Fitzpatrick WA, >1.0-dv 0 days, max dv = 0.33
			Popo Agie WA, >1.0-dv 2 days, max dv = 1.36	Popo Agie WA, >1.0-dv 0 days, max dv = 0.59	Popo Agie WA, >1.0-dv 0 days, max dv = 0.29
			Wind River RA, >1.0-dv 1 days, max dv = 1.22	Wind River RA, >1.0-dv 0 days, max dv = 0.50	Wind River RA, >1.0-dv 0 days, max dv = 0.26
			Grand Teton NP, >1.0-dv 0 days, max dv = 0.66	Grand Teton NP, >1.0-dv 0 days, max dv = 0.31	Grand Teton NP, >1.0-dv 0 days, max dv = 0.14
			Teton WA, >1.0-dv 0 days, max dv = 0.28	Teton WA, >1.0-dv 0 days, max dv = 0.14	Teton WA, >1.0-dv 0 days, max dv = 0.06
			Yellowstone NP, >1.0-dv 0 days, max dv = 0.31	Yellowstone NP, >1.0-dv 0 days, max dv = 0.15	Yellowstone NP, >1.0-dv 0 days, max dv = 0.06
			Washakie WA, >1.0-dv 0 days, max dv = 0.48	Washakie WA, >1.0-dv 0 days, max dv = 0.23	Washakie WA, >1.0-dv 0 days, max dv = 0.10
		Cumulative	**Bridger WA, >1.0-dv 39 days, max dv = 6.82**	**Bridger WA, >1.0-dv 15 days, max dv = 3.78**	**Bridger WA, >1.0-dv 6 days, max dv = 2.62**
			Fitzpatrick WA, >1.0-dv 3 days, max dv = 1.58	Fitzpatrick WA, >1.0-dv 0 days, max dv = 0.85	Fitzpatrick WA, >1.0-dv 0 days, max dv = 0.57
			Popo Agie WA, >1.0-dv 6 days, max dv = 1.67	Popo Agie WA, >1.0-dv 0 days, max dv = 0.97	Popo Agie WA, >1.0-dv 0 days, max dv = 0.75
			Wind River RA, >1.0-dv 5 days, max dv = 1.54	**Wind River RA, >1.0-dv 2 days, max dv = 1.19**	Wind River RA, >1.0-dv 0 days, max dv = 0.96
			Grand Teton NP, >1.0-dv 0 days, max dv = 0.83	Grand Teton NP, >1.0-dv 0 days, max dv = 0.49	Grand Teton NP, >1.0-dv 0 days, max dv = 0.35
			Teton WA, >1.0-dv 0 days, max dv = 0.34	Teton WA, >1.0-dv 0 days, max dv = 0.23	Teton WA, >1.0-dv 0 days, max dv = 0.17
			Yellowstone NP, >1.0-dv 0 days, max dv = 0.40	Yellowstone NP, >1.0-dv 0 days, max dv = 0.25	Yellowstone NP, >1.0-dv 0 days, max dv = 0.18
			Washakie WA, >1.0-dv 0 days, max dv = 0.58	Washakie WA, >1.0-dv 0 days, max dv = 0.33	Washakie WA, >1.0-dv 0 days, max dv = 0.23
	Wyoming Regional Communities	Project	**Big Piney, >1.0-dv 18 days, max dv = 3.93**	**Big Piney, >1.0-dv 4 days, max dv = 1.89**	Big Piney, >1.0-dv 0 days, max dv = 0.92
			Big Sandy, >1.0-dv 62 days, max dv = 5.76	**Big Sandy, >1.0-dv 21 days, max dv = 2.92**	**Big Sandy, >1.0-dv 4 days, max dv = 1.45**
			Boulder, >1.0-dv 33 days, max dv = 4.58	**Boulder, >1.0-dv 10 days, max dv = 2.30**	**Boulder, >1.0-dv 2 days, max dv = 1.10**
			Bronx, >1.0-dv 9 days, max dv = 3.82	**Bronx, >1.0-dv 1 days, max dv = 1.60**	Bronx, >1.0-dv 0 days, max dv = 0.89
			Cora, >1.0-dv 14 days, max dv = 6.70	**Cora, >1.0-dv 1 days, max dv = 3.03**	**Cora, >1.0-dv 1 days, max dv = 1.75**
			Daniel, >1.0-dv 16 days, max dv = 5.50	**Daniel, >1.0-dv 1 days, max dv = 2.42**	**Daniel, >1.0-dv 1 days, max dv = 1.37**
			Farson, >1.0-dv 13 days, max dv = 4.88	**Farson, >1.0-dv 5 days, max dv = 2.21**	**Farson, >1.0-dv 1 days, max dv = 1.19**
			Labarge, >1.0-dv 6 days, max dv = 2.59	**Labarge, >1.0-dv 2 days, max dv = 1.27**	Labarge, >1.0-dv 0 days, max dv = 0.57
			Merna, >1.0-dv 5 days, max dv = 1.64	Merna, >1.0-dv 0 days, max dv = 0.75	Merna, >1.0-dv 0 days, max dv = 0.35
			Pinedale, >1.0-dv 21 days, max dv = 8.48	**Pinedale, >1.0-dv 3 days, max dv = 4.07**	**Pinedale, >1.0-dv 1 days, max dv = 2.37**
		Cumulative	**Big Piney, >1.0-dv 36 days, max dv = 4.32**	**Big Piney, >1.0-dv 19 days, max dv = 2.57**	**Big Piney, >1.0-dv 13 days, max dv = 2.28**
			Big Sandy, >1.0-dv 74 days, max dv = 6.18	**Big Sandy, >1.0-dv 32 days, max dv = 3.48**	**Big Sandy, >1.0-dv 12 days, max dv = 2.13**
			Boulder, >1.0-dv 40 days, max dv = 5.58	**Boulder, >1.0-dv 20 days, max dv = 3.60**	**Boulder, >1.0-dv 9 days, max dv = 3.09**
			Bronx, >1.0-dv 15 days, max dv = 3.88	**Bronx, >1.0-dv 1 days, max dv = 1.68**	Bronx, >1.0-dv 0 days, max dv = 0.97
			Cora, >1.0-dv 17 days, max dv = 6.77	**Cora, >1.0-dv 7 days, max dv = 3.13**	**Cora, >1.0-dv 2 days, max dv = 1.86**
			Daniel, >1.0-dv 23 days, max dv = 5.56	**Daniel, >1.0-dv 11 days, max dv = 2.52**	**Daniel, >1.0-dv 2 days, max dv = 1.47**
			Farson, >1.0-dv 21 days, max dv = 5.05	**Farson, >1.0-dv 11 days, max dv = 2.68**	**Farson, >1.0-dv 10 days, max dv = 1.87**
			Labarge, >1.0-dv 16 days, max dv = 3.97	**Labarge, >1.0-dv 11 days, max dv = 2.85**	**Labarge, >1.0-dv 6 days, max dv = 2.30**
			Merna, >1.0-dv 10 days, max dv = 1.93	**Merna, >1.0-dv 4 days, max dv = 1.11**	**Merna, >1.0-dv 1 days, max dv = 1.03**
			Pinedale, >1.0-dv 27 days, max dv = 8.56	**Pinedale, >1.0-dv 8 days, max dv = 4.18**	**Pinedale, >1.0-dv 6 days, max dv = 2.50**

Direct project and cumulative impacts from all modeled Preferred Alternative scenarios are less than applicable ambient air quality standards and PSD increments at all PSD Class I and sensitive Class II areas. The PSD demonstrations serve information purposes only and do not constitute a regulatory PSD Increment consumption analysis, which may be completed as necessary by WDEQ-AQD.

Direct project and cumulative impacts from all modeled Preferred Alternative scenarios are less than applicable ambient air quality standards with in JIDPA.

Direct project and cumulative impacts from all Preferred Alternative scenarios would result in no significant acidification at any acid-sensitive lake analyzed.

Direct project sulfur deposition impacts from the Preferred Alternative high emissions scenario were greater than the thresholds of concern at the Bridger Wilderness Area and less than the thresholds at all other sensitive areas. Direct project sulfur deposition impacts from all other Preferred Alternative scenarios were less than the thresholds. Direct project nitrogen deposition impacts from all Preferred Alternative scenarios were greater than the thresholds of concern at the Bridger and Popo Agie Wilderness Areas. Direct project nitrogen deposition impacts were greater than the thresholds of concern at the Wind River Roadless Area for the “low emissions” scenario, and at the Fitzpatrick Wilderness Area and Wind River Roadless Area for the “high emissions” scenario. The exceedences of these thresholds trigger a management concern but are not necessarily indicative of an adverse impact (NPS 2004).

Direct project and cumulative total deposition impacts from all Preferred Alternative scenarios were less than deposition levels of concern.

Direct project visibility (regional haze) impacts was greater than the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area for all analyzed scenarios, (ranging from 3 days per year up to 31 days per year), and under the high emissions scenario direct project visibility impacts were greater than the 1.0-dv threshold at the Fitzpatrick Wilderness

Area (maximum of 3 days), Popo Agie Wilderness Area (maximum of 2 days) and Wind River Roadless Area (maximum of 1 day).

Cumulative visibility impacts were greater than the 1.0-dv threshold at the Bridger Wilderness Area for all analyzed scenarios, (ranging from 6 days per year up to 39 days per year), and under the high emissions scenario impacts were greater than the 1.0-dv thresholds at the Fitzpatrick Wilderness Area (maximum of 3 days), Popo Agie Wilderness Area (maximum of 6 days) and Wind River Roadless Area (maximum of 5 days).

Direct project visibility impacts were greater than the 1.0-dv threshold at most of the analyzed mid-field locations, with maximum potential impacts ranging from 4 days per year at Big Sandy under the lowest emissions scenario up to 62 days per year under the "high emissions" scenario.

Cumulative visibility impacts were greater than the 1.0-dv threshold at most of the analyzed mid-field locations, with maximum potential impacts ranging from 12 days per year at Big Sandy under the lowest emissions scenario up to 74 days per year under the "high emissions" scenario.

Early-Project-Development Stage

An analysis of JIDP early-project-development stage air quality conditions in the vicinity of the JIDPA was also performed. What was modeled and presented for the Preferred Alternative considered the "most likely case" maximum emissions scenario for the JIDP. However, when quantifying maximum cumulative impacts regionally, it is possible that peak regional impacts could occur prior to JIDP maximum emissions as a result of the development of other natural gas projects in the region, specifically the Pinedale Anticline Project (PAP), South Piney Project (SPP), Riley Ridge Project (RRP), and Jack Morrow Hills Project (JMHP). The BLM performed this analysis because 1) regional impacts appear to be greatest during the early stages of JIDP development due to accelerated development paces in these nearby project areas, and 2) the emissions from increased drilling near Pinedale had not been adequately characterized in the

DEIS. The Record of Decision (ROD) for the Pinedale Anticline EIS (BLM 1999) stated that if emissions of nitrogen oxides (NOx) from the Jonah and Pinedale Anticline gas fields reached 693.5 tons per year, the BLM would perform further air quality analyses. The analysis for the Questar Year-round drilling EA (BLM 2004), published after completion of the DEIS analysis, indicated that NOx emissions had substantially exceeded that level, due mainly to emissions from drill rigs. Drill rig emissions were higher than assumed in the PAPA EIS because:

- there were more drill rigs operating than estimated;
- conditions required drill rig engines to have larger horsepower than estimated; and
- directional drilling required drill rigs to operate for a longer period of time per well than estimated.

Results for the early-project-development stage modeling analyses are summarized in Tables ES-3 and ES-4. Table ES-3 provides a summary of the potential concentration and deposition impacts for both direct project and cumulative scenarios and Table ES-4 provides a summary of the potential impacts to visibility (regional haze) for these scenarios. Results summaries shown in green (normal text) in these tables indicate that potential impacts are below ambient air quality standards, PSD increments, and BLM-recognized significant threshold values and levels of concern. Results summaries shown in red (**bold text**) indicate that potential impacts are above these levels. These modeling analyses are not directly comparable to the results presented earlier or in the DEIS due to differences in the regional emissions inventories and the expanded compression estimates included in this analysis. A complete disclosure of all modeled impacts from the early-project-development stage modeling analyses with comparisons to ambient air quality standards, PSD increments, and to BLM and other FLM significance threshold values and levels of concern is presented in the text of this document.

Direct project and cumulative impacts from early-project-development stage source emissions would be less than the applicable ambient air quality standards and PSD increments at all PSD Class I and sensitive Class II areas. The PSD demonstrations serve information purposes only and do not constitute a regulatory PSD Increment consumption analysis, which may be completed as necessary by WDEQ-AQD.

Direct project and cumulative impacts from early-project-development stage source emissions would be less than the applicable ambient air quality standards with in JIDPA.

Direct project and cumulative impacts from early-project-development stage source emissions would not result in significant acidification at any acid-sensitive lake analyzed.

Direct project sulfur deposition impacts from early-project-development stage source emissions would be below thresholds of concern at all analyzed sensitive areas.

Direct project nitrogen deposition impacts from early-project-development stage source emissions were greater than the thresholds of concern at the Bridger and Popo Agie Wilderness Areas. The exceedences of these thresholds trigger a management concern but are not necessarily indicative of an adverse impact (NPS 2004).

Table ES-3 Early-Project-Development-Stage Air Quality Concentrations and Deposition Impacts

Air Quality Component	**Criteria**	**Source Group & Impact Area**	**Early-Project-Development Stage: WDR250**
Concentrations	Air Quality Standards	Project: In-Field	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS
		Cumulative: In-Field	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS
		Project: Far-Field	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS
		Cumulative: Far-Field	PM_{10} < NAAQS&WAAQS $PM_{2.5}$ < NAAQS&WAAQS NO_2 < NAAQS&WAAQS SO_2 < NAAQS&WAAQS
	PSD Class I Increments[1]	Cumulative: Far-Field	PM_{10} < increment NO_2 < increment SO_2 < increment
	PSD Class II Increments[1]	Cumulative: Far-Field	PM_{10} < increment NO_2 < increment SO_2 < increment
Atmospheric Deposition	N Deposition	Project: Far-Field	**Bridger WA, N > DAT** Fitzpatrick WA, N < DAT **Popo Agie WA, N > DAT** Wind River RA, N < DAT Grand Teton NP, N < DAT Teton WA, N < DAT Yellowstone NP, N < DAT Washakie WA, N < DAT
		Total: Far-Field	N < LOC, All Areas
	S Deposition	Project: Far-Field	S < DAT, All Areas
		Total: Far-Field	S < LOC, All Areas
	Sensitive Lakes	Project: Far-Field	ANC Change < LAC, All Lakes
		Cumulative: Far-Field	ANC Change < LAC, All Lakes

[1] The PSD demonstrations serve information purposes only and do not constitute a regulatory PSD Increment consumption analysis.

Table ES-4 Early-Project-Development-Stage Visibility (Regional Haze) Impacts

Air Quality Component	**Impact Area**	**Source Group**	**Early-Project-Development Stage: WDR250**
Visibility (Regional Haze)	PSD Class I and Sensitive Class II Areas	Project	**Bridger WA, >1.0-dv 9 days, max dv = 2.42** Fitzpatrick WA, >1.0dv 0 days, max dv = 0.95 **Popo Agie WA, >1.0-dv 2 days, max dv = 1.06** **Wind River RA, >1.0-dv 1 days, max dv = 1.01** Grand Teton NP, >1.0-dv 0 days, max dv = 0.67 Teton WA, >1.0-dv 0 days, max dv = 0.37 Yellowstone NP, >1.0-dv 0 days, max dv = 0.32 Washakie WA, >1.0-dv 0 days, max dv = 0.43
		Cumulative	**Bridger WA, >1.0-dv 61 days, max dv = 6.57** **Fitzpatrick WA, >1.0-dv 11 days, max dv = 3.37** **Popo Agie WA, >1.0-dv 23 days, max dv = 3.35** **Wind River RA, >1.0-dv 15 days, max dv = 3.39** **Grand Teton NP, >1.0-dv 8 days, max dv = 2.63** **Teton WA, >1.0-dv 4 days, max dv = 1.33** **Yellowstone NP, >1.0-dv 3 days, max dv = 1.22** **Washakie WA, >1.0-dv 2 days, max dv = 1.70**
	Wyoming Regional Communities	Project	**Big Piney, >1.0-dv 24 days, max dv = 6.62** **Big Sandy, >1.0-dv 24 days, max dv = 3.66** **Boulder, >1.0-dv 18 days, max dv = 3.37** **Bronx, >1.0-dv 8 days, max dv = 1.79** **Cora, >1.0-dv 11 days, max dv = 2.17** **Daniel, >1.0-dv 14 days, max dv = 2.93** **Farson, >1.0-dv 33 days, max dv = 5.18** **Labarge, >1.0-dv 11 days, max dv = 5.73** **Merna, >1.0-dv 7 days, max dv = 2.46** **Pinedale, >1.0-dv 14 days, max dv = 2.94**
		Cumulative	**Big Piney, >1.0-dv 85 days, max dv = 14.43** **Big Sandy, >1.0-dv 108 days, max dv = 8.42** **Boulder, >1.0-dv 131 days, max dv = 10.59** **Bronx, >1.0-dv 63 days, max dv = 9.60** **Cora, >1.0-dv 73 days, max dv = 9.95** **Daniel, >1.0-dv 88 days, max dv = 12.68** **Farson, >1.0-dv 77 days, max dv = 10.85** **Labarge, >1.0-dv 39 days, max dv = 11.12** **Merna, >1.0-dv 33 days, max dv = 6.25** **Pinedale, >1.0-dv 113 days, max dv = 10.32**

Total deposition impacts from early-project-development stage source emissions and cumulative source emissions were less than deposition levels of concern.

Direct project visibility (regional haze) impacts from early-project-development stage source emissions were greater than the "just noticeable visibility change" (1.0-dv) threshold at the Bridger Wilderness Area (up to 9 days per year), Popo Agie Wilderness Area (maximum of 2 days) and at the Wind River Roadless Area (maximum of 1 day).

Cumulative visibility impacts from early-project-development stage sources and cumulative sources were greater than the 1.0-dv threshold at all of the analyzed areas with maximum impacts occurring at the Bridger Wilderness Area, (up to 61 days per year).

Direct project visibility impacts from early-project-development stage sources were greater than the 1.0-dv threshold at all of the analyzed mid-field locations, with maximum potential impacts occurring at Farson, where up to 33 days per year of impairment could occur.

Cumulative visibility impacts from early-project-development stage and regional sources were greater than the 1.0-dv threshold at all of the analyzed mid-field locations, with maximum potential impacts occurring at Boulder, where up to 131 days per year of impairment could occur.

TABLE OF CONTENTS

Section Page

1.0 INTRODUCTION 1

2.0 PREFERRED ALTERNATIVE MODELING ANALYSES 4
  2.1 LOW EMISSONS CONFIGURATION 6
  2.2 HIGH EMISSIONS CONFIGURATION 6
  2.3 MITIGATION ANALYSES 6
  2.4 MODEL RESULTS 7
    2.4.1 Concentration 9
    2.4.2 Deposition 11
    2.4.3 Sensitive Lakes 12
    2.4.4 Visibility 13

3.0 EARLY PROJECT DEVELOPMENT STAGE MODELING 19
  3.1 EMISSIONS INVENTORIES 21
    3.1.1 Year 2006 Drilling and Flaring Emissions 21
    3.1.2 Year 2002 Drilling and Flaring Emissions 23
    3.1.3 Expanded Compression 25
    3.1.4 Permitted Source Emissions Inventory 26
  3.2 MODEL PARAMETERS 26
  3.3 MODEL RESULTS 29
    3.3.1 Concentration 31
    3.3.2 Deposition 32
    3.3.3 Sensitive Lakes 32
    3.3.4 Visibility 33

LIST OF TABLES

Table 2.1 Modeling Scenarios Analyzed for Preferred Alternative and Regional Emissions, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005. 8

Table 2.2 NAAQS, WAAQS, PSD Class I and Class II Increments, and PSD Class I and Class II Significance Levels for Comparison to Far-field Analysis Results (µg/m^3). 9

Table 2.3 Background Ambient Air Quality Concentrations (µg/m^3). 11

Table 2.4 Background ANC Values for Acid Sensitive Lakes. 13

Table 2.5 IMPROVE Background Aerosol Extinction Values. 14

Table 2.6 FLAG Report Background Extinction Values.[1] 15

Table 2.7 Monthly f(RH) Factors from Regional Haze Rule Guidance. 16

Table 3.1 Summary of Year 2006 Drilling Rigs Counts and Flaring Operations.................22

Table 3.2 Summary of Year 2002 Drilling Rigs Counts and Flaring Operations..................24

Table 3.3 Summary of Expanded Field Compression Estimates..25

LIST OF FIGURES

Figure 1 Jonah Infill Project Study Area……………………………………………………3

Figure 2 Source Locations for Early Project Development Stage Assessment……………28

Figure 3 JIDP and Atlantic Rim/Seminoe Road Projects Cumulative Study Area………..30

LIST OF APPENDICES

APPENDIX A..................... JUNE 2005 AIR QUALITY IMPACT ASSESSMENT PROTOCOL

APPENDIX B ....PREFERRED ALTERNATIVE EMISSIONS INVENTORY

APPENDIX C ....PREFERRED ALTERNATIVE MODELING RESULTS

APPENDIX D..........EARLY PROJECT DEVELOPMENT STAGE EMISSIONS INVENTORY

APPENDIX E .... EARLY PROJECT DEVELOPMENT STAGE MODELING RESULTS

ACRONYMS AND ABBREVIATIONS

ANC	acid neutralizing capacity
AQRV	air quality related value
AQTSD	air quality technical support document
BLM	U.S. Department of Interior, Bureau of Land Management
CDPHE/APCD	Colorado Department of Public Health and Environment/Air Pollution Control Division
DAT	data analysis threshold (deposition)
DEIS	draft environmental impact statement
dv	deciview
EPA	U.S. Environmental Protection Agency
FEIS	final environmental impact statement
FLAG	Federal Land Manager's Air Quality Related Values Workgroup
FLM	Federal Land Manager
IDEQ	Idaho Division of Environmental Quality
JMHP	Jack Morrow Hills Project
JIDP	Jonah Infill Drilling Project
JIDPA	Jonah Infill Drilling Project Area
LAC	level of acceptable change (ANC)
LOC	level of concern (deposition)
LOP	life-of-project
NAAQS	national ambient air quality standard
NO_2	nitrogen dioxide
NO_x	oxides of nitrogen
NP	National Park
NPS	National Park Service
PAP	Pinedale Anticline Project
PM	particulate matter
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PSD	Prevention of Significant Deterioration
RA	road-less area
RFFA	reasonably foreseeable future actions
RFD	reasonably foreseeable development
RRP	Riley Ridge Project
SO_2	sulfur dioxide
SPP	South Piney Project
TRC	TRC Environmental Corporation
USDA Forest Service	U.S. Department of Agriculture, Forest Service
UDEQ-AQD	Utah Department of Environmental Quality-Air Quality Division

ACRONYMS AND ABBREVIATIONS (continued)

VOC	volatile organic compound
WA	wilderness area
WAAQS	Wyoming ambient air quality standard
WDEQ-AQD	Wyoming Department of Environmental Quality, Air Quality Division
WDR	well development rate
WOGCC	Wyoming Oil and Gas Conservation Commission
WRAP	Western Regional Air Partnership

1.0 INTRODUCTION

TRC Environmental Corporation (TRC) has prepared this Air Quality Technical Support Document (AQTSD) supplement to summarize additional air quality analyses that have been performed in support of the proposed Jonah Infill Drilling project (JIDP). These air quality modeling analyses have been requested by the Bureau of Land Management (BLM) to supplement the air quality analyses that were performed and presented for a range of project alternatives in the *Draft Environmental Impact Statement, Jonah Infill Drilling Project, Sublette County, Wyoming* (DEIS) (BLM 2005) and provided in detail in the *Draft Air Quality Technical Support Document for the Jonah Infill Drilling Project Environmental Impact Statement* (AQTSD) (TRC 2004). The additional air quality analyses quantify project-specific and cumulative air quality impacts from additional configurations of the proposed JIDP Preferred Alternative which were not analyzed as part of the DEIS, and quantify project-specific and cumulative impacts from potential emissions which reflect early-project-development stage conditions existing in the region surrounding the Jonah Infill Drilling Project area (JIDPA). The additional analyses were deemed necessary by the BLM to evaluate alternative potential mitigation strategies for the Preferred Alternative in an effort to identify possible project development requirements to reduce adverse air quality impacts, and to identify maximum early-project-development stage regional emissions (i.e., drilling) which could reveal that regional impacts are more severe at this stage due to impacts from the development of other regional projects, which at present have not been adequately evaluated.

The methodologies used for these analyses are described in the June 2005, *Air Quality Impact Assessment Protocol, Jonah Infill Drilling Project Draft Environmental Impact Statement Impact Analysis Supplement* (provided in Appendix A), which was developed by TRC with input from the BLM, Wyoming Department of Environmental Quality Air Quality Division (WDEQ-AQD), U.S. Environmental Protection Agency (EPA), National Park Service (NPS), and U.S. Department of Agriculture Forest Service (USDA Forest Service).

These analyses involve the use of the CALMET and CALPUFF models to assess impacts from project and non-project cumulative air emissions on air quality and air quality related values (AQRVs) at far-field and mid-field locations within the JIDPA cumulative study area, shown in Figure 1. Cumulative analyses include project impacts plus impacts from permitted sources, reasonably foreseeable development (RFD), and reasonably foreseeable future actions (RFFA) which were projected to exist after a specified date and would be located within a defined regional area (see TRC 2004 for further detail). All air emissions sources within the study domain were not explicitly modeled; some sources were considered to already be included ambient air background values. Far-field pollutant impacts were assessed at the Prevention of Significant Deterioration (PSD) Class I areas (Bridger, Fitzpatrick, Teton, and Washakie Wilderness Areas and Grand Teton and Yellowstone National Parks), and at the sensitive Class II Popo Agie Wilderness Area and Wind River Roadless Area. Far-field analyses include impact assessments of concentration, visibility, acid deposition, and lake acidity (at sensitive lakes within the Wilderness Areas). Mid-field visibility impact analyses were performed at the Wyoming regional community locations of Big Piney, Big Sandy, Boulder, Bronx, Cora, Daniel, Farson, LaBarge, Merna, and Pinedale.

The Preferred Alternative modeling analyses presented in this document are directly comparable to the analyses conducted for the DEIS. Unlike the Preferred Alternative modeling analyses, early-project-development stage modeling is not directly comparable to either the analyses conducted for the DEIS or the Preferred Alternative modeling analyses contained herein.

The remainder of this AQTSD supplement summarizes the analysis of the Preferred Alternative additional configurations (Section 2.0) and the analysis of early-project-development stage conditions in the JIDPA region (Section 3.0).

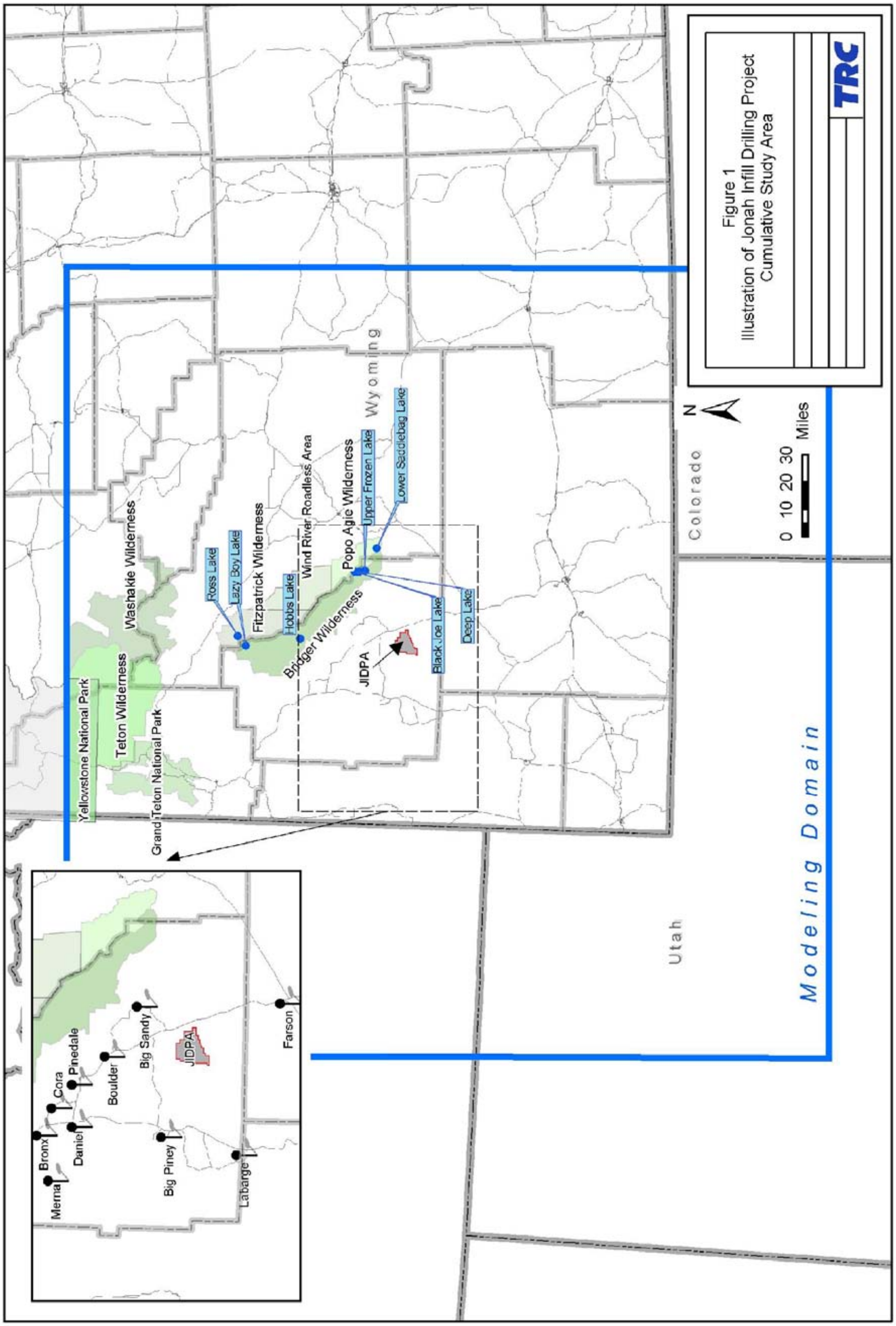


Figure 1
Illustration of Jonah Infill Drilling Project
Cumulative Study Area

2.0 PREFERRED ALTERNATIVE MODELING ANALYSES

The Preferred Alternative for the JIDP consists of the development of 3,100 new natural gas wells on approximately 8,316 acres of new surface disturbance in the JIDPA, and assumes approximately 50% directionally drilled wells and 50% straight hole wells. Depending upon the authorized rate of development (75, 150, or 250 wells per year), development operations are expected to last from approximately 12 to 42 years, with a total life-of-project (LOP) of approximately 76 to 105 years. Modeling scenarios presented in the DEIS for Alternative F approximate the potential impacts for the Preferred Alternative. These modeling scenarios assumed the maximum field emissions which could potentially occur concurrently (i.e., the final year of construction representing the maximum annual construction activity rate combined with nearly full-field production). Three well development rates (WDRs) were analyzed--250 wells/year (WDR250), 150 wells/year (WDR150), and 75 wells/year (WDR75). Modeling results presented in the DEIS for Alternative F with a WDR of 250 wells per year are assumed to represent the maximum impacts from the Preferred Alternative at peak year emissions. Peak year project emissions were assumed to occur in year 2017, and included emissions from 2,850 wells in production and 250 wells under construction, consistent with the field configuration anticipated for year 2017 (the field at nearly full production and the last year of construction in the field). The modeling also assumed a 50/50 split between straight and directional wells (consistent with the Preferred Alternative) and a 50/50 split between EPA Tier 1 and Tier 2 emissions levels for drilling rig engines. The modeling included 80 percent flareless completions (20 percent of completions flared) and JIDPA compression emissions at maximum levels projected at the time of the DEIS.

Additional configurations of the Preferred Alternative were modeled herein to provide a representation of the range of possible impacts (low and high emissions scenarios), and a representation of impacts which could occur using various mitigation methods in the JIDPA. Each of the modeling scenarios are based upon anticipated field characteristics in year 2017, the presumed year of peak project emissions. For the low and high emissions scenario, WDR250, WDR150 and WDR75 were analyzed (i.e., 20, 12, and 6 drill rigs operating continuously). The low emissions scenario assumes all drilling rig engines are at EPA Tier 2 emissions levels, and the high emissions scenario assumes a combination of 80 percent Tier 0 (AP-42) (EPA 1995) emission levels and 20 percent Tier 1 emission levels for the drilling rigs. Four mitigation scenarios were analyzed. The mitigation scenarios were based on emission reduction percentages of 20, 40, 60, and 80 percent from the JIDP high emissions configuration at a 250WDR. A total of 10 additional configurations of the Preferred Alternative were modeled to determine direct project impacts of PM_{10}, $PM_{2.5}$, NO_x, and SO_2 emissions. Only JIDP emissions differ from those previously modeled for the DEIS; non-project emissions remain unchanged. (Note that volatile organic compound [VOC] emissions were not modeled for this interim report, and revised VOC emissions and corresponding ozone impacts will be included in the final environmental impact statement [FEIS].) Direct project and regional emissions of PM_{10}, $PM_{2.5}$, NO_x, and SO_2 emissions were modeled for all scenarios, a total of 20 modeling scenarios. These additional scenarios are described in Sections 2.1 – 2.3.

Non-project regional emissions include sources newly permitted by state agencies through June 30, 2003, RFD, RFFA, and Operator-projected compressions estimates. These data were originally compiled as part of the DEIS using data obtained from the BLM, WDEQ-AQD, Colorado Department of Public Health and Environment/Air Pollution Control Division (CDPHE/APCD), Utah Department of Environmental Quality-Air Quality Division (UDEQ-AQD), and Idaho Division of Environment Quality (IDEQ). These non-project regional sources are modeled as they were in the DEIS to maintain consistency and comparability with results reported in the original DEIS and AQTSD.

Modeling analyses for these additional configurations follow the methodologies described in the *Air Quality Impact Assessment Protocol, Jonah Infill Drilling Project, Sublette County, Wyoming* (2003 Protocol) (TRC 2003) which preceded the AQTSD, and are directly comparable to the analyses conducted for the DEIS. The CALMET (Version 5.53) and CALPUFF (Version 5.711) modeling system that was developed and applied for the DEIS analyses was used to estimate both project and cumulative pollutant impacts at far-field PSD Class I and sensitive Class II areas, at mid-field Wyoming regional community locations, and within the JIDPA. All model methodologies, switch settings, source parameters, and model receptors are identical to analyses performed for the DEIS. Model results for the Preferred Alternative scenarios are summarized in Section 2.4.

2.1 LOW EMISSIONS CONFIGURATION

Project sources for the low emissions analysis included all drilling rig engine emissions at Tier 2 emission levels. WDRs of 250, 150, and 75 were analyzed, with 20, 12, and 6 drill rigs operating continuously, respectively. A 50/50 split between straight and directionally drilled wells was assumed. All other project sources were identical to Alternative F in the DEIS. Drill rig engine sizes and source parameters are also consistent with assumptions in the DEIS. Tier 2 drilling rig emissions calculations are shown in Appendix B. A summary of all project emissions modeled is provided in Table B.1.1 of Appendix B. Modeling was performed for both project-specific and cumulative emissions scenarios.

2.2 HIGH EMISSIONS CONFIGURATION

Project sources for the high emissions analysis included 80% of drilling rig engine emissions at Tier 0 emission levels (AP-42 levels) (EPA 1995) and 20% of engine emissions at Tier 1 emission levels. WDR250, WDR150, and WDR75 were analyzed, with 20, 12, and 6 drill rigs operating continuously, respectively. A 50/50 split between straight and directionally drilled wells was assumed. All other project sources were identical to Alternative F in the DEIS. Drill rig engine sizes and source parameters are also consistent with assumptions in the DEIS. Tier 0 and Tier 1 drilling rig emissions calculations are shown in Appendix B. A summary of all project emissions modeled is provided in Table B.1.1 of Appendix B. Modeling was performed for both project-specific and cumulative emissions scenarios.

2.3 MITIGATION ANALYSES

Because the actual mitigation methods to be utilized in the JIDPA are not yet known, four general mitigation scenarios were analyzed, each assuming a certain percentage of emissions control would occur in the field. The scenarios were based on the JIDP Preferred Alternative high emissions configuration at a 250WDR with a 50/50 split between straight and directionally drilled wells. This configuration was analyzed with emissions at 1) 80% of Preferred Alternative high emissions, 2) 60% of Preferred Alternative high emissions, 3) 40% of Preferred Alternative high emissions, and 4) 20% of Preferred Alternative high emissions. These analyses are sensitivity modeling runs that can be used to identify minimum impacts levels from project-specific source emissions. Drill rig engine sizes and source parameters are consistent with assumptions presented in the DEIS. A summary of project emissions modeled for each mitigation scenario is provided in Table B.1 of Appendix B. Modeling was performed for both project-specific and cumulative emissions scenarios.

2.4 MODEL RESULTS

CALPUFF modeling was performed to compute direct project impacts for each of the analyzed scenarios and for estimating cumulative impacts from potential project and regional sources. Regional emission inventories of existing state-permitted RFD and RFFA sources were modeled in combination with project sources to provide cumulative impact estimates for each scenario. A total of 20 modeling scenarios were evaluated in this analysis. These model results are directly comparable to all other alternatives analyzed and presented in the DEIS. A list of these scenarios is summarized in Table 2.1.

For each far-field sensitive area, CALPUFF-modeled concentration impacts were post-processed with POSTUTIL and CALPOST to derive: 1) concentrations for comparison to Wyoming and National ambient air quality standards (WAAQS and NAAQS), PSD Class I significance thresholds, and PSD Class I and II Increments; 2) deposition rates for comparison to sulfur (S) and nitrogen (N) deposition levels of concern and to calculate changes to acid neutralizing capacity (ANC) at sensitive lakes; and 3) light extinction changes for comparison to visibility impact thresholds. For the mid-field analyses, CALPOST concentrations were post-processed to

Table 2.1 Modeling Scenarios Analyzed for Preferred Alternative and Regional Emissions, Jonah Infill Drilling Project, Sublette County, Wyoming, 2005.

Modeling Scenario	Source Impacts Evaluated	Scenario Description	Number of New Wells in Production	Number of Wells under Construction
1	Direct Project	Low Emissions – Tier 2 Drill Rigs	2,850	250/year
2	Direct Project	Low Emissions – Tier 2 Drill Rigs	2,950	150/year
3	Direct Project	Low Emissions – Tier 2 Drill Rigs	3,025	75/year
4	Direct Project	High Emissions – 80% Tier 0, 20% Tier 1 Drill Rigs	2,850	250/year
5	Direct Project	High Emissions – 80% Tier 0, 20% Tier 1 Drill Rigs	2,950	150/year
6	Direct Project	High Emissions – 80% Tier 0, 20% Tier 1 Drill Rigs	3,025	75/year
7	Direct Project	Mitigation Analysis (20 % Emissions Reduction)	2,850	250/year
8	Direct Project	Mitigation Analysis (40 % Emissions Reduction)	2,850	250/year
9	Direct Project	Mitigation Analysis (60 % Emissions Reduction)	2,850	250/year
10	Direct Project	Mitigation Analysis (80 % Emissions Reduction)	2,850	250/year
11	Cumulative[1]	Low Emissions – Tier 2 Drill Rigs	2,850	250/year
12	Cumulative[1]	Low Emissions – Tier 2 Drill Rigs	2,950	150/year
13	Cumulative[1]	Low Emissions – Tier 2 Drill Rigs	3,025	75/year
14	Cumulative[1]	High Emissions – 80% Tier 0, 20% Tier 1 Drill Rigs	2,850	250/year
15	Cumulative[1]	High Emissions – 80% Tier 0, 20% Tier 1 Drill Rigs	2,950	150/year
16	Cumulative[1]	High Emissions – 80% Tier 0, 20% Tier 1 Drill Rigs	3,025	75/year
17	Cumulative[1]	Mitigation Analysis (20 % Emissions Reduction)	2,850	250/year
18	Cumulative[1]	Mitigation Analysis (40 % Emissions Reduction)	2,850	250/year
19	Cumulative[1]	Mitigation Analysis (60 % Emissions Reduction)	2,850	250/year
20	Cumulative[1]	Mitigation Analysis (80 % Emissions Reduction)	2,850	250/year

1. Includes regional source emissions inventory.

estimate light extinction changes at regional communities for comparison to the visibility impact thresholds. For in-field locations, CALPUFF concentrations were post-processed to compute maximum concentration impacts for comparison to WAAQS and NAAQS. All post-processing methods and background data assumptions are consistent with the analyses presented in the DEIS.

2.4.1 Concentration

The CALPOST and POSTUTIL post-processors were used to summarize concentration impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ at PSD Class I and sensitive PSD Class II areas and at in-field locations. Predicted impacts are compared to applicable ambient air quality standards, PSD Class I and Class II Increments, and significance levels as shown in Table 2.2.

Table 2.2 NAAQS, WAAQS, PSD Class I and Class II Increments, and PSD Class I and Class II Significance Levels for Comparison to Far-field Analysis Results ($\mu g/m^3$).

Pollutant/Averaging Time	NAAQS	WAAQS	PSD Class I Increment	PSD Class II Increment	PSD Class I Significance Level[1]	PSD Class II Significance Level
NO_2						
Annual[2]	100	100	2.5	25	0.1	1.0
SO_2						
3-hour[3]	1,300	1,300	25	512	1.0	25.0
24-hour[3]	365	260	5	91	0.2	5.0
Annual[2]	80	60	2	20	0.1	1.0
PM_{10}						
24-hour[3]	150	150	8	30	0.3	5.0
Annual[2]	50	50	4	17	0.2	1.0
$PM_{2.5}$						
24-hour[4]	65	65	--	--	--	--
Annual [4]	15	15	--	--	--	--

[1] Proposed Class I significance levels from 61 *Federal Register* 142, pg. 38292, July 23, 1996.
[2] Annual arithmetic mean.
[3] No more than one exceedance per year is allowed.
[4] Standard not yet enforced in Wyoming; -- = no current or proposed value.

The PSD demonstrations serve information purposes only and do not constitute a regulatory PSD Increment consumption analysis, which may be completed as necessary by WDEQ-AQD. The approach to this PSD screening analysis is consistent with the 2003 Protocol.

PM_{10} concentrations were computed by adding predicted CALPUFF concentrations of PM_{10} (fraction of PM greater than $PM_{2.5}$), $PM_{2.5}$, SO_4, and NO_3. $PM_{2.5}$ concentrations were calculated as the sum of modeled $PM_{2.5}$, SO_4, and NO_3 concentrations. Consistent with the DEIS analyses for post-processing the PM_{10} impacts at all far-field receptor locations, project traffic emissions of PM_{10} (production and construction) were not included in the total estimated impacts, only the $PM_{2.5}$ impacts were considered. This assumption was based on supporting documentation from the Western Regional Air Partnership (WRAP) analyses of mechanically generated fugitive dust emissions that suggest that particles larger than $PM_{2.5}$ tend to deposit out rapidly near the emissions source and do not transport over long distances (Countess et al. 2001). However, the total PM_{10} impacts from traffic emissions were included in all in-field concentration estimates.

Far-field Results

The maximum predicted concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ at each of the analyzed PSD Class I and sensitive Class II areas, for each of the 20 modeled direct project and cumulative source scenarios, are provided in Appendix C. Predicted direct impacts are compared to applicable PSD Class I and Class II Increments and significance levels, and then added to representative background pollutant concentrations (Table 2.3), the total concentration is compared to applicable NAAQS and WAAQS. Cumulative impacts from all analyzed scenarios are compared directly to applicable PSD Class I and Class II Increments, and to the NAAQS and WAAQS when background pollutant concentrations are added. Tables C.1.1-C.1.20 provide the maximum modeled NO_2 concentrations at each of the sensitive areas. The maximum modeled SO_2 concentrations are provided in Tables C.2.1-C.2.20, and the maximum modeled PM_{10} and $PM_{2.5}$ impacts are provided in Tables C.3.1-C.3.20, and Tables C.4.1-C.4.20, respectively. Summaries of results by scenario for NO_x, SO_2, PM_{10}, and $PM_{2.5}$ are provided in Tables C.10.1-C10.2, C.10.3-C.10.4, C.10.5-C.10.6, and C.10.7-C.10.8, respectively.

Table 2.3 Background Ambient Air Quality Concentrations ($\mu g/m^3$).

Pollutant	Averaging Period	Measured Background Concentration
NO_2[1]	Annual	3.4
PM_{10}[2]	24-hour	33
	Annual	16
$PM_{2.5}$[2]	24-hour	13
	Annual	5
SO_2[3]	3-hour	132
	24-hour	43
	Annual	9

[1] Data collected at Green River Basin Visibility Study site, Green River, Wyoming during period January-December 2001 (Air Resource Specialists 2002).

[2] Data collected by WDEQ-AQD at Emerson Building, Cheyenne, Wyoming, Year 2001.

[3] Data collected at LaBarge Study Area at the Northwest Pipeline Craven Creek Site 1982-1983.

In-Field Results

The maximum predicted concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ within and nearby the JIDPA, for each of the 20 modeled direct project and cumulative scenarios are provided in Appendix C, Tables C.5.1 - C.5.20. A summary of results by scenario is provided in Tables C.10.9 and C.10.10. Predicted direct project and cumulative impacts are added to representative background pollutant concentrations and are compared to applicable NAAQS and WAAQS.

2.4.2 Deposition

Maximum predicted S and N deposition impacts were estimated for each analyzed direct project and cumulative source scenario. The POSTUTIL utility was used to estimate total S and N fluxes from CALPUFF predicted wet and dry fluxes of SO_2, SO_4, NO_x, NO_3, and HNO_3. CALPOST was then used to summarize the annual S and N deposition values from the POSTUTIL program. Predicted direct project impacts were compared to the NPS deposition analysis thresholds (DATs) for total N and S deposition in the western U.S., which are defined as 0.005 kilograms per hectare per year (kg/ha-year) for both N and S. Total deposition impacts from direct project and regional sources were compared to USDA Forest Service levels of concern, defined as 5 kg/ha-yr for S and 3 kg/ha-yr for N (Fox et al. 1989). It is understood that the USDA Forest Service no longer considers these levels of concern to be protective; however, in the absence of alternative Federal Land Manager (FLM)-approved values, comparisons with these values were made. The maximum predicted N and S deposition impacts for each of the analyzed scenarios are provided in Appendix C, Tables C.6.1 – C.6.4. A summary of results by scenario is provided in Tables C.10.11 - C.10.14.

2.4.3 Sensitive Lakes

The CALPUFF-predicted annual deposition fluxes of S and N at sensitive lake receptors were used to estimate the change in acid neutralizing capacity (ANC). A list of the sensitive lakes and the background ANC values is provided in Table 2.4. The change in ANC was calculated following the January 2000, USDA Forest Service Rocky Mountain Region's *Screening Methodology for Calculating ANC Change to High Elevation Lakes, User's Guide* (USDA Forest Service 2000). The predicted changes in ANC are compared with the USDA Forest Service's Level of Acceptable Change (LAC) thresholds of 10% for lakes with ANC values greater than 25 microequivalents per liter (µeq/l) and 1 µeq/l for lakes with background ANC values of 25 µeq/l or less. Of the seven lakes listed in Table 2.4 and identified by the USDA Forest Service as acid sensitive, Upper Frozen and Lazy Boy lakes are considered extremely acid sensitive.

ANC calculations were performed for each of the analyzed direct project and cumulative source scenarios, with the results presented in Appendix C, Tables C.7.1 – C.7.20. A summary of results by scenario is provided in Tables C.10.15 and C.10.16.

Table 2.4 Background ANC Values for Acid Sensitive Lakes.

Wilderness Area	Lake	Latitude (Deg-Min-Sec)	Longitude (Deg-Min-Sec)	10th Percentile Lowest ANC Value (μeq/l)	Number of Samples	Monitoring Period
Bridger	Black Joe	42°44'22"	109°10'16"	67.0	61	1984-2003
Bridger	Deep	42°43'10"	109°10'15"	59.9	58	1984-2003
Bridger	Hobbs	43°02'08"	109°40'20"	69.9	65	1984-2003
Bridger	Lazy Boy	43°19'57"	109°43'47"	18.8	1	1997
Bridger	Upper Frozen	42°41'13"	109°09'39"	5.0	6	1997-2003
Fitzpatrick	Ross	43°22'41"	109°39'30"	53.5	44	1988-2003
Popo Agie	Lower Saddlebag	42°37'24"	108°59'38"	55.5	43	1989-2003

2.4.4 Visibility

The CALPUFF model-predicted concentration impacts at far-field PSD Class I and sensitive Class II areas and at mid-field regional community locations were post-processed with CALPOST to estimate potential impacts to visibility (regional haze) for each analyzed direct project and cumulative source scenario for comparison to visibility impact thresholds. CALPOST estimated visibility impacts from predicted concentrations of PM_{10}, $PM_{2.5}$, SO_4, and NO_3. PM_{10} emissions from project traffic emissions were not included in the total estimated impacts (see Section 2.4.1), only the impacts to visibility from $PM_{2.5}$ were considered.

Visibility impairment calculations were performed using estimated natural background visibility conditions obtained from FLAG (2000) (FLAG method) and measured background visibility conditions from the Bridger Wilderness Area and Yellowstone National Park IMPROVE sites (IMPROVE method). IMPROVE-method data are based on the quarterly mean of the 20% cleanest days as shown in Table 2.5.

Table 2.5 IMPROVE Background Aerosol Extinction Values.[1]

IMPROVE Site	Quarter	Hygroscopic (Mm^{-1})[2]	Non-hygroscopic (Mm^{-1})[2]	Monitoring Period
Bridger Wilderness Area	1	0.845	1.666	1989-2002
	2	1.730	3.800	1988-2002
	3	1.902	5.637	1988-2002
	4	0.915	2.035	1988-2002
Yellowstone National Park	1	1.126	2.973	1988-2002
	2	1.502	4.531	1988-2002
	3	1.811	7.330	1988-2002
	4	1.033	2.990	1988-2002

[1] Cooperative Institute for Research in the Atmosphere (2003).
[2] Mm^{-1} = inverse megameters.

The IMPROVE background visibility data are provided as reconstructed aerosol total extinction data, based on the quarterly mean of the 20% cleanest days measured at the Bridger Wilderness Area and Yellowstone National Park IMPROVE sites for the historical monitoring period of record through December 2002.

For the FLAG method, estimated natural background visibility values as provided in Appendix 2.B of FLAG (2000), and monthly relative humidity factors as provided in the *Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule* (EPA 2003) were used. The natural background visibility data used with the FLAG visibility analysis for each area analyzed are shown in Table 2.6.

Table 2.6 FLAG Report Background Extinction Values.[1]

Site	Season	Hygroscopic (Mm^{-1})[2]	Non-hygroscopic (Mm^{-1})[2]
Bridger, Fitzpatrick , Teton, and Waskakie Wilderness Areas, and Grand Teton and Yellowstone National Parks[3]	Winter	0.6	4.5
	Spring	0.6	4.5
	Summer	0.6	4.5
	Fall	0.6	4.5

[1] FLAG (2000).
[2] Mm^{-1} = inverse megameters
[3] Also used for Popo Agie Wilderness, Wind River Roadless Area, and regional communities.

The IMPROVE method used the measured background conditions at the Bridger Wilderness Area and at the Yellowstone National Park site, and the monthly relative humidity factors as provided in EPA (2003). Visibility data from the Bridger Wilderness Area IMPROVE site were used for the Bridger, Fitzpatrick, and Popo Agie Wilderness Areas and for the Wind River Roadless Area, and visibility data from the Yellowstone National Park IMPROVE site were used for the Teton and Washakie Wilderness Areas and for Grand Teton and Yellowstone National Parks. Background visibility data measured at the Bridger Wilderness Area IMPROVE site are cleaner (more pristine) than the FLAG data during quarters 1 and 4. Therefore since visibility impacts are calculated as percent increases of modeled light extinction above background values, the use of these more pristine background data will result in higher estimated visibility impacts than with the use of the FLAG natural background data during these quarters.

CALPOST visibility processing method “MVISBK=6” was used in combination with the two sets of background visibility data and monthly relative humidity factors. These visibility processing methods are consistent with the original DEIS and AQTSD analyses.

Background visibility data monitored at the Bridger Class I Wilderness Area IMPROVE site, an area more pristine than populated residential areas (i.e., lacking suburban/rural emissions such as those from traffic and wood stoves), were used to estimate potential visibility impairment at the regional community locations. These data were used because no visibility monitoring has been conducted in the populated areas of the region. Since visibility impacts are calculated as percent increases of modeled light extinction above background values, the use of a more pristine background likely results in an overestimate of potential visibility impacts at these locations.

As recommended in EPA (2003), monthly relative humidity factors determined from the Bridger IMPROVE site were used for the Bridger and Fitzpatrick Wilderness Areas; Yellowstone IMPROVE data were used for Yellowstone and Grand Teton National Parks and for the Teton Wilderness Area; and North Absaroka IMPROVE data were used for the Washakie Wilderness Area. Relative humidity data for the Bridger site were also used for the Popo Agie Wilderness Area and for the Wind River Roadless Area. Table 2.7 provides the relative humidity factors (f[RH]) that were used in the analyses.

Table 2.7 Monthly f(RH) Factors from Regional Haze Rule Guidance.

IMPROVE Site	Quarter	Months	f(RH) Values
Bridger Wilderness Area[1]	1	Jan, Feb, Mar	2.5, 2.3, 2.3
	2	Apr, May, Jun	2.1, 2.1, 1.8
	3	Jul, Aug, Sep	1.5, 1.5, 1.8
	4	Oct, Nov, Dec	2.0, 2.5, 2.4
North Absaroka Wilderness Area[2]	1	Jan, Feb, Mar	2.4, 2.2, 2.2
	2	Apr, May, Jun	2.1, 2.1, 1.9
	3	Jul, Aug, Sep	1.6, 1.5, 1.8
	4	Oct, Nov, Dec	2.0, 2.3, 2.4
Yellowstone National Park[3]	1	Jan, Feb, Mar	2.5, 2.3, 2.2
	2	Apr, May, Jun	2.1, 2.1, 1.9
	3	Jul, Aug, Sep	1.7, 1.6, 1.8
	4	Oct, Nov, Dec	2.1, 2.4, 2.5

[1] Used for Bridger, Fitzpatrick, and Popo Agie Wilderness Areas, Wind River Roadless Area, and regional communities.
[2] Used for Washakie Wilderness Area.
[3] Used for Teton Wilderness Area and Yellowstone and Grand Teton National Parks.

Change in atmospheric light extinction relative to background conditions is used to measure regional haze. Analysis thresholds for atmospheric light extinction are set forth in FLAG (2000), with the results reported in percent change in light extinction and change in deciview (dv). The thresholds are defined as 5% and 10% of the reference background visibility or 0.5 and 1.0 dv for project sources alone and cumulative source impacts, respectively. The BLM considers a 1.0 dv change as a significant adverse impact; however, there are no applicable local, state, tribal, or federal regulatory visibility standards. It is the responsibility of the FLM or Tribal government responsible for that land to determine when adverse impacts are significant or not, and these may differ from BLM levels for significant adverse impacts (e.g., the USDA Forest Service considers a 0.5-dv change as a threshold for protection of visibility in sensitive areas).

Far-Field Results

The maximum predicted far-field visibility impacts for each of the analyzed scenarios are provided in Appendix C, Tables C.8.1 – C.8.20. A summary of results by scenario is provided in Tables C.10.17 - C.10.20. Predicted impacts are shown using both the FLAG and IMPROVE background visibility data. For each Class I and sensitive Class II area the maximum predicted change in dv and the estimated number of days per year that could potentially exceed 0.5 and 1.0 dv thresholds are provided. Tables that present all predicted impacts above the thresholds and the days when the impacts were predicted to occur are also provided in Appendix C (Tables C.8.21 – C.8.32) for each Class I and sensitive Class II area where the maximum predicted change in dv is estimated to exceed 0.5 and 1.0 dv thresholds.

Mid-Field Results

The maximum predicted mid-field visibility impacts for each of the analyzed Preferred Alternative scenarios are provided in Appendix C, Tables C.9.1 – C.9.20. A summary of results by scenario is provided in Tables C.10.21 - C.10.24. Predicted impacts are shown using both the FLAG and IMPROVE background visibility data. The maximum predicted visibility impacts (dv) at regional communities and the estimated number of days per year that could potentially exceed the 1.0 dv threshold are provided for each community location using both the FLAG and IMPROVE background visibility data. Tables that present all predicted impacts above the threshold and the days when the impacts were predicted to occur are also provided in Appendix C (Tables C.9.21 – C.9.40) for each regional community location.

3.0 EARLY-PROJECT-DEVELOPMENT STAGE MODELING

At the request of the BLM, an analysis of JIDP early-project-development stage air quality conditions in the vicinity of the JIDPA was performed. What has been modeled and presented in the DEIS and supplemented herein for the Preferred Alternative (see Section 2.0) considers the "most likely case" emissions scenarios for the JIDP. However, when quantifying maximum cumulative impacts regionally, it is possible that peak regional impacts could occur prior to JIDP maximum emissions as a result of the development of other natural gas projects in the region, specifically the Pinedale Anticline Project (PAP), South Piney Project (SPP), Riley Ridge Project (RRP), and Jack Morrow Hills Project (JMHP). The BLM requested this analysis because it was considered probable that regional impacts would be greatest during the early stages of JIDP development due to accelerated development paces in these nearby project areas. Unlike the Preferred Alternative modeling analyses (see Section 2.0), modeling analyses of the early-project-development stage emissions are not directly comparable to the results presented in the DEIS for reasons explained below.

The goal of this analysis was to quantify a maximum PM_{10}, $PM_{2.5}$, NO_x, and SO_2 emissions scenario that could potentially occur within the next few years in the air basin located southwest of the Bridger Wilderness Area, as a result of 1) increased well drilling and flaring activities among several active natural gas field developments, and 2) expanded compression requirements, beyond what was analyzed for the DEIS. To accomplish this goal a study baseline year, determined based on available background pollutant data, was selected. Emissions estimates of well drilling and flaring were quantified for this baseline year for the JIDP, PAP, SPP, RRP and JMHP. Emission estimates of well drilling, flaring, and expanded compression for these projects, and other companies operating within these project areas, which are representative of current year or early-project-development stage conditions, were then determined. Emission estimates for the baseline year were subtracted from the early-project-development stage emissions. This emissions "netting" determined the emissions changes from background to current conditions, and avoided "double-counting" existing background conditions in future air quality conditions. These emission changes were then modeled in combination with other JIDP sources and regional sources to estimate both project-specific and cumulative pollutant impacts at far-field PSD Class I and sensitive Class II areas, at mid-field Wyoming regional community locations, and within the JIDPA. Other JIDP sources include expanded compression estimates beyond what was analyzed for the DEIS, production and construction traffic emissions and wellsite heater emission representative of early project emissions, and wind erosion as it was calculated and analyzed in the DEIS (BLM 2005, TRC 2004). Non-project regional emissions, with the exception of the PAP, SPP, RRP, and JMHP, included in the DEIS and as described in detail in the AQTSD were included in the modeling analyses. For the PAP, SPP, RRP, and JMHP, the well drilling and flaring emissions differences were included along with any emissions that were included in the permitted source and RFD inventories for the DEIS analyses. The regional emissions include sources newly permitted by the state agencies through June 30, 2003, RFD, RFFA, and Operator-projected compression estimates. These data were originally compiled as part of the DEIS using data obtained from the BLM, WDEQ-AQD, CDPHE/APCD, UDEQ-AQD, and IDEQ. These inventories were updated to include additional source emissions permitted through March 31, 2004, and these additional source emissions were included in the cumulative modeling analyses.

The emissions information available for well drilling and flaring activities and expanded compression requirements, obtained prior to a cut-off date of May 26, 2005, were used in the analysis. A study baseline year of 2002 was used because background visibility data through 2002 were available. Year 2006 was selected as representative of a maximum emissions scenario for regional emissions. The 2006 inventory also included recent expanded compression estimates, in addition to the expanded compression estimates that were obtained prior to the DEIS analyses and included in the DEIS modeling. Details on the additional emissions inventories developed for this analysis are provided in Section 3.1. The modeling analyses of the early-project-development stage emissions are not directly comparable to the results presented in Section 2.4 or in the DEIS due to differences (emissions increases) in the regional (non-project) emissions inventories and the expanded compression estimates included in this analysis.

The modeling analysis was performed generally following the methodologies used for the DEIS and AQTSD. The CALMET and CALPUFF model versions that were used for the DEIS analysis were used to estimate direct JIDP and cumulative pollutant impacts at far-field PSD Class I and sensitive Class II areas, and at mid-field Wyoming regional community locations and within the JIDPA. A discussion of the model parameters is provided in Section 3.2. Model results for the early-project-development stage modeling scenarios are summarized in Section 3.3.

3.1 EMISSIONS INVENTORIES

3.1.1 Year 2006 Drilling and Flaring Emissions

Emissions for drilling activities and completion flaring were developed for the JIDP, PAP, SPP, RRP, and JMHP based on a review of proposed well development rates and drilling activities for each project, from information available from the Wyoming Oil and Gas Conservation Commission (WOGCC) for drill rig "spud" activity data, and from information and estimates provided by the BLM, Pinedale Field Office. Emissions were determined for monthly drilling activities to capture seasonal variations in drilling. Table 3.1 provides a summary of the project-specific drilling rig and flare information that was used for year 2006 modeling.

A WDR250 was used for the JIDP (i.e., 20 drill rigs operating continuously per month), with 3 completion flares operating continuously per month. For the JIDP it was assumed that 50% of the wells would be directionally drilled and 50% of the wells would be straight hole, approximately 80% of the wells would have flareless completions, and there would be an 80%/20% combination of drilling engines with Tier 0 and Tier 1 emissions levels, respectively. Drill rig engine sizes and flare assumptions are identical to those used for the DEIS analyses. Three additional drill rigs and 1 additional completion flare were also added to account for potential expanded Jonah Field operations. These emissions were determined using JIDP emissions estimates, assuming directional drilling for each of the three rigs and an 80%/20% combination for Tier 0/Tier 1 drill rig emissions.

Table 3.1 Summary of Year 2006 Drilling Rigs Counts and Flaring Operations.

Field	Months	Operating Drilling Rigs	Operating Flares
JIDP	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec	20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20, 20	3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3
JIDP – Expanded Jonah Field Operators	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec	3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 3	1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1
PAP	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec	25, 25, 25, 25, 25, 30, 35, 35, 35, 30, 25, 25	4, 4, 4, 4, 4, 5, 5, 5, 5, 5, 4, 4
SPP	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec	0, 0, 0, 0, 3, 3, 3, 3, 3, 3, 0, 0	0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 0, 0
RRP	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec	2, 2, 2, 2, 3, 3, 6, 6, 6, 3, 2, 2	1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1
JMHP	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec	1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1	1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1
Pinedale Field Office – Wildcat Rigs	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec	0, 0, 0, 0, 0, 0, 3, 3, 0, 0, 0, 0	0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0

For the PAP, the 2006 monthly well development rates were determined from well development rates obtained from the WOGCC for year 2004 and from drill rig estimates provided by the BLM, Pinedale Field Office, which include estimates from Questar, BP AMOCO, Yates, Anschutz, Shell, Stone Energy, and Ultra Petroleum. Emissions data were determined from drill rig data obtained from the WDEQ for Questar Corporation’s year-round drilling project along the Pinedale Anticline. Drill rig emissions were calculated using the emissions data for the 6 year-round drilling rigs from Questar's year-round drilling project, assuming an additional 6 5,000 horsepower (hp) drill rigs to account for other Operator's year-round drilling projects, and basing the remainder of the drill rig assumptions off Questar's data for a 3,216 hp drill rig. Since actual drill rig data was available there were no additional assumptions made for straight/directional drill rig percentages. Emissions from Questar's 6 year-round drilling rigs assumes Tier 0 emissions for 3 drill rigs, Tier 1 emissions for 2 drill rigs, and a combination of Tier 0/Tier 1 emissions on 1 drill rig. Emissions from the six 5,000 hp year-round drill rigs and the additional 3,216 hp drill rigs were determined assuming an 80%/20% Tier 0/Tier 1 emissions ratio. Completion flaring estimates assume approximately 80% flareless completions, with flare emissions estimates obtained from the Pinedale Anticline EIS (BLM 1999). Emissions calculations for the drill rigs and completion flares are provided in Appendix D.

For the SPP, year 2006 drilling activity was assumed to occur only during the summer months (May-Oct) with 3 drill rigs and 1 flare operating continuously for these months. Two 2,100 hp rigs and 1 2,600 hp rig were assumed. Flaring emissions estimates were obtained from the SPP *Emissions Inventory for the South Piney Natural Gas Development Project* (BLM 2003). The RRP estimates include 2 to 6 drill rigs (each at 2,100 hp) and 1 flare operating throughout the year with an increase in activity in the summer months. JIDP flaring emissions were utilized for the RRP. JMHP estimates include a single operating rig (2,600 hp) and flare operating continuously throughout the year (JIDP flaring emissions were used). 3 additional 5,000 hp "wildcat" drilling rigs and 1 completion flare were added to the inventory to account for exploratory drilling north of the Pinedale Anticline in the summer months (July and August). For the SPP, RRP, JMHP, and the "wildcat" rigs it was assumed that 100% of the wells will be straight hole, 100% of the wells will be flared, and 100% of drilling engines will be at Tier 0 emissions levels. Emissions calculations for each project area are provided in Appendix D.

3.1.2 <u>Year 2002 Drilling and Flaring Emissions</u>

Baseline study year emissions for drilling activities and completion flaring were developed for the JIDP, PAP, SPP, RRP, and JMHP based on a review of actual monthly well development rates and drilling activities that occurred in the region during 2002. Year 2002 emissions were quantified to determine the level of emissions that existed in background ambient air quality during 2002. Well development rates and drilling activities for each project were determined from WOGCC data for drill rig "spud" activity that occurred in the project areas during year 2002.

For each project area drill rig engine sizes and flaring estimates were assumed to be consistent with the estimates used for the 2006 calculations. For the PAP year 2002 calculations, 3,216 hp engine sizes (Questar data) were used for each drill rig. It was assumed that during year 2002 all drilling engines would be at Tier 0 emissions levels. For all project areas, 100% straight hole drilling was assumed. Completion flaring emissions was determined from a review of actual well development rates and the assumption that 100% of the developed wells required flaring. A summary of the drilling rig and flare information that was used for the year 2002 modeling is provided in Table 3.2.

3.1.3 Expanded Compression

The BLM, field Operators, and other gas compression companies operating nearby were contacted to determine an estimate of expanded field compression requirements for the area. The expanded compression is in addition to the compression estimates that were obtained, from field Operators, state permits, and RFD, and modeled for the DEIS. A summary of the recent (up through May 26, 2005) expanded compression estimates used for this analysis and the field compression estimates that were included in the DEIS analyses are provided in Table 3.3. Emissions for expanded field compression were calculated based on best available data information obtained from the WDEQ-AQD. These emissions are shown in Appendix D, Tables D.1.54 – D.1.60.

Table 3.2 Summary of Year 2002 Drilling Rigs Counts and Flaring Operations.

Field	Months	Operating Drilling Rigs	Operating Flares
JIDP	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec	6, 6, 6, 8, 5, 7, 4, 5, 8, 5, 4, 5	3, 3, 3, 4, 2, 3, 2, 2, 4, 2, 2, 2
PAP	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec	4, 3, 3, 1, 7, 3, 8, 5, 3, 3, 0, 1	2, 1, 1, 1, 3, 1, 4, 2, 1, 1, 0, 1
SPP	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec	0, 0, 0, 0, 0, 0, 0, 0, 2, 0, 2, 1	0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 1
RRP	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec	0, 0, 0, 0, 1, 2, 2, 4, 2, 2, 1, 1	0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1
JMHP	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec	1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1	1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1

Table 3.3 Summary of Expanded Field Compression Estimates.

Field	Permitted/RFD Compression Included in DEIS Analysis	Expanded Compression Included in DEIS Analysis	Expanded Compression Estimates Beyond those included in the DEIS
JIDP	13,269 hp (Falcon) 0 hp (Luman) 9,405 hp (Bird) 5,285 hp (Jonah)	7,336 hp (Falcon) 11,604 hp (Luman) 11,004 hp (Bird) 3,900 hp (Jonah)	2,888 hp (Falcon) 11,248 hp (Luman) 30,928 hp (Bird) 3,000 hp (Jonah)
PAP	12,094 hp (Paradise) 25,110 hp (Gobblers Knob, Mesa 1, Mesa 2)	7,336 hp (Paradise) 10,000 hp (Gobblers Knob)	9,624 hp (Paradise) 1,160 hp (Gobblers Knob)
SPP	48,500 hp	0 hp	0 hp
RRP	0 hp	0 hp	0 hp
JMHP	3,480 hp	0 hp	2,940 hp

3.1.4 Permitted Source Emissions Inventory

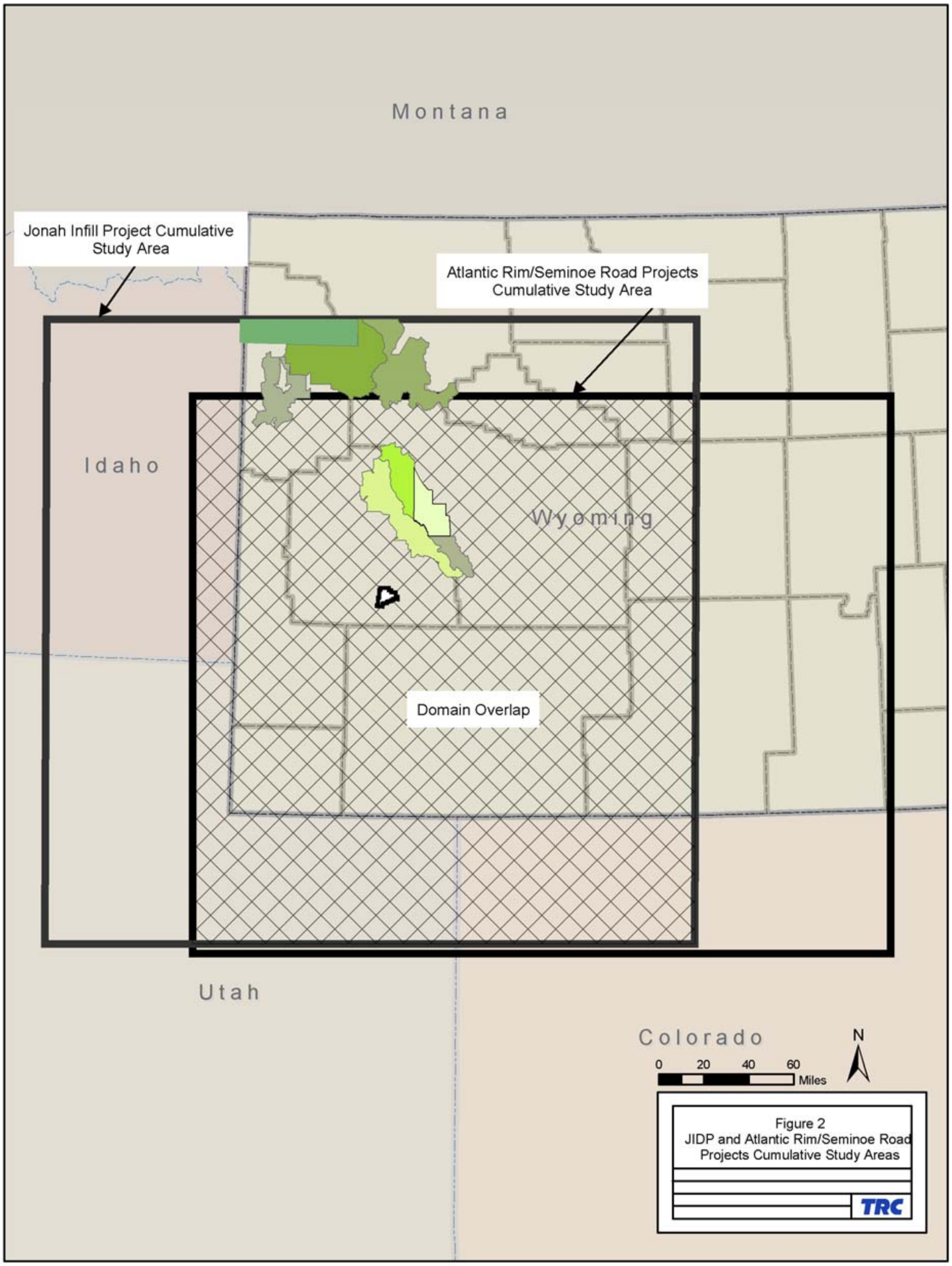
As part of the JIDP DEIS, an inventory of permitted source emissions was developed using data obtained from the WDEQ-AQD, CDPHE/APCD, UDEQ-AQD, and IDEQ. This inventory included sources that had received permits through June 30, 2003. The inventory was been updated to include additional source emissions permitted through March 31, 2004. These additional source emissions were obtained from the source inventory that was developed by TRC for the Atlantic Rim Natural Gas Project and the Seminoe Road Gas Development Project. The extent of the inventory domain for these projects and the JIDP study domain are shown on Figure 2. The cross-hatched area on Figure 2 illustrates the area within the JIDP study domain where an additional nine months (July 1, 2003 – March 31, 2004) of permitted source emissions were available and included in the modeling analysis. A list of these additional sources is summarized in Appendix, Tables D.1.61 and D.1.63.

3.2 MODEL PARAMETERS

The modeling analysis was performed generally following the methodologies used for the DEIS and AQTSD. The CALMET (Version 5.53) and CALPUFF (Version 5.711) model versions used for the DEIS analyses were used to estimate both project and cumulative pollutant impacts at far-field PSD Class I and sensitive Class II areas, at mid-field Wyoming regional community locations, and within the JIDPA. All CALPUFF model methodologies, switch settings, source parameters, and model receptors are identical to the analyses performed for the DEIS unless otherwise indicated. Modeled emissions included JIDP, PAP, SPP, RRP, and JMHP well drilling and flaring emissions differences calculated on a monthly basis (2006 minus the baseline study year 2002), well drilling and flaring estimates for other expanded Jonah Field Operators and "wildcat" drill rigs, other JIDPA emissions, expanded compression emissions, sources permitted by state agencies through March 31, 2004, and the RFD and RFFA emissions that were determined for the DEIS. The 'other' JIDPA emissions sources include expanded compression estimates, beyond what was analyzed for the DEIS, production and construction traffic emissions and wellsite heater emission representative of early project emissions, and wind erosion. For early-project-development stage analyses, production traffic, wellsite heater, and wind erosion emissions assumed 700 wells operating in year 2006. This assumption was based off 198 wells (developed in the JIDPA since January 2002 – DEIS assumption) and 2 years of well field development at a 250 WDR. Construction traffic emissions for the JIDPA were based on WDRs determined in Sections 3.1.1 and 3.1.2. Production traffic, construction traffic, wellsite heater, and wind erosion emissions, and assumptions determined for the DEIS analyses were used for the early-project-development stage analyses.

The total direct project emissions and regional emissions modeled for the early-project-development stage analyses are shown in Appendix D Table D.1.1. The calculated emissions differences for drilling rig and flaring activities for the JIDP, PAP, SPP, and RRP are given in Appendix D, Tables D.1.11, D.1.30, D.1.45, and D.1.36, respectively. For the JMHP there were no emissions changes due to drilling or flaring operations between years 2002 and 2006.
Emissions differences determined for the JIDP, PAP, SPP, RRP, and JMHP were modeled as point sources, spread within each project area. These are locations are shown in Figure 3. Representative source parameters consistent with the JIDP DEIS analyses were used for drill rig engines and flares. Emissions from expanded compression were modeled as point sources located at existing compressor station locations using existing source characterizations or estimated based on best available information.

The CALMET wind fields used for early-project-development stage analysis differ from the wind fields used for the DEIS and Preferred Alternative modeling. The CALMET wind fields used for this modeling were developed without the use of the "kinematic effects" CALMET switch setting option, which was used for all DEIS analyses and Preferred Alternative modeling. The change in wind field development was made to correct a potential CALMET model anomaly, which could produce unrealistically high wind speeds in the wind field layers above the surface layer. Model tests for the DEIS cases indicated that the use of IKINE produced more conservative (slightly higher) model predictions at the Bridger Wilderness Area.


Montana
Jonah Infill Project Cumulative Study Area
Atlantic Rim/Seminoe Road Projects Cumulative Study Area
Idaho
Wyoming
Domain Overlap
Utah
Colorado
N
0 20 40 60
Miles
Figure 2
JIDP and Atlantic Rim/Seminoe Road Projects Cumulative Study Areas
TRC

Recent CALMET model peer review studies and model developer suggestions are the basis for this change. The switch setting was originally selected based on peer review of the 1995 Southwest Wyoming Technical Air Forum (SWWYTAF) wind fields, which indicated that surface wind speeds from CALMET were underestimated. The use of IKINE produced better agreement with surface wind observations. In addition since the JIDPA is approximately 30 km from the Bridger Wilderness the use of terrain was justified as "best science" to more appropriately model terrain affects.

3.3 MODEL RESULTS

CALPUFF modeling was performed to calculate direct JIDP impacts for early-project-development stage conditions and for estimating cumulative impacts from potential project and regional sources. Regional emissions inventories of existing state-permitted, RFD, and RFFA sources were modeled in combination with project sources to provide cumulative impact estimates for each scenario.

For each far-field sensitive area, CALPUFF-modeled concentration impacts were post-processed with POSTUTIL and CALPOST to derive: 1) concentrations for comparison to ambient air quality standards (WAAQS and NAAQS), PSD Class I significance thresholds, and PSD Class I and II Increments; 2) deposition rates for comparison to sulfur (S) and nitrogen (N) deposition levels of concern and to calculate changes to ANC at sensitive lakes; and 3) light extinction changes for comparison to visibility impact thresholds. For the mid-field analyses, CALPOST concentrations were post-processed to estimate light extinction changes at regional communities for comparison to the visibility impact thresholds. For in-field locations, CALPUFF concentrations were post-processed to compute maximum concentration impacts for comparison to WAAQS and NAAQS.

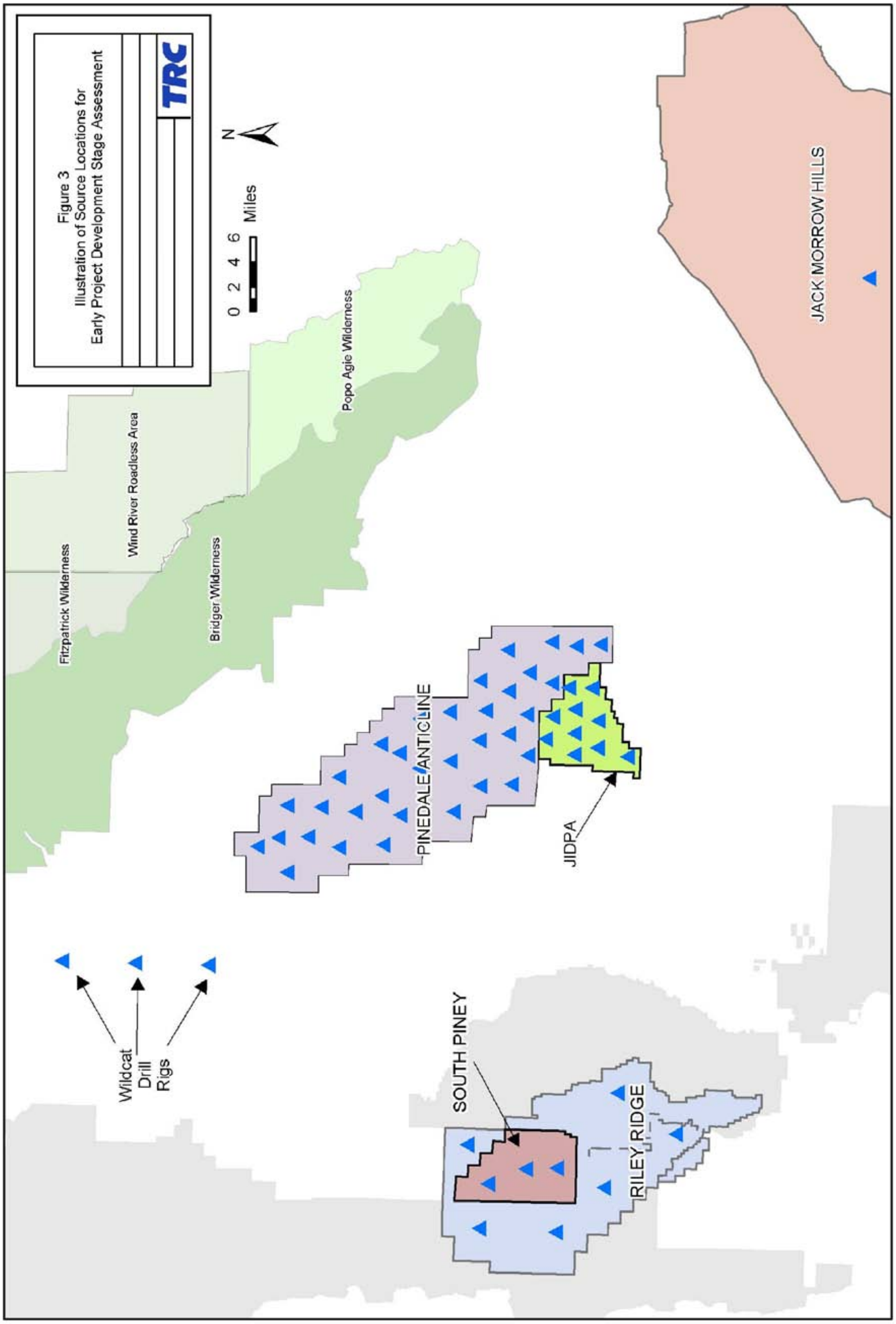


Figure 3
Illustration of Source Locations for
Early Project Development Stage Assessment

3.3.1 Concentration

The CALPOST and POSTUTIL post-processors were used to summarize concentration impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ at PSD Class I and sensitive PSD Class II areas, and at in-field locations. Predicted impacts are compared to applicable ambient air quality standards, PSD Class I and Class II Increments, and significance levels as shown in Table 2.2. The PSD demonstrations serve information purposes only and do not constitute a regulatory PSD Increment consumption analysis, which may be completed as necessary by WDEQ-AQD. The approach to this PSD screening analysis is consistent with the original DEIS and AQTSD analyses.

PM_{10} concentrations were computed by adding predicted CALPUFF concentrations of PM_{10} (fraction of PM greater than $PM_{2.5}$), $PM_{2.5}$, SO_4, and NO_3. $PM_{2.5}$ concentrations were calculated as the sum of modeled $PM_{2.5}$, SO_4, and NO_3 concentrations. Consistent with the DEIS analyses, for post-processing the PM_{10} impacts at all far-field receptor locations, project traffic emissions of PM_{10} were not included in the total estimated impacts, only the $PM_{2.5}$ impacts were considered. However, the total PM_{10} impacts from traffic emissions were included in all in-field concentration estimates.

Far-field Results

The maximum predicted concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ at each of the analyzed PSD Class I and sensitive Class II areas, for direct project and cumulative source scenarios, are provided in Appendix E. Predicted direct project impacts are compared to applicable PSD Class I and Class II Increments and significance levels, and then added to representative background pollutant concentrations (Table 2.3), the total concentration is compared to applicable NAAQS and WAAQS. Cumulative impacts are compared directly to applicable PSD Class I and Class II Increments, and to the NAAQS and WAAQS when background pollutant concentrations are added. Tables E.1.1 and E.1.2 provide the maximum modeled NO_2 concentrations at each of the sensitive areas. The maximum modeled SO_2 concentrations are provided in Tables E.2.1 and E.2.2, and the maximum modeled PM_{10} and $PM_{2.5}$ impacts are provided in Tables E.3.1 and

E.3.2, and Tables E.4.1 and E.4.2, respectively. Results summaries for NO_x, SO_2, PM_{10}, and $PM_{2.5}$ are provided in Tables E.10.1, E.10.2, E.10.3, and E.10.4, respectively.

In-Field Results

The maximum predicted concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ within and nearby the JIDPA, for both direct project and cumulative scenarios are provided in Appendix E, Tables E.5.1 and E.5.2. Results summaries are provided in Table E.10.5. Predicted direct project and cumulative impacts are added to representative background pollutant concentrations and are compared to applicable NAAQS and WAAQS.

3.3.2 Deposition

Maximum predicted S and N deposition impacts were estimated for both direct project and cumulative source scenarios. The POSTUTIL utility was used to estimate total S and N fluxes from CALPUFF predicted wet and dry fluxes of SO_2, SO_4, NO_x, NO_3, and HNO_3. CALPOST was then used to summarize the annual S and N deposition values from the POSTUTIL program. Predicted direct project impacts were compared to the NPS (0.005 kg/ha-year) DAT for total N and S deposition in the western U.S. Total deposition impacts from direct project and regional sources were compared to USDA Forest Service levels of concern, 5 kg/ha-yr for S and 3 kg/ha-yr for N. It is understood that the USDA Forest Service no longer considers these levels of concern to be protective; however, in the absence of alternative FLM-approved values, comparisons with these values were made. The maximum predicted N and S deposition impacts for each of the analyzed scenarios are provided in Appendix E, Tables E.6.1 and E.6.2. Results summaries are provided in Table E.10.6 and E.10.7.

3.3.3 Sensitive Lakes

The CALPUFF-predicted annual deposition fluxes of S and N at sensitive lake receptors were used to estimate the change in ANC. A list of the sensitive lakes and the background ANC values is provided in Table 2.4. The change in ANC was calculated following the January 2000, USDA Forest Service guidance. The predicted changes in ANC are compared with the USDA

Forest Service's Level of LAC thresholds of 10% for lakes with ANC values greater than 25 μeq/l and 1 μeq/l for lakes with background ANC values of 25 μeq/l or less.

ANC calculations were performed for both direct project and cumulative source scenarios, with the results presented in Appendix E, Tables E.7.1 and E.7.2. Results summaries are provided in Table E.10.8.

3.3.4 Visibility

The CALPUFF model-predicted concentration impacts at far-field PSD Class I and sensitive Class II areas and at mid-field regional community locations were post-processed with CALPOST to estimate potential impacts to visibility (regional haze) for both direct project and cumulative source scenarios for comparison to visibility impact thresholds. CALPOST estimated visibility impacts from predicted concentrations of PM_{10}, $PM_{2.5}$, SO_4, and NO_3. PM_{10} emissions from project traffic emissions were not included in the total estimated impacts (see Section 2.4.1), only the impacts to visibility from $PM_{2.5}$ were considered.

Visibility impairment calculations were performed using both the FLAG and IMPROVE background data sets as described in Section 2.4.4. CALPOST visibility processing methods “MVISBK=6” and “MVISBK=2” were used in combination with the two sets of background visibility data. CALPOST method “MVISBK=6”, as described in Section 2.4.4, utilizes monthly relative humidity factors in combination with background visibility data to estimate light extinction changes. This method was used for all DEIS analyses and Preferred Alternative modeling. CALPOST method “MVISBK=2” utilizes hourly relative humidity data from surface meteorological station measurements (included as part of the CALMET windfield data) in combination with background visibility data to compute potential light extinction change. Consistent with the FLAG document a relative humidity cutoff value of 98 percent was used for these calculations.

Far-Field Results

The maximum predicted far-field visibility impacts for both direct project and cumulative scenarios are provided in Appendix E, Tables E.8.1 – E.8.4. Results summaries are provided in Tables E.10.9 - E.10.12. Predicted impacts are shown using both the FLAG and IMPROVE background visibility data for each of the CALPOST visibility processing methods. For each Class I and sensitive Class II area the maximum predicted change in dv and the estimated number of days per year that could potentially exceed 0.5 and 1.0 dv thresholds are provided. Tables that present all predicted impacts above the thresholds and the days when the impacts were predicted to occur are also provided in Appendix E (Tables E.8.5 – E.8.36) for each Class I and sensitive Class II area where the maximum predicted change in dv is estimated to potentially exceed 0.5 and 1.0 dv thresholds.

Mid-Field Results

The maximum predicted mid-field visibility impacts for both direct project and cumulative scenarios are provided in Appendix E, Tables E.9.1 – E.9.4. A summary of results by scenario is provided in Tables E.10.13 - E.10.16. Predicted impacts are shown using both the FLAG and IMPROVE background visibility data for both CALPOST processing methods. The maximum predicted visibility impacts (change in dv) at regional communities and the estimated number of days per year that could potentially exceed the 1.0 dv threshold are provided for each community location. Tables that present all predicted impacts above the threshold and the days when the impacts were predicted to occur are also provided in Appendix E (Tables E.9.5 – E.9.44) for each regional community location.

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APPENDIX A

JUNE 2005 AIR QUALITY IMPACT ASSESSMENT PROTOCOL

JONAH INFILL DRILLING PROJECT
DRAFT ENVIRONMENTAL IMPACT STATEMENT
IMPACT ANALYSIS SUPPLEMENT

APPENDIX B

PREFERRED ALTERNATIVE EMISSIONS INVENTORY

The following is a list of the tables included within this appendix:

B.1.1 Summary of Maximum Field Wide Emissions Scenarios – Preferred Alternative
B.1.2 Drilling Emissions AP-42 – Straight Drilling
B.1.3 Drilling Emissions Tier 1 – Straight Drilling
B.1.4 Drilling Emissions Tier 2 – Straight Drilling
B.1.5 Drilling Emissions AP-42 – Directional Drilling
B.1.6 Drilling Emissions Tier 1 – Directional Drilling
B.1.7 Drilling Emissions Tier 2 – Directional Drilling

APPENDIX C

PREFERRED ALTERNATIVE MODELING RESULTS

LIST OF TABLES

Modeled NO_2 Concentration Impacts

Table C.1.1 Maximum Modeled NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Sources – Low Emissions WDR250

Table C.1.2 Maximum Modeled NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Sources – Low Emissions WDR150

Table C.1.3 Maximum Modeled NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Sources – Low Emissions WDR075

Table C.1.4 Maximum Modeled NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Sources – High Emissions WDR250

Table C.1.5 Maximum Modeled NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Sources – High Emissions WDR150

Table C.1.6 Maximum Modeled NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Sources – High Emissions WDR075

Table C.1.7 Maximum Modeled NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Sources – Mitigation 20% Emissions Reduction WDR250

Table C.1.8 Maximum Modeled NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Sources – Mitigation 40% Emissions Reduction WDR250

Table C.1.9 Maximum Modeled NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Sources – Mitigation 60% Emissions Reduction WDR250

Table C.1.10 Maximum Modeled NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Sources – Mitigation 80% Emissions Reduction WDR250

Table C.1.11 Maximum Modeled Cumulative NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative (Low Emissions WDR250) and Regional Sources

Table C.1.12 Maximum Modeled Cumulative NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative (Low Emissions WDR150) and Regional Sources

Table C.1.13 Maximum Modeled Cumulative NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative (Low Emissions WDR075) and Regional Sources

Table C.1.14 Maximum Modeled Cumulative NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative (High Emissions WDR250) and Regional Sources

Table C.1.15 Maximum Modeled Cumulative NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative (High Emissions WDR150) and Regional Sources

Table C.1.16 Maximum Modeled Cumulative NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative (High Emissions WDR075) and Regional Sources

Table C.1.17 Maximum Modeled Cumulative NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative (Mitigation 20% Emissions Reduction WDR250) and Regional Sources

Table C.1.18 Maximum Modeled Cumulative NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative (Mitigation 40% Emissions Reduction WDR250) and Regional Sources

Table C.1.19 Maximum Modeled Cumulative NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative (Mitigation 60% Emissions Reduction WDR250) and Regional Sources

Table C.1.20 Maximum Modeled Cumulative NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative (Mitigation 80% Emissions Reduction WDR250) and Regional Sources

Modeled SO$_2$ Concentration Impacts

Table C.2.1 Maximum Modeled SO$_2$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR250

Table C.2.2 Maximum Modeled SO$_2$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR150

Table C.2.3 Maximum Modeled SO$_2$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR075

Table C.2.4 Maximum Modeled SO$_2$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR250

Table C.2.5 Maximum Modeled SO$_2$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR150

Table C.2.6 Maximum Modeled SO$_2$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR075

Table C.2.7 Maximum Modeled SO$_2$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 20% Emissions Reduction WDR250

Table C.2.8 Maximum Modeled SO$_2$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 40% Emissions Reduction WDR250

Table C.2.9 Maximum Modeled SO$_2$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 60% Emissions Reduction WDR250

Table C.2.10 Maximum Modeled SO$_2$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 80% Emissions Reduction WDR250

Table C.2.11 Maximum Modeled Cumulative SO$_2$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR250 and Regional Sources

Table C.2.12 Maximum Modeled Cumulative SO$_2$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR150 and Regional Sources

Table C.2.13 Maximum Modeled Cumulative SO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR075 and Regional Sources

Table C.2.14 Maximum Modeled Cumulative SO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR250 and Regional Sources

Table C.2.15 Maximum Modeled Cumulative SO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR150 and Regional Sources

Table C.2.16 Maximum Modeled Cumulative SO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR075 and Regional Sources

Table C.2.17 Maximum Modeled Cumulative SO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 20% Emissions Reduction WDR250 and Regional Sources

Table C.2.18 Maximum Modeled Cumulative SO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 40% Emissions Reduction WDR250 and Regional Sources

Table C.2.19 Maximum Modeled Cumulative SO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 60% Emissions Reduction WDR250 and Regional Sources

Table C.2.20 Maximum Modeled Cumulative SO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 80% Emissions Reduction WDR250 and Regional Sources

Modeled PM_{10} Concentration Impacts

Table C.3.1 Maximum Modeled PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR250

Table C.3.2 Maximum Modeled PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR150

Table C.3.3 Maximum Modeled PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR075

Table C.3.4 Maximum Modeled PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR250

Table C.3.5 Maximum Modeled PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR150

Table C.3.6 Maximum Modeled PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR075

Table C.3.7 Maximum Modeled PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 20% Emissions Reduction WDR250

Table C.3.8 Maximum Modeled PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 40% Emissions Reduction WDR250

Table C.3.9 Maximum Modeled PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 60% Emissions Reduction WDR250

Table C.3.10 Maximum Modeled PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 80% Emissions Reduction WDR250

Table C.3.11 Maximum Modeled Cumulative PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR250 and Regional Sources

Table C.3.12 Maximum Modeled Cumulative PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR150 and Regional Sources

Table C.3.13 Maximum Modeled Cumulative PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR075 and Regional Sources

Table C.3.14 Maximum Modeled Cumulative PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR250 and Regional Sources

Table C.3.15 Maximum Modeled Cumulative PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR150 and Regional Sources

Table C.3.16 Maximum Modeled Cumulative PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR075 and Regional Sources

Table C.3.17 Maximum Modeled Cumulative PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 20% Emissions Reduction WDR250 and Regional Sources

Table C.3.18 Maximum Modeled Cumulative PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 40% Emissions Reduction WDR250 and Regional Sources

Table C.3.19 Maximum Modeled Cumulative PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 60% Emissions Reduction WDR250 and Regional Sources

Table C.3.20 Maximum Modeled Cumulative PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 80% Emissions Reduction WDR250 and Regional Sources

Modeled $PM_{2.5}$ Concentration Impacts

Table C.4.1 Maximum Modeled $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR250

Table C.4.2 Maximum Modeled $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR150

Table C.4.3 Maximum Modeled $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR075

Table C.4.4 Maximum Modeled $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR250

Table C.4.5 Maximum Modeled $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR150

Table C.4.6 Maximum Modeled $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR075

Table C.4.7 Maximum Modeled $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 20% Emissions Reduction WDR250

Table C.4.8 Maximum Modeled $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 40% Emissions Reduction WDR250

Table C.4.9 Maximum Modeled $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 60% Emissions Reduction WDR250

Table C.4.10 Maximum Modeled $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 80% Emissions Reduction WDR250

Table C.4.11 Maximum Modeled Cumulative $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR250 and Regional Sources

Table C.4.12 Maximum Modeled Cumulative $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR150 and Regional Sources

Table C.4.13 Maximum Modeled Cumulative $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR075 and Regional Sources

Table C.4.14 Maximum Modeled Cumulative $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR250 and Regional Sources

Table C.4.15 Maximum Modeled Cumulative $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR150 and Regional Sources

Table C.4.16 Maximum Modeled Cumulative $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR075 and Regional Sources

Table C.4.17 Maximum Modeled Cumulative $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 20% Emissions Reduction WDR250 and Regional Sources

Table C.4.18 Maximum Modeled Cumulative $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 40% Emissions Reduction WDR250 and Regional Sources

Table C.4.19 Maximum Modeled Cumulative $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 60% Emissions Reduction WDR250 and Regional Sources

Table C.4.20 Maximum Modeled Cumulative $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 80% Emissions Reduction WDR250 and Regional Sources

Modeled Impacts Compared to Ambient Air Quality Standards

Table C.5.1 Maximum Predicted Impacts Within the JIDPA from Preferred Alternative Low Emissions WDR250 Compared to Ambient Air Quality Standards

Table C.5.2 Maximum Predicted Impacts Within the JIDPA from Preferred Alternative Low Emissions WDR150 Compared to Ambient Air Quality Standards

Table C.5.3 Maximum Predicted Impacts Within the JIDPA from Preferred Alternative Low Emissions WDR075 Compared to Ambient Air Quality Standards

Table C.5.4 Maximum Predicted Impacts Within the JIDPA from Preferred Alternative High Emissions WDR250 Compared to Ambient Air Quality Standards

Table C.5.5 Maximum Predicted Impacts Within the JIDPA from Preferred Alternative High Emissions WDR150 Compared to Ambient Air Quality Standards

Table C.5.6 Maximum Predicted Impacts Within the JIDPA from Preferred Alternative High Emissions WDR075 Compared to Ambient Air Quality Standards

Table C.5.7 Maximum Predicted Impacts Within the JIDPA from Preferred Alternative Mitigation 20% Emissions Reduction WDR250 Compared to Ambient Air Quality Standards

Table C.5.8 Maximum Predicted Impacts Within the JIDPA from Preferred Alternative Mitigation 40% Emissions Reduction WDR250 Compared to Ambient Air Quality Standards

Table C.5.9 Maximum Predicted Impacts Within the JIDPA from Preferred Alternative Mitigation 60% Emissions Reduction WDR250 Compared to Ambient Air Quality Standards

Table C.5.10 Maximum Predicted Impacts Within the JIDPA from Preferred Alternative Mitigation 80% Emissions Reduction WDR250 Compared to Ambient Air Quality Standards

Table C.5.11 Maximum Predicted Cumulative Impacts Within the JIDPA from Preferred Alternative Low Emissions WDR250 and Regional Sources - Compared to Ambient Air Quality Standards

Table C.5.12 Maximum Predicted Cumulative Impacts Within the JIDPA from Preferred Alternative Low Emissions WDR150 and Regional Sources - Compared to Ambient Air Quality Standards

Table C.5.13 Maximum Predicted Cumulative Impacts Within the JIDPA from Preferred Alternative Low Emissions WDR075 and Regional Sources - Compared to Ambient Air Quality Standards

Table C.5.14 Maximum Predicted Cumulative Impacts Within the JIDPA from Preferred Alternative High Emissions WDR250 and Regional Sources - Compared to Ambient Air Quality Standards

Table C.5.15 Maximum Predicted Cumulative Impacts Within the JIDPA from Preferred Alternative High Emissions WDR150 and Regional Sources - Compared to Ambient Air Quality Standards

Table C.5.16 Maximum Predicted Cumulative Impacts Within the JIDPA from Preferred Alternative High Emissions WDR075 and Regional Sources - Compared to Ambient Air Quality Standards

Table C.5.17 Maximum Predicted Cumulative Impacts Within the JIDPA from Preferred Alternative Mitigation 20% Emissions Reduction WDR250 and Regional Sources - Compared to Ambient Air Quality Standards

Table C.5.18 Maximum Predicted Cumulative Impacts Within the JIDPA from Preferred Alternative Mitigation 40% Emissions Reduction WDR250 and Regional Sources - Compared to Ambient Air Quality Standards

Table C.5.19 Maximum Predicted Cumulative Impacts Within the JIDPA from Preferred Alternative Mitigation 60% Emissions Reduction WDR250 and Regional Sources - Compared to Ambient Air Quality Standards

Table C.5.20 Maximum Predicted Cumulative Impacts Within the JIDPA from Preferred Alternative Mitigation 80% Emissions Reduction WDR250 and Regional Sources - Compared to Ambient Air Quality Standards

Modeled Nitrogen (N) and Sulfur (S) Deposition Impacts

Table C.6.1 Maximum Modeled Nitrogen (N) Deposition Impacts (kg/ha-yr) at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Sources

Table C.6.2 Maximum Modeled Total Nitrogen (N) Deposition Impacts (kg/ha-yr) at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative and Regional Sources

Table C.6.3 Maximum Modeled Sulfur (S) Deposition Impacts (kg/ha-yr) at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Sources

Table C.6.4 Maximum Modeled Total Sulfur (S) Deposition Impacts (kg/ha-yr) at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative and Regional Sources

Modeled Change in Acid Neutralizing Capacity

Table C.7.1 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative Low Emissions WDR250

Table C.7.2 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative Low Emissions WDR150

Table C.7.3 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative Low Emissions WDR075

Table C.7.4 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative High Emissions WDR250

Table C.7.5 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative High Emissions WDR150

Table C.7.6 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative High Emissions WDR075

Table C.7.7 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative Mitigation 20% Emissions Reduction WDR250

Table C.7.8 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative Mitigation 40% Emissions Reduction WDR250

Table C.7.9 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative Mitigation 60% Emissions Reduction WDR250

Table C.7.10 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative Mitigation 80% Emissions Reduction WDR250

Table C.7.11 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative Low Emissions WDR250 and Regional Sources

Table C.7.12 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative Low Emissions WDR150 and Regional Sources

Table C.7.13 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative Low Emissions WDR075 and Regional Sources

Table C.7.14 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative High Emissions WDR250 and Regional Sources

Table C.7.15 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative High Emissions WDR150 and Regional Sources

Table C.7.16 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative High Emissions WDR075 and Regional Sources

Table C.7.17 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative Mitigation 20% Emissions Reduction WDR250 and Regional Sources

Table C.7.18 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative Mitigation 40% Emissions Reduction WDR250 and Regional Sources

Table C.7.19 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative Mitigation 60% Emissions Reduction WDR250 and Regional Sources

Table C.7.20 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Preferred Alternative Mitigation 80% Emissions Reduction WDR250 and Regional Sources

Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas

Table C.8.1 Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR250

Table C.8.2 Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR150

Table C.8.3 Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR075

Table C.8.4 Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR250

Table C.8.5 Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR150

Table C.8.6 Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR075

Table C.8.7 Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 20% Emissions Reduction WDR250

Table C.8.8 Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 40% Emissions Reduction WDR250

Table C.8.9 Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 60% Emissions Reduction WDR250

Table C.8.10 Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 80% Emissions Reduction WDR250

Table C.8.11 Maximum Modeled Cumulative Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR250 and Regional Sources

Table C.8.12 Maximum Modeled Cumulative Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR150 and Regional Sources

Table C.8.13 Maximum Modeled Cumulative Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Low Emissions WDR075 and Regional Sources

Table C.8.14 Maximum Modeled Cumulative Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR250 and Regional Sources

Table C.8.15 Maximum Modeled Cumulative Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR150 and Regional Sources

Table C.8.16 Maximum Modeled Cumulative Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative High Emissions WDR075 and Regional Sources

Table C.8.17 Maximum Modeled Cumulative Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 20% Emissions Reduction WDR250 and Regional Sources

Table C.8.18 Maximum Modeled Cumulative Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 40% Emissions Reduction WDR250 and Regional Sources

Table C.8.19 Maximum Modeled Cumulative Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 60% Emissions Reduction WDR250 and Regional Sources

Table C.8.20 Maximum Modeled Cumulative Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Preferred Alternative Mitigation 80% Emissions Reduction WDR250 and Regional Sources

Table C.8.21 Bridger Wilderness Area – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.8.22 Bridger Wilderness Area – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.8.23 Fitzpatrick Wilderness Area – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.8.24 Fitzpatrick Wilderness Area – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.8.25 Grand Teton National Park – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.8.26 Grand Teton National Park – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.8.27 Popo Agie Wilderness Area – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.8.28 Popo Agie Wilderness Area – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.8.29 Washakie Wilderness Area – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.8.30 Washakie Wilderness Area – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.8.31 Wind River Roadless Area – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.8.32 Wind River Roadless Area – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Modeled Visibility Impacts at Wyoming Regional Community Locations

Table C.9.1 Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative Low Emissions WDR250

Table C.9.2 Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative Low Emissions WDR150

Table C.9.3 Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative Low Emissions WDR075

Table C.9.4 Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative High Emissions WDR250

Table C.9.5 Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative High Emissions WDR150

Table C.9.6 Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative High Emissions WDR075

Table C.9.7 Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative Mitigation 20% Emissions Reduction WDR250

Table C.9.8 Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative Mitigation 40% Emissions Reduction WDR250

Table C.9.9 Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative Mitigation 60% Emissions Reduction WDR250

Table C.9.10 Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative Mitigation 80% Emissions Reduction WDR250

Table C.9.11 Maximum Modeled Cumulative Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative Low Emissions WDR250 and Regional Sources

Table C.9.12 Maximum Modeled Cumulative Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative Low Emissions WDR150 and Regional Sources

Table C.9.13 Maximum Modeled Cumulative Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative Low Emissions WDR075 and Regional Sources

Table C.9.14 Maximum Modeled Cumulative Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative High Emissions WDR250 and Regional Sources

Table C.9.15 Maximum Modeled Cumulative Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative High Emissions WDR150 and Regional Sources

Table C.9.16 Maximum Modeled Cumulative Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative High Emissions WDR075 and Regional Sources

Table C.9.17 Maximum Modeled Cumulative Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative Mitigation 20% Emissions Reduction WDR250 and Regional Sources

Table C.9.18 Maximum Modeled Cumulative Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative Mitigation 40% Emissions Reduction WDR250 and Regional Sources

Table C.9.19 Maximum Modeled Cumulative Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative Mitigation 60% Emissions Reduction WDR250 and Regional Sources

Table C.9.20 Maximum Modeled Cumulative Visibility Impacts at Wyoming Regional Community Locations from Preferred Alternative Mitigation 80% Emissions Reduction WDR250 and Regional Sources

Table C.9.21 Big Piney – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.22 Big Piney – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.23 Big Sandy – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.24 Big Sandy – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.25 Boulder – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.26 Boulder – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.27 Bronx – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.28 Bronx – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.29 Cora – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.30 Cora – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.31 Daniel – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.32 Daniel – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.33 Farson – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.34 Farson – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.35 LaBarge – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.36 LaBarge – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.37 Merna – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.38 Merna – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.39 Pinedale – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Table C.9.40 Pinedale – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Each Preferred Alternative Modeling Scenario (1-20)

Summary of Maximum Modeled Impacts

Table C.10.1 Summary of Maximum Modeled NO_2 Concentration Impacts ($\mu g/m^3$) at PSD Class I and Sensitive Class II Areas from Direct Project Sources

Table C.10.2 Summary of Maximum Modeled Cumulative NO_2 Concentration Impacts ($\mu g/m^3$) at PSD Class I and Sensitive Class II Areas from Direct Project and Regional Sources

Table C.10.3 Summary of Maximum Modeled SO_2 Concentration Impacts ($\mu g/m^3$) at PSD Class I and Sensitive Class II Areas from Direct Project Sources

Table C.10.4 Summary of Maximum Modeled Cumulative SO_2 Concentration Impacts ($\mu g/m^3$) at PSD Class I and Sensitive Class II Areas from Direct Project and Regional Sources

Table C.10.5 Summary of Maximum Modeled PM_{10} Concentration Impacts ($\mu g/m^3$) at PSD Class I and Sensitive Class II Areas from Direct Project Sources

Table C.10.6 Summary of Maximum Modeled Cumulative PM_{10} Concentration Impacts ($\mu g/m^3$) at PSD Class I and Sensitive Class II Areas from Direct Project and Regional Sources

Table C.10.7 Summary of Maximum Modeled $PM_{2.5}$ Concentration Impacts ($\mu g/m^3$) at PSD Class I and Sensitive Class II Areas from Direct Project Sources

Table C.10.8 Summary of Maximum Modeled Cumulative $PM_{2.5}$ Concentration Impacts ($\mu g/m^3$) at PSD Class I and Sensitive Class II Areas from Direct Project and Regional Sources

Table C.10.9 Summary of Maximum Modeled In-field Pollutant Concentrations ($\mu g/m^3$) from Direct Project Sources Within the JIDPA Compared to Ambient Air Quality Standards

Table C.10.10 Summary of Maximum Modeled Cumulative In-field Pollutant Concentrations ($\mu g/m^3$) from Direct Project and Regional Sources Within the JIDPA Compared to Ambient Air Quality Standards

Table C.10.11 Summary of Maximum Modeled Nitrogen (N) Deposition Impacts (kg/ha-yr) at PSD Class I and Sensitive PSD Class II Areas from Direct Project Sources

Table C.10.12 Summary of Maximum Modeled Total Nitrogen (N) Deposition Impacts (kg/ha-yr) at PSD Class I and Sensitive PSD Class II Areas from Direct Project and Regional Sources

Table C.10.13 Summary of Maximum Modeled Sulfur (S) Deposition Impacts (kg/ha-yr) at PSD Class I and Sensitive PSD Class II Areas from Direct Project Sources

Table C.10.14 Summary of Maximum Modeled Total Sulfur (S) Deposition Impacts (kg/ha-yr) at PSD Class I and Sensitive PSD Class II Areas from Direct Project and Regional Sources

Table C.10.15 Summary of Maximum Modeled Change in ANC (μeq/L) at Acid Sensitive Lakes from Direct Project Sources

Table C.10.16 Summary of Maximum Modeled Cumulative Change in ANC (μeq/L) at Acid Sensitive Lakes from Direct Project and Regional Sources

Table C.10.17 Summary of Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Direct Project Sources Using FLAG Background Data

Table C.10.18 Summary of Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Direct Project Sources Using IMPROVE Background Data

Table C.10.19 Summary of Maximum Modeled Cumulative Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Direct Project and Regional Sources Using FLAG Background Data

Table C.10.20 Summary of Maximum Modeled Cumulative Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Direct Project and Regional Sources Using IMPROVE Background Data

Table C.10.21 Summary of Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Direct Project Sources Using FLAG Background Data

Table C.10.22 Summary of Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Direct Project Sources Using IMPROVE Background Data

Table C.10.23 Summary of Maximum Modeled Cumulative Visibility Impacts at Wyoming Regional Community Locations from Direct Project and Regional Sources Using FLAG Background Data

Table C.10.24 Summary of Maximum Modeled Cumulative Visibility Impacts at Wyoming Regional Community Locations from Direct Project and Regional Sources Using IMPROVE Background Data

APPENDIX D

EARLY PROJECT DEVELOPMENT STAGE
EMISSIONS INVENTORY

The following is a list of the tables included within this appendix:

Table D.1.1 Early Project Development Stage Modeling Emissions

Table D.1.2 Jonah Field – Drilling Emissions – AP-42 – Straight Drilling

Table D.1.3 Jonah Field – Drilling Emissions – Tier 1 – Straight Drilling

Table D.1.4 Jonah Field – Drilling Emissions – Tier 2 – Straight Drilling

Table D.1.5 Jonah Field – Drilling Emissions – AP-42 – Directional Drilling

Table D.1.6 Jonah Field – Drilling Emissions – Tier 1 – Directional Drilling

Table D.1.7 Jonah Field – Drilling Emissions – Tier 2 – Directional Drilling

Table D.1.8 Jonah Field – Completion Flaring Emissions

Table D.1.9 Jonah Field – Summary - 2002

Table D.1.10 Jonah Field – Summary - 2006

Table D.1.11 Jonah Field – Summary 2006-2002

Table D.1.12 Jonah Field – Expanded Field Operators – Summary - 2006

Table D.1.13 Pinedale Anticline – Drilling Emissions – Manufacturer’s/AP-42 – Rig #232

Table D.1.14 Pinedale Anticline – Drilling Emissions – Tier 1 – Rig #232

Table D.1.15 Pinedale Anticline – Drilling Emissions – Manufacturer’s/AP-42 – Rig #235

Table D.1.16 Pinedale Anticline – Drilling Emissions – Tier 1 – Rig #235

Table D.1.17 Pinedale Anticline – Drilling Emissions – Manufacturer’s/AP-42 – Rig #236

Table D.1.18 Pinedale Anticline – Drilling Emissions – Tier 1 – Rig #236

Table D.1.19 Pinedale Anticline – Drilling Emissions – Tier 1 – Caza Rig 85

Table D.1.20 Pinedale Anticline – Drilling Emissions – Tier 1 – Caza Rig 86

Table D.1.21 Pinedale Anticline – Drilling Emissions – Tier1/AP-42 – Caza Rig 24

Table D.1.22 Pinedale Anticline – Drilling Emissions – Tier 1 – Caza Rig 24

Table D.1.23 Pinedale Anticline – Drilling Emissions – AP-42 – Summer Rigs

Table D.1.24 Pinedale Anticline – Drilling Emissions – Tier 1 – Summer Rigs

Table D.1.25 Pinedale Anticline – Drilling Emissions – AP-42 – Other Winter Rigs

Table D.1.26 Pinedale Anticline – Drilling Emissions – Tier 1 – Other Winter Rigs

Table D.1.27 Pinedale Anticline – Completion Flaring Emissions

Table D.1.28 Pinedale Anticline – Summary - 2002

Table D.1.29 Pinedale Anticline – Summary - 2006
Table D.1.30 Pinedale Anticline – Summary - 2006-2002
Table D.1.31 Riley Ridge – Drilling Emissions – AP-42
Table D.1.32 Riley Ridge – Drilling Emissions – Tier 1
Table D.1.33 Riley Ridge – Completion Flaring Emissions
Table D.1.34 Riley Ridge – Summary - 2002
Table D.1.35 Riley Ridge – Summary - 2006
Table D.1.36 Riley Ridge – Summary – 2006-2002
Table D.1.37 South Piney – Drilling Emissions – AP-42 – CBM Wells
Table D.1.38 South Piney – Drilling Emissions – Tier 1 – CBM Wells
Table D.1.39 South Piney – Drilling Emissions – AP-42 – Deep Wells
Table D.1.40 South Piney – Drilling Emissions – Tier 1 – Deep Wells
Table D.1.41 South Piney – Completion Flaring Emissions – CBM Wells
Table D.1.42 South Piney – Completion Flaring Emissions – Deep Wells
Table D.1.43 South Piney – Summary - 2002
Table D.1.44 South Piney – Summary - 2006
Table D.1.45 South Piney – Summary – 2006-2002
Table D.1.46 Jack Morrow Hills – Drilling Emissions – AP-42
Table D.1.47 Jack Morrow Hills – Drilling Emissions – Tier 1
Table D.1.48 Jack Morrow Hills – Completion Flaring Emissions
Table D.1.49 Jack Morrow Hills – Summary - 2002
Table D.1.50 Jack Morrow Hills – Summary - 2006
Table D.1.51 Wildcat Rigs – Drilling Emissions – AP-42
Table D.1.52 Wildcat Rigs – Drilling Emissions – Tier 1
Table D.1.53 Wildcat Rigs – Summary – 2006
Table D.1.54 Compression Increases – Falcon Compressor Station
Table D.1.55 Compression Increases – Luman Compressor Station
Table D.1.56 Compression Increases – Bird Canyon Compressor Station
Table D.1.57 Compression Increases – Jonah Compressor Station
Table D.1.58 Compression Increases – Paradise Compressor Station

Table D.1.59 Compression Increases – Gobblers Knob Compressor Station

Table D.1.60 Compression Increases – Jack Morrow Hills Compressor Station

Table D.1.61 MSI Increases – CO Sources

Table D.1.62 MSI Increases – WY Sources

Table D.1.63 Included RFFA

APPENDIX E

EARLY PROJECT DEVELOPMENT STAGE MODELING RESULTS

LIST OF TABLES

Modeled NO_2 Concentration Impacts

Table E.1.1 Maximum Modeled NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Early Jonah Infill Project Development Stage Sources

Table E.1.2 Maximum Modeled Cumulative NO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Early Jonah Infill Project Development Stage and Regional Sources

Modeled SO_2 Concentration Impacts

Table E.2.1 Maximum Modeled SO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Early Jonah Infill Project Development Stage Sources

Table E.2.2 Maximum Modeled Cumulative SO_2 Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Early Jonah Infill Project Development Stage and Regional Sources

Modeled PM_{10} Concentration Impacts

Table E.3.1 Maximum Modeled PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Early Jonah Infill Project Development Stage Sources

Table E.3.2 Maximum Modeled Cumulative PM_{10} Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Early Jonah Infill Project Development Stage and Regional Sources

Modeled $PM_{2.5}$ Concentration Impacts

Table E.4.1 Maximum Modeled $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Early Jonah Infill Project Development Stage Sources

Table E.4.2 Maximum Modeled Cumulative $PM_{2.5}$ Concentration Impacts at PSD Class I and Sensitive PSD Class II Areas from Early Jonah Infill Project Development Stage and Regional Sources

Modeled Impacts Compared to Ambient Air Quality Standards

Table E.5.1 Maximum Predicted Impacts Within the JIDPA from Early Jonah Infill Project Development Stage Sources Compared to Ambient Air Quality Standards

Table E.5.2 Maximum Predicted Impacts Within the JIDPA from Early Project Development Stage and Regional Sources Compared to Ambient Air Quality Standards

Modeled Nitrogen (N) and Sulfur (S) Deposition Impacts

Table E.6.1 Maximum Modeled Nitrogen (N) Deposition Impacts (kg/ha-yr) at PSD Class I and Sensitive PSD Class II Areas from Early Jonah Infill Project Development Stage Sources – Direct and Total

Table E.6.2 Maximum Modeled Sulfur (S) Deposition Impacts (kg/ha-yr) at PSD Class I and Sensitive PSD Class II Areas from Early Jonah Infill Project Development Stage Sources – Direct and Total

Modeled Change in Acid Neutralizing Capacity

Table E.7.1 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Early Jonah Infill Project Development Stage Sources

Table E.7.2 Maximum Modeled Change in Acid Neutralizing Capacity (ANC) at Acid Sensitive Lakes from Early Jonah Infill Project Development Stage and Regional Sources

Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas

Table E.8.1 Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Early Jonah Infill Project Development Stage Sources – MVISBK=6

Table E.8.2 Maximum Modeled Cumulative Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Early Project Development Stage and Regional Sources – MVISBK=6

Table E.8.3 Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Early Jonah Infill Project Development Stage Sources – MVISBK=2

Table E.8.4 Maximum Modeled Cumulative Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Early Project Development Stage and Regional Sources – MVISBK=2

Table E.8.5 Bridger Wilderness Area – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=6

Table E.8.6 Bridger Wilderness Area – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=6

Table E.8.7 Fitzpatrick Wilderness Area – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=6

Table E.8.8 Fitzpatrick Wilderness Area – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=6

Table E.8.9 Grand Teton National Park – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=6

Table E.8.10 Grand Teton National Park – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=6

Table E.8.11 Popo Agie Wilderness Area – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=6

Table E.8.12 Popo Agie Wilderness Area – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=6

Table E.8.13 Teton Wilderness Area – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=6

Table E.8.14 Teton Wilderness Area – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=6

Table E.8.15 Washakie Wilderness Area – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=6

Table E.8.16 Washakie Wilderness Area – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=6

Table E.8.17 Wind River Roadless Area – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=6

Table E.8.18 Wind River Roadless Area – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=6

Table E.8.19 Yellowstone National Park – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=6

Table E.8.20 Yellowstone National Park – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=6

Table E.8.21 Bridger Wilderness Area – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=2

Table E.8.22 Bridger Wilderness Area – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=2

Table E.8.23 Fitzpatrick Wilderness Area – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=2

Table E.8.24 Fitzpatrick Wilderness Area – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=2

Table E.8.25 Grand Teton National Park – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=2

Table E.8.26 Grand Teton National Park – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=2

Table E.8.27 Popo Agie Wilderness Area – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=2

Table E.8.28 Popo Agie Wilderness Area – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=2

Table E.8.29 Teton Wilderness Area – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=2

Table E.8.30 Teton Wilderness Area – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=2

Table E.8.31 Washakie Wilderness Area – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=2

Table E.8.32 Washakie Wilderness Area – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=2

Table E.8.33 Wind River Roadless Area – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=2

Table E.8.34 Wind River Roadless Area – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=2

Table E.8.35 Yellowstone National Park – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=2

Table E.8.36 Yellowstone National Park – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Scenarios – MVISBK=2

Modeled Visibility Impacts at Wyoming Regional Community Locations

Table E.9.1 Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Early Jonah Infill Project Development Stage Sources – MVISBK=6

Table E.9.2 Maximum Modeled Cumulative Visibility Impacts at Wyoming Regional Community Locations from Early Jonah Infill Project Development Stage and Regional Sources – MVISBK=6

Table E.9.3 Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Early Jonah Infill Project Development Stage Sources – MVISBK=2

Table E.9.4 Maximum Modeled Cumulative Visibility Impacts at Wyoming Regional Community Locations from Early Jonah Infill Project Development Stage and Regional Sources – MVISBK=2

Table E.9.5 Big Piney – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.6 Big Piney – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.7 Big Sandy – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.8 Big Sandy – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.9 Boulder – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.10 Boulder – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.11 Bronx – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.12 Bronx – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.13 Cora – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.14 Cora – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.15 Daniel – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.16 Daniel – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.17 Farson – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.18 Farson – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.19 La Barge – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.20 La Barge – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.21 Merna – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.22 Merna – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.23 Pinedale – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.24 Pinedale – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=6

Table E.9.25 Big Piney – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.26 Big Piney – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.27 Big Sandy – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.28 Big Sandy – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.29 Boulder – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.30 Boulder – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.31 Bronx – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.32 Bronx – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.33 Cora – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.34 Cora – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.35 Daniel – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.36 Daniel – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.37 Farson – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.38 Farson – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.39 La Barge – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.40 La Barge – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.41 Merna – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.42 Merna – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.43 Pinedale – Summary of Days Above Visibility Thresholds Using FLAG Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Table E.9.44 Pinedale – Summary of Days Above Visibility Thresholds Using IMPROVE Background Data Predicted Δdv Shown for Early Project Development Stage – Direct and Cumulative Modeled Scenarios – MVISBK=2

Summary of Maximum Modeled Impacts

Table E.10.1	Summary of Maximum Modeled NO_2 Concentration Impacts (μg/m^3) at PSD Class II Areas from Early Project Development Stage and Regional Sources
Table E.10.2	Summary of Maximum Modeled SO_2 Concentration Impacts (μg/m^3) at PSD Class II Areas from Early Project Development Stage and Regional Sources
Table E.10.3	Summary of Maximum Modeled PM_{10} Concentration Impacts (μg/m^3) at PSD Class II Areas from Early Project Development Stage and Regional Sources
Table E.10.4	Summary of Maximum Modeled $PM_{2.5}$ Concentration Impacts (μg/m^3) at PSD Class II Areas from Early Project Development Stage and Regional Sources
Table E.10.5	Summary of Maximum Modeled In-field Pollutant Concentrations (μg/m^3) from Early Project Development Stage and Regional Sources Within the JIDPA Compared to Ambient Air Quality Standards
Table E.10.6	Summary of Maximum Modeled Nitrogen (N) Deposition Impacts (kg/ha-yr) at PSD Class I and Sensitive PSD Class II Areas from Early Project Development Stage and Regional Sources
Table E.10.7	Summary of Maximum Modeled Sulfur (S) Deposition Impacts (kg/ha-yr) at PSD Class I and Sensitive PSD Class II Areas from Early Project Development Stage and Regional Sources
Table E.10.8	Summary of Maximum Modeled Change in ANC (μeq/L) at Acid Sensitive Lakes from Early Project Development Stage and Regional Sources
Table E.10.9	Summary of Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Early Project Development Stage and Regional Sources Using FLAG Background Data – MVISBK=6
Table E.10.10	Summary of Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Early Project Development Stage and Regional Sources Using IMPROVE Background Data – MVISBK=6
Table E.10.11	Summary of Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Early Project Development Stage and Regional Sources Using FLAG Background Data – MVISBK=2
Table E.10.12	Summary of Maximum Modeled Visibility Impacts at PSD Class I and Sensitive PSD Class II Areas from Early Project Development Stage and Regional Sources Using IMPROVE Background Data – MVISBK=2

Table E.10.13 Summary of Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Early Project Development Stage and Regional Sources Using FLAG Background Data – MVISBK=6

Table E.10.14 Summary of Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Early Project Development Stage and Regional Sources Using IMPROVE Background Data – MVISBK=6

Table E.10.15 Summary of Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Early Project Development Stage and Regional Sources Using FLAG Background Data – MVISBK=2

Table E.10.16 Summary of Maximum Modeled Visibility Impacts at Wyoming Regional Community Locations from Early Project Development Stage and Regional Sources Using IMPROVE Background Data – MVISBK=2