AIR QUALITY ASSESSMENT REPORT

VERNAL AND GLENWOOD SPRINGS RESOURCE MANAGEMENT PLANS

VERNAL RESOURCE MANAGEMENT AREA, UTAH
GLENWOOD SPRINGS RESOURCE MANAGEMENT AREA, COLORADO

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1. INTRODUCTION 10
1.1 BACKGROUND 10
1.1.1 VERNAL FIELD OFFICE 10
1.1.2 GLENWOOD SPRINGS FIELD OFFICE 10
1.2 STUDY TASKS 11

2. OVERVIEW OF ASSESSMENT APPROACH 12

3. AIR QUALITY MODELING METHODOLOGY 14
3.1 MODEL SELECTION 14
3.2 IDENTIFICATION OF SENSITIVE AREAS 14
3.3 EMISSION SOURCE DESCRIPTION AND REPRESENTATION 15
3.3.1 INVENTORY SOURCES 16
3.3.1.1 Emission Calculations 17
3.3.1.2 Stack Parameters 17
3.3.1.3 Updates & Revisions to Inventory Sources 19
3.3.2 BLM SOURCES 20
3.3.2.1 Compressors 21
3.3.2.2 Glycol Dehydrators 23
3.3.2.3 Fugitive Dust From New Roads 25
3.3.2.4 Flaring Emissions 28
3.3.2.5 Location of Sources 29
3.4 MODELING DOMAIN 29
3.5 LAMBERT CONFORMAL PROJECTION 30
3.6 RECEPTOR SELECTION 30
3.7 CHEMICAL TRANSFORMATION 30
3.8 AMMONIA AND OZONE MONITORING DATA 30
3.9 DRY AND WET DEPOSITION ANALYSIS 31
3.10 VISIBILITY ANALYSIS 31
3.11 NEAR-FIELD MODELING 32
3.11.1 MODELED SOURCES 33
3.11.2 METEOROLOGICAL DATA 38
3.11.3 MODEL RECEPTORS 41
3.11.4 FLARE MODELING 41

4. CALMET ANALYSIS 43
4.1 METEOROLOGICAL OBSERVATION DATA 43
4.1.1 SURFACE METEOROLOGICAL DATA 43
4.1.2 PRECIPITATION DATA 44
4.1.3 UPPER AIR DATA 46
4.2 MM5 DATA 46
4.3 GEOPHYSICAL DATA 46

4.4 WIND FIELD MODEL OPTIONS 47
4.5 CALMET EVALUATION 48

5. ASSESSMENT OF AIR QUALITY IMPACTS 50
5.1 AMBIENT AIR QUALITY STANDARDS 50
5.1.1 AMBIENT AIR QUALITY BACKGROUND CONCENTRATION 51
5.1.2 NAAQS ANALYSIS RESULTS BY ALTERNATIVE 53
5.1.3 NAAQS ANALYSIS RESULTS FOR ALL SOURCES (CUMULATIVE) 57
5.2 PSD INCREMENT COMPARISON 58
5.2.1 PSD INCREMENT COMPARISON RESULTS BY ALTERNATIVE 59
5.2.2 PSD INCREMENT RESULTS FOR ALL SOURCES (CUMULATIVE) 77
5.3 HAZARDOUS AIR POLLUTANTS ANALYSIS 82
5.3.1 HAP ANALYSIS RESULTS BY ALTERNATIVE 83
5.3.2 HAP ANALYSIS RESULTS FOR ALL SOURCES (CUMULATIVE) 88
5.3.3 HAP CUMULATIVE INCREMENTAL RISK ANALYSIS RESULTS 88
5.4 AIR QUALITY RELATED VALUES 90
5.4.1 TOTAL SULFUR AND NITROGEN DEPOSITION CRITERIA 90
5.4.2 VISIBILITY CRITERIA 90
5.4.3 ACID NEUTRALIZATION CAPACITY 91
5.4.4 AQRV ANALYSIS RESULTS BY ALTERNATIVE 91
5.4.5 AQRV ANALYSIS RESULTS FOR ALL SOURCES (CUMULATIVE) 108
5.5 NEAR-FIELD ANALYSIS 113
5.5.1 CRITERIA POLLUTANTS 113
5.5.2 HAZARDOUS AIR POLLUTANTS ..... **ERROR! BOOKMARK NOT DEFINED.**
5.5.3 NATURAL GAS FLARE 117
5.6 DISCUSSION 118

6. REFERENCES 120

TABLE 3-1. SENSITIVE AREAS TO BE CONSIDERED IN THE ANALYSIS 15

TABLE 3-2. BASELINE DATE FOR BACKGROUND CONCENTRATIONS 16

TABLE 3-3. $PM_{2.5}$ EMISSION CALCULATION ASSUMPTIONS 17

TABLE 3-4. POINT SOURCE STACK PARAMETERS FOR MISSING DATA 18

TABLE 3-5. AREA SOURCE CATEGORIES FOR DISPERSION MODELING 19

TABLE 3-6. INVENTORY SOURCE CHANGES FOR REVISED MODELING 20

TABLE 3-7. GAS PRODUCTION PROPERTIES OF MESAVERDE AND WASATCH WELLS [A] 22

TABLE 3-8. SUMMARY OF COMPRESSOR REQUIREMENTS FOR EACH ALTERNATIVE 22

TABLE 3-9. EMISSION RATES FOR COMPRESSORS 23

TABLE 3-10. STACK PARAMETERS FOR COMPRESSORS 23

TABLE 3-11. TOTAL NUMBER OF NATURAL GAS WELLS FOR EACH ALTERNATIVE 24

TABLE 3-12. DRY GAS FLOW RATE PER WELL 24

TABLE 3-13. GLYCOL DEHYDRATOR (PER UNIT) EMISSION RATES FOR EACH ALTERNATIVE 25

TABLE 3-14. MILES OF NEW ROAD PER YEAR FOR EACH ALTERNATIVE 26

TABLE 3-15. ANNUAL FUGITIVE DUST EMISSION RATES 27

TABLE 3-16. SUMMARY AREA SOURCE PARAMETERS 28

TABLE 3-17. SUMMARY OF VERNAL RMA FLARING EMISSIONS 29

TABLE 3-18. SELECTED OZONE MONITORING STATIONS 31

TABLE 3-19. POINT SOURCE INPUT PARAMETERS 33

TABLE 3-20. AREA/VOLUME SOURCE INPUT PARAMETERS 33

TABLE 3-21. SOURCE CRITERIA POLLUTANT EMISSION RATES[A] 34

TABLE 3-22. HAP EMISSION RATES[A] 35

TABLE 3-23. RECEPTOR SPACING FOR NEAR-FIELD MODELING 41

TABLE 3-24. FLARE INPUT PARAMETERS [A] 41

TABLE 3-25. FLARE EMISSIONS[A] 42

TABLE 4-1. SURFACE METEOROLOGICAL STATIONS.....44

TABLE 4-2. PRECIPITATION METEOROLOGICAL STATIONS 45

TABLE 4-3. UPPER AIR METEOROLOGICAL STATIONS.....46

TABLE 4-4. SUMMARY OF VERTICAL GRID STRUCTURE AND BIAS 48

TABLE 4-5. LIST OF WIND VECTOR PLOTS.....49

TABLE 5-1. APPLICABLE AMBIENT AIR QUALITY STANDARDS 50

TABLE 5-2. BACKGROUND CONCENTRATIONS FOR VERNAL RMP AREA.....51

TABLE 5-3. BACKGROUND CONCENTRATIONS FOR GLENWOOD SPRINGS RMP AREA 52

TABLE 5-4. BASELINE DATE FOR BACKGROUND CONCENTRATIONS.....52

TABLE 5-5. NAAQS ANALYSIS RESULTS FOR ALT. V/ALT. B.....53

TABLE 5-6. NAAQS ANALYSIS RESULTS FOR ALT. IV/ALT. A 54

TABLE 5-7. NAAQS ANALYSIS RESULTS FOR GLENWOOD ALT. III (PREFERRED).....55

TABLE 5-8. NAAQS ANALYSIS RESULTS FOR ALT. II/ALT. C 56

TABLE 5-9. NAAQS ANALYSIS RESULTS FOR ALT. I/ALT. D 57

TABLE 5-10. NAAQS ANALYSIS RESULTS FOR ALL SOURCES (CUMULATIVE)[A] 58

TABLE 5-11. INCREMENT STANDARDS FOR CLASS I AND CLASS II AREAS.....59

TABLE 5-12. INCREMENT COMPARISON RESULTS FOR ALT. V/ALT. B.....60

TABLE 5-13. INCREMENT COMPARISON RESULTS FOR ALT. IV/ALT. A 60

TABLE 5-14. INCREMENT COMPARISON RESULTS FOR ALT. III (PREFERRED).....61

TABLE 5-15. INCREMENT COMPARISON RESULTS FOR ALT. II/ALT. C 61

TABLE 5-16. INCREMENT COMPARISON RESULTS FOR ALT. I/ALT. D 62

TABLE 5-17. SO_2 INCREMENT COMPARISON FOR ALT. V/ALT. B 63

TABLE 5-18. SO_2 INCREMENT COMPARISON FOR ALT. IV/ALT. A.....64

TABLE 5-19. SO_2 INCREMENT COMPARISON FOR GMA ALT. III (PREFERRED) 65

TABLE 5-20. SO_2 INCREMENT COMPARISON FOR ALT. II/ALT. C 66

TABLE 5-21. SO_2 INCREMENT COMPARISON FOR ALT. I/ALT. D 67

TABLE 5-22. PM_{10} INCREMENT COMPARISON FOR ALT. V/ALT. B 68

TABLE 5-23. PM10 INCREMENT COMPARISON FOR ALT. IV/ALT. A 69

TABLE 5-24. PM10 INCREMENT COMPARISON FOR GMA ALT. III (PREFERRED).....70

TABLE 5-25. PM10 INCREMENT COMPARISON FOR ALT. II/ALT. C 71

TABLE 5-26. PM_{10} INCREMENT COMPARISON FOR ALT. I/ALT. D 72

TABLE 5-27. NO_x INCREMENT COMPARISON FOR ALT. V/ALT. B 73

TABLE 5-28. NO_x INCREMENT COMPARISON FOR ALT. IV/ALT. A.....74

TABLE 5-29. NOX INCREMENT COMPARISON FOR GMA ALT. III (PREFERRED) 75

TABLE 5-30. NO_x INCREMENT COMPARISON FOR ALT. II/ALT. C.....76

TABLE 5-31. NO_x INCREMENT COMPARISON FOR ALT. I/ALT. D.....77

TABLE 5-32. INCREMENT COMPARISON FOR CUMULATIVE ANALYSIS (ALL SOURCES)[A].....78

TABLE 5-33. SO_2 INCREMENT COMPARISON FOR ALL SOURCES (CUMULATIVE)[A].....79

TABLE 5-34. PM10 INCREMENT COMPARISON FOR ALL SOURCES (CUMULATIVE)[A] 80

TABLE 5-35. NOX INCREMENT COMPARISON FOR ALL SOURCES (CUMULATIVE)[A].....81

TABLE 5-36. SUMMARY OF HAP LEVELS 82

TABLE 5-37. RECOMMENDED HAPS BACKGROUND CONCENTRATION 83

TABLE 5-38. HAP ANALYSIS RESULTS FOR ALT. V/ALT. B 83

TABLE 5-39. HAP ANALYSIS RESULTS FOR ALT. IV/ALT. A.....84

TABLE 5-40. HAP ANALYSIS RESULTS FOR GMA ALT. III (PREFERRED) 84

TABLE 5-41. HAP ANALYSIS RESULTS FOR ALT. II/ALT. C....85

TABLE 5-42. HAP ANALYSIS RESULTS FOR ALT. I/ALT. A....85

TABLE 5-43. INCREMENTAL RISK ASSESSMENT RESULTS BY ALTERNATIVE....87

TABLE 5-44. HAP ANALYSIS RESULTS FOR ALL SOURCES (CUMULATIVE)[A]....88

TABLE 5-45. INCREMENTAL CUMULATIVE RISK ASSESSMENT RESULTS....89

TABLE 5-46. SULFUR DEPOSITION RESULTS FOR ALT. V/ALT. B....92

TABLE 5-47. SULFUR DEPOSITION RESULTS FOR ALT. IV/ ALT. A....93

TABLE 5-48. SULFUR DEPOSITION RESULTS FOR GMA ALT. III (PREFERRED)....94

TABLE 5-49. SULFUR DEPOSITION RESULTS FOR ALT. II/ALT. C....95

TABLE 5-50. SULFUR DEPOSITION RESULTS FOR ALT. I/ALT. D....96

TABLE 5-51. NITROGEN DEPOSITION RESULTS FOR ALT. V/ ALT. B....97

TABLE 5-52. NITROGEN DEPOSITION RESULTS FOR ALT. IV/ALT. A....98

TABLE 5-53. NITROGEN DEPOSITION RESULTS FOR GMS ALT. III (PREFERRED)....99

TABLE 5-54. NITROGEN DEPOSITION RESULTS FOR ALT. II/ALT. C....100

TABLE 5-55. NITROGEN DEPOSITION RESULTS FOR ALT. I/ALT. D....101

TABLE 5-56. SCREENING VISIBILITY MODELING RESULTS FOR ALT. V/ALT. B....102

TABLE 5-57. SCREENING VISIBILITY MODELING RESULTS FOR ALT. IV/ALT. A....103

TABLE 5-58. SCREENING VISIBILITY MODELING RESULTS FOR GMA ALT. III (PREFERRED)....104

TABLE 5-59. SCREENING VISIBILITY MODELING RESULTS FOR ALT. II/ALT. C....105

TABLE 5-60. SCREENING VISIBILITY MODELING RESULTS FOR ALT. I/ALT. D....106

TABLE 5-61. ACID NEUTRALIZATION CAPACITY FOR SELECTED LAKES – GMA SOURCES ONLY....107

TABLE 5-62. ACID NEUTRALIZATION CAPACITY FOR SELECTED LAKES – VMA SOURCES ONLY....108

TABLE 5-63. SULFUR DEPOSITION RESULTS FOR ALL SOURCES (CUMULATIVE)[A]....109

TABLE 5-64. NITROGEN DEPOSITION RESULTS FOR ALL SOURCES (CUMULATIVE)[A]....110

TABLE 5-65. SCREENING VISIBILITY MODELING RESULTS FOR ALL SOURCES (CUMULATIVE)[A] 111

TABLE 5-66. REFINED VISIBILITY ANALYSIS – ALL SOURCES (CUMULATIVE) 112

TABLE 5-67. ACID NEUTRALIZATION CAPACITY FOR SELECTED LAKES – ALL SOURCES (CUMULATIVE) 112

TABLE 5-68 NEAR-FIELD NON-FUGITIVE DUST CRITERIA MODELING RESULTS [A] 114

TABLE 5-69 NEAR-FIELD PM_{10} AND $PM_{2.5}$ FUGITIVE DUST MODELING RESULTS – ROAD ONLY 115

TABLE 5-70 NEAR-FIELD PM_{10} AND $PM_{2.5}$ FUGITIVE DUST MODELING RESULTS – ROAD AND OTHER SOURCES[A] 115

TABLE 5-71 NEAR-FIELD HAPS MODELING RESULTS[A] 116

TABLE 5-72. NEAR-FIELD RISK ASSESSMENT RESULTS 117

TABLE 5-73. NEAR-FIELD FLARE MODELING RESULTS[A] 118

FIGURE 3-1 ARRANGEMENT OF SOURCES AND MODEL RECEPTORS.....36

FIGURE 3-2 ARRANGEMENT OF ROAD SOURCES AND MODEL RECEPTORS FOR ROAD SOURCES ONLY MODELING 37

FIGURE 3-3 GRAND JUNCTION, CO, METEOROLOGICAL WIND ROSE.....39

FIGURE 3-4 SALT LAKE CITY, UT METEOROLOGICAL WIND ROSE.....40

LIST OF APPENDICES

APPENDIX A - MODELING SUPPORT FIGURES

APPENDIX B – CALMET MODEL VALIDATION FIGURES

APPENDIX C – INVENTORY SOURCE REVIEW

APPENDIX D – SELECTED EMISSIONS CALCULATIONS FOR BLM SOURCES

APPENDIX E – DETAILED MODELING RESULTS

APPENDIX F – MODELING AND FUGITIVE DUST CALCULATION FILES AND RELATED TABLES (FILES AVAILABLE FROM BLM-NSTC AIR QUALITY STAFF)

LIST OF ATTACHMENTS

ATTACHMENT 1 – ISC3 INPUT FILES PROVIDED BY CDPHE

ATTACHMENT 2 - MEMO FROM MR. HOWARD GEBHART, AIR RESOUCE SPECIALIST, INC., REGARDING THE TOM BROWN COMPANY'S LISBON, UT GAS PLANT

1. INTRODUCTION

The Bureau of Land Management (BLM), Vernal Field Office (under the management of Utah BLM) and Glenwood Springs Field Office (under the management of Colorado BLM) have prepared Resource Management Plans (RMP) and environmental impact statements (EIS) for specific resource areas within northeastern Utah and northwestern and north central Colorado. Due to the close timing and overlapping modeling domains of these resource areas, Utah BLM and Colorado BLM worked cooperatively to prepare one combined air quality impact analysis. This document discusses the air quality assessment methodology and results used by both the Vernal Field Office and the Glenwood Springs Field Office RMP areas.

The air quality assessment included an evaluation of potential impacts associated with future development, including ambient air quality and Air Quality Related Values (AQRVs) managed by Federal Land Managers (FLM). The proposed model for assessing these impacts is the CALPUFF air dispersion model (Version 5.5, Level 010730-1)[1]. The CALMET diagnostic meteorological model was used to develop the meteorological file. Input data to the CALMET model (Version 5.2, Level 000602d) were formatted from the best available Mesoscale Meteorological Model (MM5) data in conjunction with the surface and upper air meteorological data from the weather stations within the modeling domain.

1.1 BACKGROUND

1.1.1 VERNAL FIELD OFFICE

The Vernal Field Office administers two land use plans: the Diamond Mountain RMP and the Book Cliffs RMP. In order to address land management issues on a regional scale, and solve issues that transcend planning boundaries, the Diamond Mountain RMP and the Book Cliffs RMP were combined into one comprehensive action resulting in a new Vernal Field Office RMP. Compatibility issues from combining the two RMPs were resolved as a part of this action.

The area covered by the Vernal Field Office RMP lies within northeastern Utah adjacent to the Colorado and Wyoming borders. The Diamond Mountain RMP was completed in 1994 and covers lands in Daggett, Duchesne, and Uintah Counties. The Book Cliffs RMP was completed in 1985 and covers Uintah County plus 3,000 acres of public land in Grand County previously under the management of the Moab Field Office.

1.1.2 GLENWOOD SPRINGS FIELD OFFICE

The Glenwood Springs Field Office manages 568,000 acres of public lands, extending from Vail on the east to Parachute on the west and from Toponas on the north to Aspen on the south. In 1997, congressional legislation transferred to BLM approximately 56,000 acres of Department of Energy's Naval Oil Shale Reserves lands northwest of Rifle, known as the Roan Plateau. The Roan Plateau area

[1] http://earthtec.vwh.net/download/cpuff.htm

was the focus of land use planning and allocation decisions involving the spectrum of uses from wilderness to oil and gas leasing (Colorado BLM, 2001).

1.2 STUDY TASKS

The following tasks were performed for the assessment of air quality impacts from development scenarios in the Vernal Field Office RMP and the Glenwood Springs Field Office RMP:

1. Describe the Affected Environment, including existing climate and air quality conditions and applicable air quality regulations, standards, etc.

2. Develop air pollutant emission inventories for the various activities associated with existing management and proposed alternatives for the Vernal and Glenwood Springs Field Offices RMP. Several scenarios were considered, representing different degrees of development.

3. Develop meteorological data necessary to use the CALMET wind field model (Earth Tech, Inc. 2001b) to drive the CALPUFF atmospheric dispersion model (Earth Tech, Inc. 2001c), based on the Mesoscale Meteorological Model (MM5) developed by Pennsylvania State University and the National Center for Atmospheric Research (UCAR 2002).

4. Assess the near-field and far-field air quality impacts of development activities, including direct and cumulative impacts to criteria and hazardous air pollutants by Alternative.

5. Assess potential visibility impacts within mandatory Federal Class I areas and at specific Class II areas of concern.

6. Assess total sulfur and nitrogen deposition impacts within mandatory Federal Class I areas and at specific Class II areas of concern. Potential changes in Acid Neutralizing Capacity (ANC) were also evaluated per the Forest Service's guidance method (USDA-FS 2000).

2. OVERVIEW OF ASSESSMENT APPROACH

This modeling analysis followed a general modeling procedure used in previous National Environmental Policy Act (NEPA) assessments and Clean Air Act New Source Review (NSR) permit applications. The CALPUFF model was used to estimate the potential impacts on air quality and AQRVs from proposed and other "reasonably foreseeable" sources in the modeling domain. The CALPUFF modeling domain included the entire Vernal Field Office RMP area and Glenwood Springs Field Office RMP area, several mandatory Federal Class I areas, and other sensitive Class II areas specified by the BLM and the states. This modeling domain covered eastern Utah, the southwestern border of Wyoming, and western Colorado.

Outputs from the air quality modeling were used to assess the potential impacts on near- and far-field air quality and AQRVs. The following assessments were conducted:

1. Prediction of the potential direct and cumulative air quality impacts of emissions from the existing and foreseeable oil, gas, and mineral development scenarios (five [Glenwood] and four [Vernal] alternative scenarios).
2. Comparison of the potential direct and cumulative air quality impacts plus the existing background concentration to the applicable National Ambient Air Quality Standards (NAAQS) and to those state Ambient Air Quality Standards that are more stringent than the NAAQS.
3. Visibility assessment impacts within mandatory Federal Class I areas and specific Class II areas of concern.
4. Atmospheric deposition of total sulfur and nitrogen within mandatory Federal Class I areas and specific Class II areas of concern.

The pollutants evaluated in the various modeling analyses are listed below:

National and State Ambient Air Quality Standards (NAAQS) Analysis

- nitrogen dioxide (NO_2)
- carbon monoxide (CO)
- particulate matter less than 10 microns in diameter (PM_{10})
- particulate matter less than 2.5 microns in diameter ($PM_{2.5}$)
- sulfur dioxide (SO_2)

Hazardous Air Pollutants (HAP) Analysis

- formaldehyde
- hydrogen sulfide (H_2S)
- benzene, toluene, ethylbenzene, and xylenes (BTEX)

Class II Increment Comparison

- NO_2
- PM_{10}
- SO_2

Class I Increment Comparison

- NO_2
- PM_{10}
- SO_2

Class I Visibility and Deposition Analysis

- Regional Haze Impacts (NO_3, PM_{10}, and SO_4)
- Atmospheric Deposition (total nitrogen and total sulfur)

3. AIR QUALITY MODELING METHODOLOGY

In order to quantify potential direct and cumulative air quality impacts from the Proposed Action and other Alternatives (including the "No Action" Alternative), it was necessary to use a predictive atmospheric dispersion computer model. These models are typically used by air quality regulatory agencies when specifying emissions control measures and when issuing construction and/or operating permits to industrial applicants. These same models can also be used to determine potential air quality impacts by Federal land management agencies under NEPA. The following sections described the setup of the modeling analysis.

3.1 MODEL SELECTION

The CALPUFF air dispersion model is the preferred model for long-range transport recommended by the Federal Land Manager Air Quality Related Value Workgroup (FLAG) guidance and the Interagency Workgroup on Air Quality Modeling (IWAQM) phase 2 summary report. This air quality modeling analysis used the CALPUFF air dispersion model for both short-range and long-range transport evaluations. The CALPUFF model can effectively predict concentrations at both the near-field and far-field receptors. The IWAQM phase 2 report states that:

"The CALMET/CALPUFF modeling system… was a relatively new Lagrangian puff modeling system, which had additional algorithms to provide simulation of local-scale short-range dispersion using methods already endorsed by the EPA. Thus, use of this newer modeling system allowed one model to be used for all sources in an analysis, regardless of the transport distance involved." (IWAQM 1998)

Furthermore, in a separate case study conducted by Trinity Consultants, CALPUFF was shown to predict more realistic results than other models such as ISCST3 and AERMOD in a short-range analysis. (Carper 2002). Its ability to model chemical transformation and deposition and its ability to interpret terrain effects make it a valuable tool in near-field analyses.

A table summarizing the CALPUFF variable values is provided in Appendix F. All the CALPUFF input and output list files are provided on CD in Appendix F.

3.2 IDENTIFICATION OF SENSITIVE AREAS

Before conducting the analysis, it was necessary to specify the locations of potential impact (sensitive receptors) and the specific modeling system to be used. With recommendations from the States of Utah Colorado, and several Federal agencies, BLM chose twelve mandatory Federal Class I and ten Federal Class II areas to be considered in the analysis. Figure A-1 of Appendix A presents a map of the selected Class I and Class II areas and the boundaries of the two field offices. These selected sensitive areas are also listed in Table 3-1.

TABLE 3-1. SENSITIVE AREAS TO BE CONSIDERED IN THE ANALYSIS

Mandatory Federal Class I Area (unless otherwise specified) [a]	Managing Agency [b]	Class Category	State
Arches NP	NPS	Class I	UT
Black Canyon of the Gunnison NP	NPS	Class I	CO
Browns Park NWR	FWS	Class II	UT
Canyonlands NP	NPS	Class I	UT
Capitol Reef NP	NPS	Class I	UT
Colorado NM	NPS	Class II [d, e]	CO
Dinosaur NM	NPS	Class II [d, e]	UT/CO
Eagles Nest WA	FS	Class I	CO
Flaming Gorge NRA	FS	Class II [c]	UT/WY
Flat Tops WA	FS	Class I	CO
High Uintas WA	FS	Class II [d]	UT
Holy Cross WA	FS	Class II [d]	CO
Hunter-Frying Pan WA	FS	Class II [d]	CO
La Garita WA	FS	Class I	CO
Maroon Bells-Snowmass WA	FS	Class I	CO
Mount Zirkel WA	FS	Class I	CO
Ouray NWR	FWS	Class II	UT
Raggeds WA	FS	Class II [d]	CO
Rawah WA	FS	Class I	CO
USFS Request (Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo)	FS	Class II	UT
Weminuche WA	FS	Class I	CO
West Elk WA	FS	Class I	CO

[a] NP= National Park, WA=Wilderness Area, NWR=National Wildlife Refuge, NM=National Monument, NRA=National Recreation Area.

[b] NPS= USDI - National Park Service. FS= USDA - Forest Service. FWS=US Fish & Wildlife Service

[c] Sensitive Class II areas included in the analysis per CDPHE. (Machovec 2002)

[d] Sensitive Class II areas included in the analysis. (Archer 2001a and Archer 2002a)

[e] SO_2 increment in these Class II areas in Colorado has the same protection as Class I areas.

3.3 EMISSION SOURCE DESCRIPTION AND REPRESENTATION

Two groups of sources were modeled within this analysis. The first included new and modified emission sources that have commenced operation since the monitoring baseline date. Data for these sources were provided by the Colorado Department of Public Health and Environment (CDPHE) and Utah Department

of Environmental Quality (UDEQ) state inventories[2]. These sources were referred to as the "inventory sources." The second group included future proposed sources expected due to BLM oil and gas development: compressors for gas compression, glycol dehydrators, and fugitive dust from new roads. Data for these sources are outlined below in Section 3.3.2 and referred to as "BLM sources."

3.3.1 INVENTORY SOURCES

Emission inventory data of the existing sources were obtained from UDEQ and CDPHE. The monitoring date of the background concentration was used to determine whether a source from the emission inventory had already been included in the background concentration. Background air quality data were values recommended by UDEQ and CDPHE. (Chick 2002 and Sprott 2003)[3]. A discussion of the background concentration and monitoring baseline date can be found in Section 5.1.1; the proposed baseline date for each pollutant is summarized in Table 3-2.

TABLE 3-2. BASELINE DATE FOR BACKGROUND CONCENTRATIONS

Pollutant	**PM_{10}**	**$PM_{2.5}$**	**NO_2**	**CO**	**SO_2**
Proposed Baseline Date	2000	2001	2000	2001	2000

If a source in the emission inventory was in operation before the monitoring date of the background concentration, this source was assumed to be included in the background and was not modeled. This analysis also assumed that there are some reasonable emissions variations through the years. If an emission source shows some increases or decreases between the year before and the year after the baseline date, and the inventory information provided by the States does not show that the source went through modification, the emissions changes were assumed to be a part of expected variation and were not modeled. The following sources in the emission inventory were modeled because they were not considered a part of the background:

- Any source that commenced operation after the monitoring baseline date.
- Any emissions increase from a source with a permit issued after the monitoring baseline date. If the last permit issue date was unavailable, the emission increase was modeled. The UDEQ inventory did not provide a permit issue date. Therefore, any emissions increase after the monitoring baseline date was modeled.

Trinity conducted a review of all sources provided in the Utah and Colorado source inventory and all Title V permits available on the UDEQ and CDPHE websites. The review was

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[2] Deborah McMurtrie, SIP/Rules Section, Planning Branch, Division of Air Quality, Department of Environmental Quality, (801) 536-4187. Dave Thayer, Public Health Engineer Colorado Department of Public Health and Environment, Air Pollution Control Division / Stationary Sources Program, david.thayer@state.co.us, Voice:303-692-3187, FAX:303-782-0278.

[3] Background concentrations recommended by CDPHE in the review comments provided by Nancy Chick, dated on December 20, 2002. Background concentrations recommended by the Utah Department of Environmental Quality in memorandum No. DAQP-003-03, dated on January 17, 2003 from Richard W. Sprott to Yu Shan Huang.

conducted on a per-pollutant basis since each pollutant had a different monitoring baseline date. As discussed in Section 3.4, the modeling domain was set such that it extended 50 km beyond all sources and receptors. Therefore, only sources inside 50 km of the modeling domain boundary were modeled. Figure A-1 in Appendix A shows the modeling domain boundary.

The stack parameters and emission rates for all inventory sources are listed in Appendix C. A list of all inventory sources that were excluded from the analysis is also provided in Appendix C, indicating the reason for exclusion.

3.3.1.1 EMISSION CALCULATIONS

Long-term (annual) emission rates were used for both short-term averaging periods (i.e., 1-hour, 3-hour, 8-hour, and 24-hour) and long-term averaging periods (i.e., annual). Sources identified in the Title V review were modeled at maximum potential short-term emission rates based on the permit limits. Emission rates from the Title V sources were calculated using AP-42 emission factors unless emission factors were specified within the permit itself.

UDEQ and CDPHE do not keep an emission inventory for $PM_{2.5}$. Emission rates for $PM_{2.5}$ were estimated from PM_{10} emissions using emission data provided in AP-42. Table 3-3 summarizes the $PM_{2.5}$ calculation assumptions.

TABLE 3-3. $PM_{2.5}$ EMISSION CALCULATION ASSUMPTIONS

Source Description	$PM_{2.5}$ Emission Rate
Natural Gas Combustion (AP-42 1.3 and 3.0)	$PM_{2.5}$ = 100% of PM_{10} emissions
Fugitive Particulates (AP-42 13.2)	$PM_{2.5}$ = 30% of PM_{10} emissions
Coal Combustion (AP-42 1.1)	$PM_{2.5}$ = 50% of PM_{10} emissions

If the location and stack parameters for two or more sources were identical, they were represented by one source with an emission rate equal to the sum of the combined sources. Sources with an emission rate or emission increase of less than one ton per year were excluded from the modeling analysis because their emissions were considered insignificant. Using this filtering method 99.5% of the emissions in Colorado and 99.3% of the emissions in Utah were modeled.

3.3.1.2 STACK PARAMETERS

Stack parameters were taken directly from state inventories. Missing stack parameters were filled using realistic assumptions based on the type of equipment identified. The assumptions were based on similar equipment within the inventory, whose stack parameters were reported. These are summarized in Table 3-4.

TABLE 3-4. POINT SOURCE STACK PARAMETERS FOR MISSING DATA

Unit	Stack Height (m)	Diameter (m)	Exit Velocity (m/s)	Temperature (K)
Ajax Natural Gas Engine	6	0.3	15	500
Amine Reboiler	6	0.91	1	500
Boiler	6	0.91	5	600
Caterpillar Engine	6	0.91	40	900
Diesel Generator	6	0.61	30	755
Glycol Dehydrator	1.83	0.23	0.45	294
Natural Gas Engine	6	0.91	30	755
Natural Gas Flare	4	0.3	30	755
Small Boiler or Heater	6	0.9	5	422
Waukesha Natural Gas Engine	5	0.4	30	700

If the location of the source was not provided in either UTM or latitude and longitude coordinates, the coordinates were filled based on the street address provided. If coordinates for the street address were not accessible, the approximate center of the county was chosen as the location of the source. However, no sources were placed within 10 km of any modeled sensitive areas. This "buffer zone" provided a more realistic analysis of existing and expected sources. The buffer zone of 10 km was appropriate due to the additional stringency of air quality permitting requirements for sources located within 10 km of Class I areas[4].

Gravel pits, storage piles, haul roads, and other fugitive sources were modeled as area sources. Since parameters were not provided in the State's emission inventory for area sources, BLM National Science and Technology Air Quality (NSTC-AQ) Staff, in consultation with Trinity and members of the Air Quality Stakeholders Group, developed a 3-tier scheme (small, medium, and large) to better represent area sources of fugitive dust in the dispersion modeling. The parameters associated with each category are shown in Table 3-5 below. This scheme was undertaken because, in the opinion of BLM staff and stakeholders, the previous assumption used for these area sources (10 x 10 meter square) did not accurately represent the types of sources involved, and could possibly produce artificially high modeled concentrations at nearby receptors.

Because the source information provided by Trinity Consultants (from State agencies) to the BLM contained little information regarding descriptive details of the permitted facilities, professional judgment of BLM NSTC-AQ staff was used to place each of the area sources into one of the categories. Also, CDPHE general modeling guidance, as described by Mr. Chip Hancock (personal communication, CDPHE 2004) was followed

[4] For sources located within 10 km of any Class I area, the Prevention of Significant Deterioration (PSD) permitting rules consider any net emissions increase that will have an air quality impact greater than 1 $\mu g/m^3$ (24-hour average) at the Class I area to be a significant increase.

in selecting initial sigma z and release height values. Mr. Hancock indicated that the total of the initial sigma z and release should not exceed approximately 10.

TABLE 3-5. AREA SOURCE CATEGORIES FOR DISPERSION MODELING

Size Category	Dimensions (meters)		Effective Height	Initial sigma z[a]
	X-Dimension	Y-Dimension	(meters)	(meters)
SMALL	20	20	3	2.79
MEDIUM	150	150	5	4.65
LARGE	400	400	7	3.26

[a] For small, medium sources, sigma z = (2 * release ht.)/2.15; For large sources, sigma z = release ht./2.15. (See the ISC Model User's Guide [EPA, 1995b], pp 3-28 to 3-35 for further information)

3.3.1.3 UPDATES & REVISIONS TO INVENTORY SOURCES

In addition to the changes described above, a review of the modeled inventory sources was undertaken by BLM NSTC-AQ staff to determine, to the extent possible given project timelines, if any given modeled inventory source should have been included and if the parameters for these sources were correct.

Initially it was determined that, due to the large number of modeled inventory sources (approximately 250), a full-scale review of every source would not be possible. Therefore BLM NSTC-AQ staff developed a screening procedure, described below, to select a limited number of sources to be reviewed.

This screening procedure took the form of a series of spreadsheets (10 total), measuring the distance from each of the inventory sources to the maximum impact receptor in each of five Class I areas (Arches NP, Canyonlands NP, Maroon Bells WA, Mt. Zirkel WA, and West Elk). These areas had the highest impacts from the previous modeling. Stack (release) height and particulate emissions were also examined. Based on this analysis, a few of the sources were selected for further review. Of these, the changes shown in Table 3-6 were made to the inventory sources included in the modeling. Several more sources (Public Service Company, Hayden Plant [2 sources], Duckels Construction Inc. [Yampa Aggregates], and Valco Inc. [Rozman Pits]) were to be examined for possible changes/exclusion. However, information needed to determine their status was not available within project deadlines. Therefore, these sources remained unchanged in the modeling. Tables C-1 and C-2 (Appendix C) list all modeled sources.

As stated above, because of the limited time available to complete the modeling analysis, not all inventory sources were checked for accuracy of the information provided. Based on the results of the focused BLM analysis, however, it is likely that some sources remaining in the modeling should have been screened out.

TABLE 3-6. INVENTORY SOURCE CHANGES FOR REVISED MODELING

State	Facility Name	Source(s) Removed, Added or Modified	Comments/Explanation	Reference
UT	Hunter Power Plant	All previously modeled sources removed	No permit modification that would impact emissions occurred since 1998. Any change (increase) in emissions "was typical" and likely due to shutdowns in 2000.	(UDEQ, 2004a)
UT	Moab Salt Incorporated (a.k.a. Salt & Potash Production Facility)	Source coordinates changed	Previous coordinates placed facility approximately 1.5 km from max impact receptor in Arches NP. According to Mr. David Prey, UDEQ, this is incorrect and in fact the facility is approximately 35 km away. Mr. Prey provided corrected lat/long values.	(UDEQ, 2004a, b)
UT	Huntington Power Plant	All previously modeled sources removed	Title V revision due to issuance of DAQE-119-02 for adding coal blending equipment in 2002. However, all emissions changes were negative. Previously, it was assumed that any change, regardless of direction, was positive and was therefore modeled. This was not appropriate in the opinion of BLM NSTC Air Quality staff	See Tables BLM M-30, M-31 available from, BLM NSTC-AQ Staff
UT	Tom Brown Lisbon Gas Plant	All previously modeled sources except LGP11 (two new boilers) removed	Memo from Mr. Howard Gebhart, Air Resource Specialists, Inc., air quality consultant for this facility, stated that only one source (LGP11) showed any changes after 2000. Therefore, all other sources were removed from the modeling.	See Attachment 2 to this Technical Support Document
CO	Bowie Resources Ltd.	Area source of PM10, PM2.5 removed	Mr. Chip Hancock (CDPHE) indicated that this facility had dramatically reduced their permitted hauling capacity (6 Million TPY to 400 K TPY), thereby reducing their fugitive PM emissions below 2000, 2001 levels (161.2 TPY from 953 TPY). Therefore, it was removed from the modeling.	CDPHE, 2004
CO	American Soda	2 area, 15pt sources of PM_{10} added	Added at the request of the CDPHE. Only Piceance and Parachute sources added. "NAAQS/PSD" sources (non-American Soda sources) not added. (Taken from ISC model input files provided to the BLM by CDPHE)	See Attachment 1 to this Technical Support Document and tables BLM M-1 to M-3

3.3.2 BLM SOURCES

Four development alternatives were modeled for both RMP Areas. The Glenwood Springs alternative name is listed first, with the corresponding Vernal alternative in parenthesis: Alternative I (No Action; Alternative D), Alternative II (Alternative C), Alternative IV (Alternative A), and Alternative V (Alternative B). The fifth Alternative for Glenwood

Springs (Alternative III; Preferred) was not explicitly modeled. This newest Alternative was added shortly before the revised dispersion modeling was conducted, making it difficult from a cost and timeline basis. More important, however, is the fact that the number of wells is identical to Alternative IV and differs only in that development on top of the Plateau would be deferred until 80% of the area on BLM lands below the cliffs is drilled. BLM believes that this minor difference between the two Alternatives does not warrant separate modeling.

In fact, this assumption is borne out in the results (See Chapter 5). Potential visibility impacts to Class I areas differ very little between Alternatives, and the differences are similarly small for the comparison of results to the NAAQS standards and PSD Increments. Therefore, the results for Alternative III (Preferred) will be assumed to be equal to Alternative IV.

The development alternatives were based on BLM's proposed plans for resource development, which included estimates for the number of wells drilled for oil and gas, compressor stations, and pipelines, along with other foreseeable development activities by non-BLM entities.

Each development alternative covered development activity for an extended period of time, 15 years for the Vernal Management Area (VMA) and 20 years for Glenwood Springs Management Area (GMA). This modeling analysis predicted, at most, annual average air quality impacts, as well as short-term impacts. Therefore, modeling was based on a single year of activity; there would be little or no variation in activity levels from year to year according to BLM field office personnel (BLM 2004a, b).

3.3.2.1 COMPRESSORS

For each development scenario, the number of expected compressors was determined based on expected gas production. Required compression was calculated using the rule of thumb that 1,100 horsepower (hp) of compression was required to move 10 million cubic feet per day (MMCF/Day) of gas, going from a field pressure of 250 pounds per square inch (psi) to a sales line pressure of 800 psi[5]. Gas production was calculated from the number of new wells per year and the gas production potential of each well. Gas production for each well gradually declines over the life of the well. Table 3-7 summarizes the gas production properties of two types of well: Wasatch and Mesaverde.

[5] Per Dave Cesark, Williams Production RMT Company, on February 21, 2003.

TABLE 3-7. GAS PRODUCTION PROPERTIES OF MESAVERDE AND WASATCH WELLS [a]

	Typical Mesaverde well	Typical Wasatch well
Decline type	hyperbolic	exponential
Decline rate (first 4 yrs)	0.35	0.13
Decline rate (5-23 yrs)	0.15	0.13
Hyperbolic exponent	0.4	N/A
Initial production (MCF/D)	1,200	270

[a] Information provided in an email from Craig Nicholls, BLM, to Eri Ottersburg, Trinity Consultants, on 2/26/03.

Expected gas production and compressor requirements for each alternative are summarized in Table 3-8. Detailed calculations are provided in Appendix D.

TABLE 3-8. SUMMARY OF COMPRESSOR REQUIREMENTS FOR EACH ALTERNATIVE

	Maximum Predicted	Balanced Use	Resource Protection	Continuation of Current
Vernal Management Area				
Wasatch Wells (%)	85%	85%	85%	85%
Mesaverde Wells (%)	15%	15%	15%	15%
Gas recovered (MCF/Year)	228,880,547	226,265,311	221,203,213	230,493,231
Compression required (hp)	68,978	68,190	66,664	69,464
Number of compressors @ 1,000 hp	69	68	67	69
Glenwood Springs Management Area				
Wasatch Wells (%)	25%	25%	25%	25%
Mesaverde Wells (%)	75%	75%	75%	75%
Gas recovered (MCF/Year)	222,086,410	203,330,833	172,871,194	169,236,392
Compression required (hp)	66,930	61,278	52,098	51,003
Number of compressors @ 1,000 hp	67	61	52	51

Modeled emissions from compressors include SO_2, NO_x, CO, PM_{10}, $PM_{2.5}$, BTEX, and formaldehyde. Emission rates were calculated using AP-42 emission factors for a 4-stroke Lean-burn engine. However, the NO_x emission rate for compressors in Utah was calculated based on a Best Available Control Technology (BACT) limit of 0.7 grams per horsepower-hour (g/hp-hr). This emission rate was based on the stringent BACT limits in Utah. The NO_x emission rate for compressors in Colorado was based on 1.5 g/hp-hr. The value of 1.5 g/hp-hr NOx emissions for the proposed Colorado compressors was determined in consultation with BLM Air Quality Technical staff. This value was used in recent BLM air quality analyses and is believed to be reasonably achievable by the industry without significant additional cost, while helping to minimize potential impacts from natural gas development. The State of Colorado (Machovec, 2003) has indicated it

does not have emission control technology requirements for compressor engines (unless the controls are needed to show compliance with ambient air quality standards during the minor source permitting process). Consequently, if natural gas pipeline compressors are permitted at emission rates greater than 1.5 g/hp-hr, cumulative NOx air quality impacts could be greater than those reported in this EIS. The emission rate for each pollutant is shown in Table 3-9 and detailed emission calculations are provided in Appendix D.

TABLE 3-9. EMISSION RATES FOR COMPRESSORS

Pollutant	Emission Rate (tpy)	Emission Rate (lb/hr)	Emission Rate (g/sec)
CO	2.01E+01	4.59E+00	5.78E-01
NO_x - Colorado	1.45E+01	3.36E+00	4.24E-01
NO_x - Utah	6.76E+00	1.54E+00	1.94E-01
PM_{10}	3.60E-01	8.23E-02	1.04E-02
$PM_{2.5}$	3.60E-01	8.23E-02	1.04E-02
SO_2	2.12E-02	4.84E-03	6.10E-04
Benzene	1.59E-02	3.63E-03	4.57E-04
Ethylbenzene	1.43E-03	3.27E-04	4.12E-05
Formaldehyde	1.91E+00	4.35E-01	5.48E-02
Toluene	1.47E-02	3.36E-03	4.24E-04
Xylenes	6.64E-03	1.52E-03	1.91E-04

Since the compressor type has not yet been determined, exact stack parameters were unknown. For the purpose of this analysis, stack parameters were assigned based on typical gas pipeline compressors. These stack parameters are summarized in Table 3-10 below.

TABLE 3-10. STACK PARAMETERS FOR COMPRESSORS

Parameter	Value
Stack Height (m)	6.1
Diameter (m)	0.91
Exit Velocity (m/s)	30
Temperature (K)	755.4

3.3.2.2 GLYCOL DEHYDRATORS

This analysis assumed one glycol dehydrator per gas well. The number of gas wells for each alternative is summarized in Table 3-11.

TABLE 3-11. TOTAL NUMBER OF NATURAL GAS WELLS FOR EACH ALTERNATIVE

	New Wells				
	Alternative A	**Alternative B**	**N/A**	**Alternative C**	**Alternative D**
Vernal Management Area[a,b]					
East Tavaputs Plateau	717.0	718.7	**N/A**	643.1	709.8
West Tavaputs Plateau	471.9	473.3	**N/A**	452.1	452.1
Monument Butte-Redwash	4655.5	4741.5	**N/A**	4632.5	4588.8
Altamont-Bluebell	424.8	424.8	**N/A**	424.8	424.8
Tabiona-Ashely Valley	29.6	29.7	**N/A**	29.2	29.3
Manila-Clay Basin	44.0	44.6	**N/A**	44.0	42.8
	Alternative I	**Alternative II**	**Alternative III**	**Alternative IV**	**Alternative V**
Glenwood Springs Management Area[c]					
Roan Plateau	2996	3046	3465	3465	3723

[a] Values from BLM, 2004b. Fractional values result from multiplication of proposed number of wells by percentage of open space. Includes a small number of CBM wells.

[b] Includes new oil wells, which were treated as conventional natural gas wells for emissions calculations and modeling.

[c] Values from Walsh, 2004a.,

Emissions for the glycol dehydrators were calculated using the GRI-GLYCalc program[6]. Engineering estimates of a typical glycol dehydrator were used to determine input values for GRI-GLYCalc. A summary of input values for each scenario can be found in Appendix D. An electronic copy of the GRI-GLYCalc input files are provided on CD-ROM in Appendix F. The dry gas flow rate for each management area, summarized in Table 3-12, was calculated from the annual expected gas recovery.

TABLE 3-12. DRY GAS FLOW RATE PER WELL

Management Area	**Dry Gas Flow Rate per Well (MMSCF/Day)**
Vernal Management Area	0.1992
Glenwood Springs Management Area	0.1453

Modeled emissions from glycol dehydrators included BTEX and hydrogen sulfide. The emission rate output from GRI-GLYCalc for each alternative is shown in Table 3-13. These emission rates represent the emissions for each glycol dehydrating unit. GRI-GLYCalc output files are provided in Appendix D.

6 GRI's Glycol Dehydrator Emission Estimator, GRI-GLYCalc, Version 4.0, Developed by URS Radian, © 1996, 2000.

TABLE 3-13. GLYCOL DEHYDRATOR (PER UNIT) EMISSION RATES FOR EACH ALTERNATIVE

	Vernal Management Area	Glenwood Springs Management Area
Pollutant	**(lb/hr)**	**(lb/hr)**
Hydrogen Sulfide	1.15E-06	1.05E-07
Benzene	2.92E-01	2.67E-02
Toluene	4.59E-01	4.19E-02
Ethylbenzene	5.32E-02	4.85E-03
Xylenes	8.67E-01	7.91E-02

Due to the large number of glycol dehydrators, they were modeled as area sources. This method distributed the emissions sources evenly across the management area, while keeping the total number of sources modeled small, thus allowing faster model runs to meet project timelines. In reality, about one glycol dehydrator was located at each well, and well spacing was 20 to 40 acres. Each area source was modeled as covering a large, square area, with the same parameters as the inventory sources (See Table 3-5 above). The same area sources were used to model fugitive dust from roads, described below. See Table 3-16 in Section 3.3.2.3 for further description of the area sources for each alternative.

3.3.2.3 FUGITIVE DUST FROM NEW ROADS

PM_{10} and $PM_{2.5}$ emissions were modeled for new roads. Emission rates were calculated using the AP-42 Final Section 13.2.2 (EPA 2003a, for Industrial Roads) and Section 13.2.3, Heavy Equipment Operations (EPA 1995a). The miles of new roads per year were calculated for the VMA[7] by assuming 0.60 miles of new roads were constructed per well pad. For the GMA, the miles of new roads per year for each alternative were calculated as a weighted sum the percent of wells above and below the cliffs and the round trip distance associated with each location. The total miles per year are summarized in Table 3-14.

[7] Mineral Potential Report for the Vernal Planning Area.

TABLE 3-14. MILES OF NEW ROAD PER YEAR FOR EACH ALTERNATIVE

	New Miles of Road				
	Alternative A	**Alternative B**	**N/A**	**Alternative C**	**Alternative D**
Vernal Management Area[a]					
East Tavaputs Plateau	28.7	28.7	**N/A**	25.7	28.4
West Tavaputs Plateau	18.9	18.9	**N/A**	18.1	18.1
Monument Butte-Redwash	186.2	189.7	**N/A**	185.3	183.6
Altamont-Bluebell	17.0	17.0	**N/A**	17.0	17.0
Tabiona-Ashely Valley	1.2	1.2	**N/A**	1.2	1.2
Manila-Clay Basin	1.8	1.8	**N/A**	1.8	1.7
	Alternative I	**Alternative II**	**Alternative III**	**Alternative IV**	**Alternative V**
Glenwood Springs Management Area[b]					
Roan Plateau	561	725	848	848	958

[a] – Fractional values result from multiplication of fractional well numbers by 0.6 miles of new road per well.

[b] – Mileage figures based on number of well pads per alternative, not wells, because some of the pads have multiple wells. See fugitive dust calculations CD, available from BLM NSTC-AQ staff upon request.

PM_{10} and $PM_{2.5}$ emission rates are summarized in Table 3-15. A summary of emission rate calculations is given in Appendix D. Detailed information, including all spreadsheets used to calculate fugitive dust emission rates, is available from BLM NSTC-AQ staff upon request. Primary road traffic occurred during daylight working hours, particularly during the well construction period. Therefore, road emissions were limited by the assumption that the road source was only in use between 7 am and 7 pm each day.

TABLE 3-15. ANNUAL FUGITIVE DUST EMISSION RATES

	PM_{10} Emissions (Tons per year; tpy)				
	Alternative A	**Alternative B**	**N/A**	**Alternative C**	**Alternative D**
Vernal Management Area					
East Tavaputs Plateau	13.7	13.7	**N/A**	12.3	13.5
West Tavaputs Plateau	9.0	9.0	**N/A**	8.6	8.6
Monument Butte-Redwash	88.7	90.3	**N/A**	88.3	87.4
Altamont-Bluebell	8.1	8.1	**N/A**	8.1	8.1
Tabiona-Ashely Valley	0.6	0.6	**N/A**	0.6	0.6
Manila-Clay Basin	0.8	0.8	**N/A**	0.8	0.8
Glenwood Springs Management Area	**Alternative I**	**Alternative II**	**Alternative III**	**Alternative IV**	**Alternative V**
Roan Plateau	431	547	656	656	737
	$PM_{2.5}$ Emissions (tpy)				
	Alternative A	**Alternative B**	**N/A**	**Alternative C**	**Alternative D**
Vernal Management Area					
East Tavaputs Plateau	2.0	2.0	**N/A**	1.8	2.0
West Tavaputs Plateau	1.3	1.3	**N/A**	1.3	1.3
Monument Butte-Redwash	13.0	13.3	**N/A**	13.0	12.9
Altamont-Bluebell	1.2	1.2	**N/A**	1.2	1.2
Tabiona-Ashely Valley	0.1	0.1	**N/A**	0.1	0.1
Manila-Clay Basin	0.1	0.1	**N/A**	0.1	0.1
Glenwood Springs Management Area	**Alternative I**	**Alternative II**	**Alternative III**	**Alternative IV**	**Alternative V**
Roan Plateau	63	80	96	96	108

Fugitive dust emissions from roads were modeled as area sources. However, the locations of potential roads were unknown. Each road was represented as one or several squares. The sum of the area of the square(s) equals the effective area of new roads. This was calculated based on a 30-foot-wide road and the miles of new road in each alternative. For example, a 1,000 foot-long-road has an effective area of 30,000 square feet. The road was represented by one or more squares with a total area of 30,000 square feet. Table 3-16 below further describes the area sources for each alternative. The road sources were distributed throughout the management areas in a grid pattern. The effective height and the initial sigma Z for each source was set to that of a large area source, as described above (See Table 3-5).

TABLE 3-16. SUMMARY AREA SOURCE PARAMETERS

Vernal/Roan Alternative	Total area of road @ 30 ft wide (meters^2)	Dimension (meters)	Area of Each Source (meters^2)	Number of Area Sources
Alt B/Alt V				
East Tavaputs Plateau	2,326,863	510	260,100	9
West Tavaputs Plateau	1,532356	510	260,100	6
Monument Butte-Redwash	15,351,080	920	846,400	18
Altamont-Bluebell	1,375,332	590	348,100	4
Tabiona-Ashely Valley	96,157	310	96,100	1
Manila-Clay Basin	144,397	380	144,400	1
Roan Plateau	5,151,831	465	216,225	24
Alt A/Alt IV				
East Tavaputs Plateau	2,321,359	510	260,100	9
West Tavaputs Plateau	1,527,823	510	260,100	6
Monument Butte-Redwash	15,072,647	940	883,600	17
Altamont-Bluebell	1,375332	580	336,400	4
Tabiona-Ashely Valley	95,833	310	96,100	1
Manila-Clay Basin	142,454	380	144,400	1
Roan Plateau	3,974,154	425	180,625	22
Alt C/Alt II				
East Tavaputs Plateau	2,082,101	510	260,100	8
West Tavaputs Plateau	1,463,719	540	291,600	5
Monument Butte-Redwash	14,998,182	940	883,600	17
Altamont-Bluebell	1,375,332	580	336,400	4
Tabiona-Ashely Valley	94,538	310	96,100	1
Manila-Clay Basin	142,454	380	144,400	1
Roan Plateau	2,735,772	380	144,400	19
Alt D/Alt I				
East Tavaputs Plateau	2,298,048	500	250,000	9
West Tavaputs Plateau	1,463,719	490	240,100	6
Monument Butte-Redwash	14,856,699	910	828,100	18
Altamont-Bluebell	1,375,332	580	336,400	4
Tabiona-Ashely Valley	94,862	310	96,100	1
Manila-Clay Basin	138,569	370	136,900	1
Roan Plateau	2,237,991	345	119,025	19

3.3.2.4 FLARING EMISSIONS

During preparation of the revised CALPUFF input files, the BLM Vernal Field Office (VFO) provided information that a significant percentage of their proposed new wells

would require flaring (60% of Natural Gas wells; BLM 2004b). It was determined that the most efficient way to add these emissions to the modeling was to distribute the flaring emissions evenly across the existing point sources. The distribution was weighted by the percent of the total area covered by each sub-region. As has been discussed previously, this is an acceptable method of locating these sources, since their exact locations are not known.

The results of the emissions calculations are shown in Table 3-17. According to VFO personnel, the flared gas is called "sweet gas" and is assumed to contain no sulfur. Therefore, no emissions were estimated for SO_2. A detailed breakdown of flaring emissions by region for each alternative is presented in Table BLM M-7, on the emissions calculation CD available from BLM NSTC-AQ staff.

According to GMA personnel, approximately 5% or less of the proposed new wells would require flaring. Preliminary emissions calculations were completed for the GMA; however the results showed the level of emissions to be insignificant. Therefore, these emissions were not included in the modeling.

TABLE 3-17. SUMMARY OF VERNAL RMA FLARING EMISSIONS

Alternative	NOx (tpy)	CO (tpy)
Alternative A	26	141
Alternative B	26	143
Alternative C	25	138
Alternative D	25	139

3.3.2.5 LOCATION OF SOURCES

Sources were evenly distributed across each development area in a grid pattern. Because the exact location of the emission sources would be determined later in the New Source Review process by the construction permit applicants, the source locations used in the model do not represent the actual location of the emission sources in the development plans. Source locations are shown in Figures A-2 and A-3 of Appendix A.

3.4 MODELING DOMAIN

The modeling domain covered most of eastern Utah, the southwestern border of Wyoming, and western Colorado, extending from 37.15° to 41.99° Latitude North, and 105.63° to 112.05° Longitude West. The resulting grid was 138 by 143 at 4 km spacing. This domain extended at least 50 km in each direction beyond the sources and the included Class I and Class II areas. A map of the domain is presented in Figure A-1 of Appendix A.

3.5 LAMBERT CONFORMAL PROJECTION

Due to the size of the modeling domain, the Lambert conformal projection was used as the coordinate system for all modeling objects, including receptor and source locations. It is a conical type of conformal map projection similar to the Mercator projection and is typically used for modeling domains with an east-west expanse greater than 200 km. Latitude and Longitude coordinates were converted to the Lambert conformal projection by defining two standard parallels and a reference latitude and longitude. The two standard parallels were chosen as 37º N and 42º N, such that the entire modeling domain was between the parallels. The scale of the map was constant or distortion-free along the standard parallels. Map distortion increases with increasing distance from the standard parallels. The reference latitude and longitude were chosen arbitrarily and defined the origin of the Lambert conformal projection coordinates (0, 0). The southwest corner of the domain (37.15° N, 112.05° W) was chosen as the reference point with the intention that all values within the modeling domain had a positive X and Y value.

3.6 RECEPTOR SELECTION

Within the two RMP areas, receptor locations were placed at 3 km intervals, a minimum of 4 km from each source. Receptors within 4 km of a source were modeled in the ISC near-field modeling, discussed in Section 3.11.3.

For each Class I and Class II area, a grid of receptors was placed at 2 km spacing within the area. At the request of the USDA Forest Service, certain Class II areas west of the Vernal Management area were modeled. Receptors were placed in a grid with 2 km spacing, covering areas surrounding Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo. Figures A-4 through A-27 of Appendix A show the receptor grid for each sensitive area and the RMP areas.

3.7 CHEMICAL TRANSFORMATION

The CALPUFF model is capable of modeling linear chemical transformation effects by using pseudo-first-order chemical reaction mechanisms for the conversion of sulfur dioxide (SO_2) to sulfate (SO_4) and nitrogen oxides (NO_x) (which consists of nitric oxide [NO] and nitrogen dioxide [NO_2]) to nitrate (NO_3) and nitric acid (HNO_3). In this study, five chemical species (SO_2, SO_4, NO_x, HNO_3, and NO_3) were modeled using the MESOPUFF II chemical transformation scheme (Scire et al. 2000).

3.8 AMMONIA AND OZONE MONITORING DATA

The CALPUFF model requires background concentrations of ammonia (NH_3) and ozone (O_3) to calculate chemical transformations of NO_x to NO_3 and HNO_3. The IWAQM Phase II Report recommends a background NH_3 concentration of 0.5 parts per billion (ppb) for forested land and 10 ppb for grassland (IWAQM 1998). According to USGS land use data, about 40% of the modeling domain is forest and about 53% is rangeland. For this modeling analysis, background NH_3 concentrations of 5 ppb during the growing season, between April and September, and 1 ppb during the dormant season, between October and March were used.

Hourly ozone data were also required to evaluate chemical transformation of air pollutants. The EPA and state air quality regulatory agencies operate several ozone monitors within and around the modeling domain. Selected ozone monitoring stations are listed in Table 3-18 below and shown in a plot in Figure A-28 of Appendix A. For any hour with missing data, CALPUFF used a default value of 80 ppb.

TABLE 3-18. SELECTED OZONE MONITORING STATIONS

Station	County	State	Station ID	Station Type a	Latitude	Longitude
Gothic	Gunnison	CO	GTH161	CASTNET	38.96	106.99
Mesa Verde NP	Montezuma	CO	MEV405	CASTNET	37.20	108.49
Rocky Mountain NP	Larimer	CO	ROM406	CASTNET	40.28	105.55
Centennial	Albany	WY	CNT169	CASTNET	41.36	106.24
Canyonlands NP	San Juan	UT	CAN407	CASTNET	38.46	109.82
Logan	Cache	UT	490050002-1	SLAMS	41.73	111.84

[a] Station Type: CASTNET = Clean Air Status and Trends Network, available on http://www.epa.gov/castnet/. SLAMS = State and Local Air Monitoring Stations.

3.9 DRY AND WET DEPOSITION ANALYSIS

A full resistance model is provided in CALPUFF for the computation of dry deposition rates of gases and particulate matter as a function of geophysical parameters, meteorological conditions, and pollutant species. To compute the depletion and wet deposition fluxes due to precipitation scavenging, CALPUFF uses an empirical scavenging coefficient approach. Gas-phase dry deposition fluxes were modeled for SO_2, NO_x, and HNO_3. Particulate-phase dry deposition was modeled for SO_4, NO_3, $PM_{2.5}$, and PM_{10}. Wet deposition was modeled for SO_2, SO_4, HNO_3, and NO_3. Results are reported in total (wet + dry) sulfur and nitrogen deposition.

In addition, where background lake chemistry data were available for sensitive lakes identified by the USDA- Forest Service (USFS), USDI - National Park Service, or USDI - Fish and Wildlife Service, an analysis of potential changes to Acid Neutralizing Capacity (ANC) was performed using the procedure recommended by the USFS (2000).

3.10 VISIBILITY ANALYSIS

Visibility is affected by plume impairment (heterogeneous) or regional haze (homogeneous). Since potential air pollutant emission sources include many small sources spread over a very large area, discrete visible plumes are not likely to impact distant sensitive areas. At this preliminary resource planning stage, the emission sources in this analysis consisted of sources that do not have a defined location. In addition, the U.S. Congress has delegated implementation of the Clean Air Act (including the determination of "visual impacts of plumes from present and future coal-fired power plants in the Coal Bed Methane emphasis area") to applicable local, state and tribal air quality regulatory agencies (with EPA oversight). These agencies are able to determine the visual impact of the plume from individual emission sources during the new source review process. Therefore, this analysis did not evaluate the near-field visibility impact of the sources at the resource planning stage.

Regional haze degradation is caused by fine particles and gases scattering and absorbing light. Potential changes to regional haze were calculated in terms of a perceptible "just noticeable change" (1.0 deciview [dv]) in visibility when compared to background conditions. A 1.0 dv change is considered potentially significant in mandatory Federal PSD Class I areas as described in the EPA Regional Haze Regulations (40 CFR 51.300 et seq.), and originally presented in Pitchford and Malm (1994). A 1.0 dv change is defined as about a 10 percent change in the extinction coefficient (corresponding to a 2 to 5 percent change in contrast, for a black target against a clear sky, at the most optically sensitive distance from an observer), which is a small but noticeable change in haziness under most circumstances when viewing scenes in mandatory Federal Class I areas.

The first level screening analysis for visibility follows the recommendations in the FLAG (2000) Guideline document. Specifically, this analysis compared daily modeled primary (PM_{10}) and secondary (sulfate and nitrate) particulate matter concentrations to "natural" background conditions and seasonal relative humidity (f[RH]) values. From this comparison, a potential change in deciview was calculated. FLAG identified a 0.5 dv (5 percent change in extinction) threshold as the "Limit of Acceptable Change" (LAC) for a single source impact, and a 1.0 deciview (10 percent change in extinction) threshold for the cumulative impacts of several sources.

If the seasonal screening analysis indicated that predicted changes in visibility due to BLM sources exceeded the 1.0 deciview LAC, a daily refined analysis would be conducted based on hourly IMPROVE (2002) optical monitoring data measured at Canyonlands National Park for 1987 through 2001. However, the results show that BLM sources alone caused no exceedance of the 1.0 deciview threshold. Therefore, a refined visibility analysis was not performed for Alternatives I-V.

3.11 NEAR-FIELD MODELING

The following describes the methodology used for conducting near-field dispersion modeling for the Vernal/Roan Plateau air quality analysis, as performed by BLM's National Science and Technology Center. The near-field modeling methodology generally follows that used in a previous modeling analysis for the Glenwood Springs area performed by the National Park Service (NPS, 1998). Trinity Consultants, the primary modeling contractor for the far-field (CALPUFF) analysis, were also consulted, where practicable, to make sure the two methodologies (near- and far-field) were consistent. Finally, further details were developed in response to comments from EPA, Region 8, on Trinity's protocol for far-field modeling (EPA, 2003b) and subsequent meetings with EPA NEPA and Air Quality staff.

The ISCST3 model, as contained in Lakes Environmental ISC-AERMOD View software (Lakes, 2002) package, was used for all of the near-field modeling. Unless stated otherwise, the regulatory default options built into the model were used. All modeling assumed flat terrain, rural dispersion conditions, and building downwash effects for a hypothetical structure.

A hypothetical grouping of sources was used that provides an estimate of potential near-field pollutant impacts. These sources included wells pads, glycol dehydrators, natural gas compressors, and unpaved roads. Details of the source types and configurations are discussed below. Appropriate operating

parameters were used for each source, and were in all cases, unless otherwise stated, the same as those used in the CALPUFF modeling performed by Trinity.

3.11.1 MODELED SOURCES

Tables 3-19 and 3-20 below show the sources included in the near-field modeling and their source input parameters. The emission rates for each pollutant are shown in Tables 3-21 and 3-22. Figures 3-1 and 3-2 show the arrangement of the sources as input to the model. Not all sources were included in the runs for each pollutant, because not every source emits all of the pollutants. As with the far-field CALPUFF modeling, vehicle exhaust emissions were not included in the modeling. These figures show all of the sources present in the hypothetical arrangement. Note that receptors extend beyond the edges of the Figures.

Flaring emissions and source parameters are presented in section 3.11.4 below.

TABLE 3-19. POINT SOURCE INPUT PARAMETERS

Source Name	Release Height (m)	Exit Velocity (m/s)	Exit Temperature (K)	Inside Stack Diameter (m)
Glycol Dehydrator	1.83	0.45	294.3[a]	0.13
Natural Gas Compressor	6.1	30	755.4	0.91

[a] Ambient temperature

TABLE 3-20. AREA/VOLUME SOURCE INPUT PARAMETERS

Source Name	Source Type	Release Height (m)	Length of Side(s) (m)a	Initial Lateral Dimension (m)[b]	Initial Vertical Dimension[c]
Road[d]	Volume	1.0	12.2	2.84	0.47
Well Pad[e]	Area	3.0	100/100	n/a	2.79

[a] Volume source assumed to be square; area source values for X and Y dimensions

[b] Value equal to length of side/4.3 (EPA,1995b)

[c] Value equal to release height/2.15 (EPA,1995b)

[d] Road consists of series of 67 of equal volume sources

[e] Area source parameters used are the same as those for inventory area sources in CALPUFF modeling (small area)

TABLE 3-21. SOURCE CRITERIA POLLUTANT EMISSION RATES[A]

Source Name	Pollutant		Emission Rate (gram/sec)
Compressor[b,c]	Carbon Monoxide (CO)		5.78E-02
	Oxides of Nitrogen (NOx)[d]	Vernal	0.70
		Glenwood Springs	1.50
	PM_{10}		1.04E-02
	$PM_{2.5}$		1.04E-02[c]
	Sulfur Dioxide (SO_2)		6.10E-04
Well Pad Construction[e,f]	PM_{10}	Vernal	4.79E-07
		Glenwood Springs	3.70E-06
	$PM_{2.5}$	Vernal	7.33E-08
		Glenwood Springs	5.50E-07
Roads[,f]	PM_{10}	Vernal	4.61E-07
		Glenwood Springs	1.08E-05
	$PM_{2.5}$	Vernal	6.47E-08
		Glenwood Springs	1.57E-06

[a] Values for compressors, roads, from Trinity Consultants (Trinity, 2003a)

[b] 1,100 hp natural gas compressor

[c] $PM_{2.5}$ assumed equal to PM_{10} for this source because specific information for $PM_{2.5}$ not available.

[d] Emission rate in grams/horsepower-hr (g/hp-hr)

[e] Values include well pad construction, construction traffic, drilling traffic, and test and completion traffic.

[f] Emission rates in g/sec-m^2

TABLE 3-22. HAP EMISSION RATES[A]

Source Name	Pollutant	Emission Rate (gram/sec)
Compressors[b]	Benzene	4.57E-4
	Ethylbenzene	4.12E-5
	Formaldehyde	5.48E-02
	Toluene	4.24E-4
	Xylenes	1.91E-4
Glycol Dehydrator Vernal RMA	Benzene	3.68E-02
	Ethylbenzene	6.70E-03
	Hydrogen Sulfide (H_2S)	1.45E-07
	Toluene	5.78E-02
	Xylenes	1.09E-01
Glycol Dehydrator Glenwood Springs RMA	Benzene	3.36E-03
	Ethylbenzene	6.11E-04
	Hydrogen Sulfide (H_2S)	1.32E-08
	Toluene	5.28E-03
	Xylenes	9.97E-03

[a] All values from Trinity Consultants (Trinity, 2003a)

[b] 1,100 hp natural gas compressor

FIGURE 3-1 ARRANGEMENT OF SOURCES AND MODEL RECEPTORS

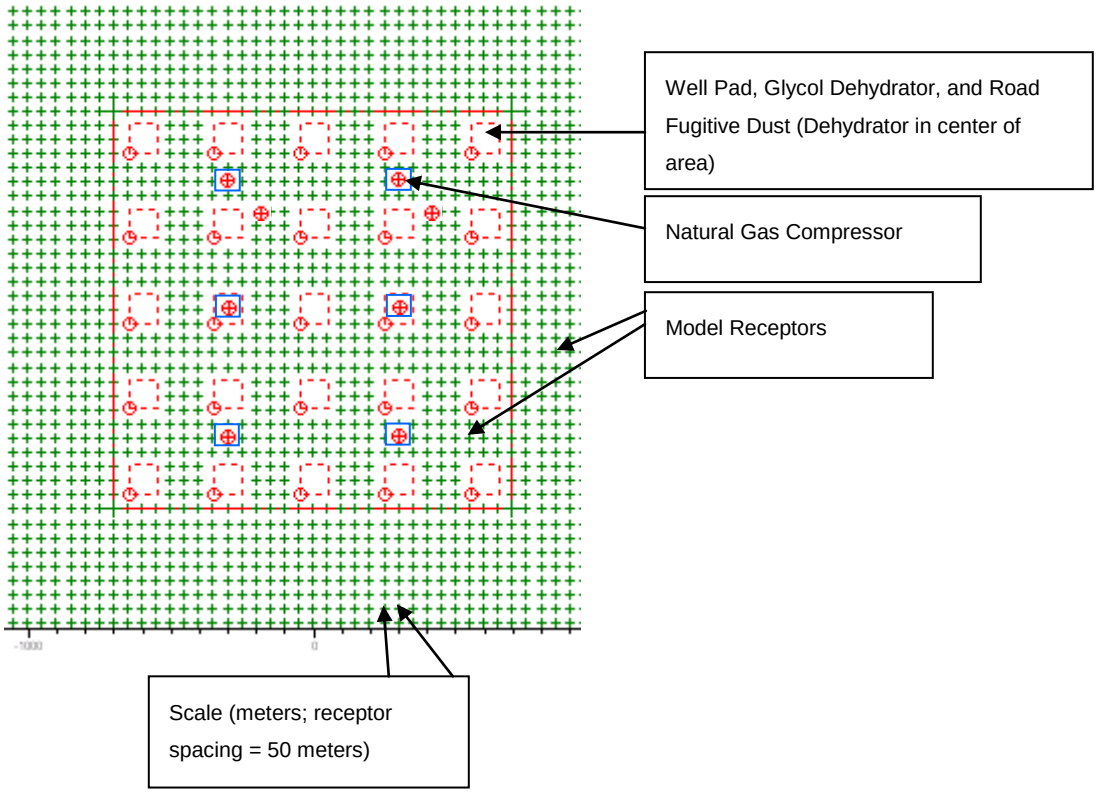
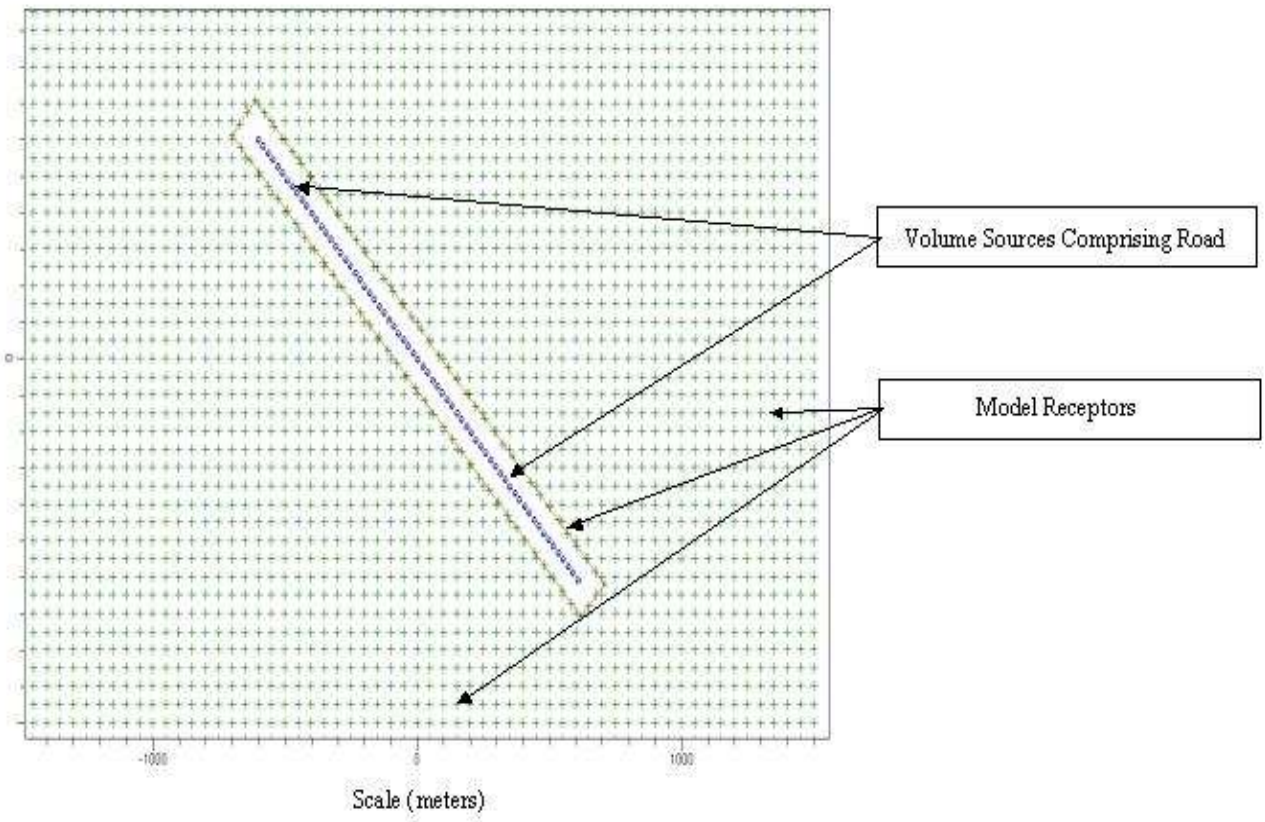


FIGURE 3-2 ARRANGEMENT OF ROAD SOURCES AND MODEL RECEPTORS FOR ROAD SOURCES ONLY MODELING



Sources were modeled as seen in the above figures. 25 well pads were arranged in a 5 x 5 matrix, with 300-meter spacing between the center of each pad, which is approximately equivalent to 20-acre well spacing (the midpoint of possible well spacing values provided; 10, 20, and 40-acre spacing). Each well pad was identified as a 100m x 100m area source, which corresponds to the disturbed area for a well pad (2.34 acres). A glycol dehydrator was co-located at the center of each well pad. Six compressors were modeled as point sources and equally spaced with the 5 x 5 well matrix. This number of compressors is within the range of possible compressor-to-well ratios provided by Trinity Consultants (Trinity, 2003b).

The hypothetical road was modeled as a series of 67 equally spaced volume sources running diagonally northwest to southeast across the matrix of well pads. This orientation of the road was determined in preliminary ISC3 modeling, using 10 volume sources for each of 4

orientations (NW-SE, NE-SW, E-W, and N-S). The volume sources were separated by half of the lateral dimension of 12.2 meters, which is equivalent to a 40-foot-wide road. The separation of the volume sources represents the midpoint of the guidance provided in the ISCST3 User's Guide (EPA, 1995b). A release height of 1 meter was used for all road fugitive dust sources (suggested by Trinity), as an approximation of the wheel height of the dust-generating vehicles (Trinity, 2003b). The emissions were calculated for each site based on the actual miles of travel

For the runs combining fugitive dust from roads and pads, road emissions were calculated from the total length of road associated with 25 wells for each site and distributed over the 25 well pad area sources.

A hypothetical building was co-located with each compressor to simulate the effects of building downwash that typically occur with structures associated with point sources. After discussions with Trinity (Trinity, 2003c), hypothetical building dimensions were determined to be as follows: height – 10 meters; length and width – 20 meters.

3.11.2 METEOROLOGICAL DATA

Meteorological data for the period 1987-1991 from Grand Junction, Colorado (Glenwood Springs MA) and Salt Lake City, Utah (Vernal MA) were used in the modeling. Surface and upper air data for both sites were downloaded from the WebMet web site (http://www.webmet.com). This same data is available from the EPA SCRAM web site. The raw surface and upper air data were processed with the EPA-approved PCRAMMET meteorological processing software to combine the surface and upper-air data into a model-ready format.

Wind roses for the 5-year period from each location are presented below. Individual wind roses for each year can be seen in Appendix A.

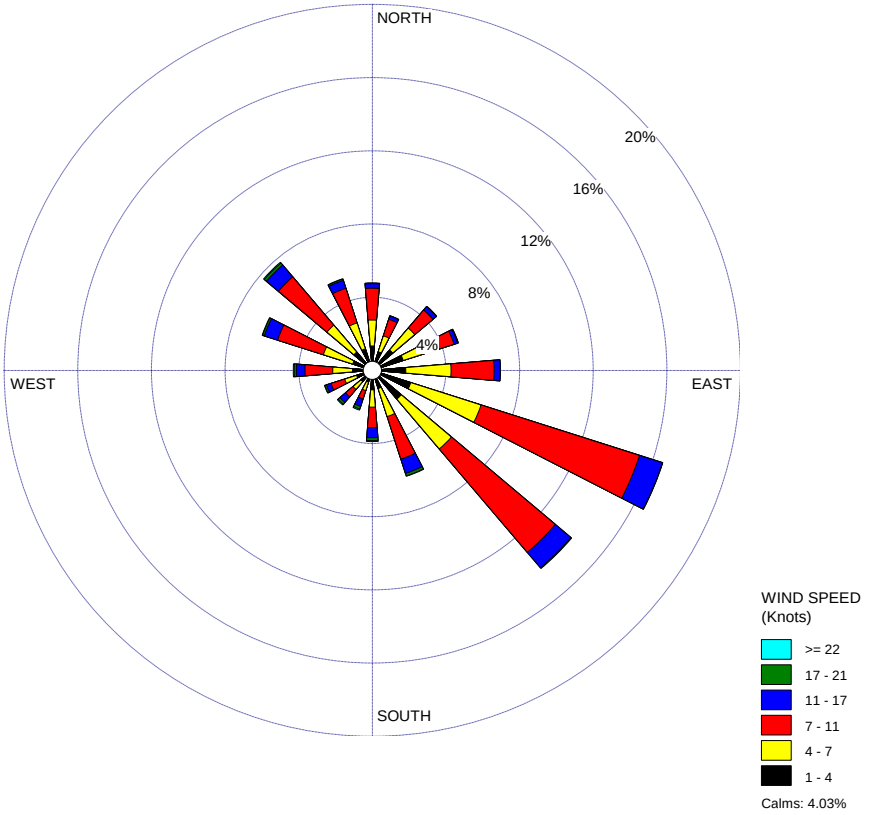
FIGURE 3-3 GRAND JUNCTION, CO, METEOROLOGICAL WIND ROSE

WIND ROSE PLOT:

Glenwood Springs RMA - Near Field Meteorological Data
1987-1991 Conglomerated Data Wind Rose

DISPLAY:

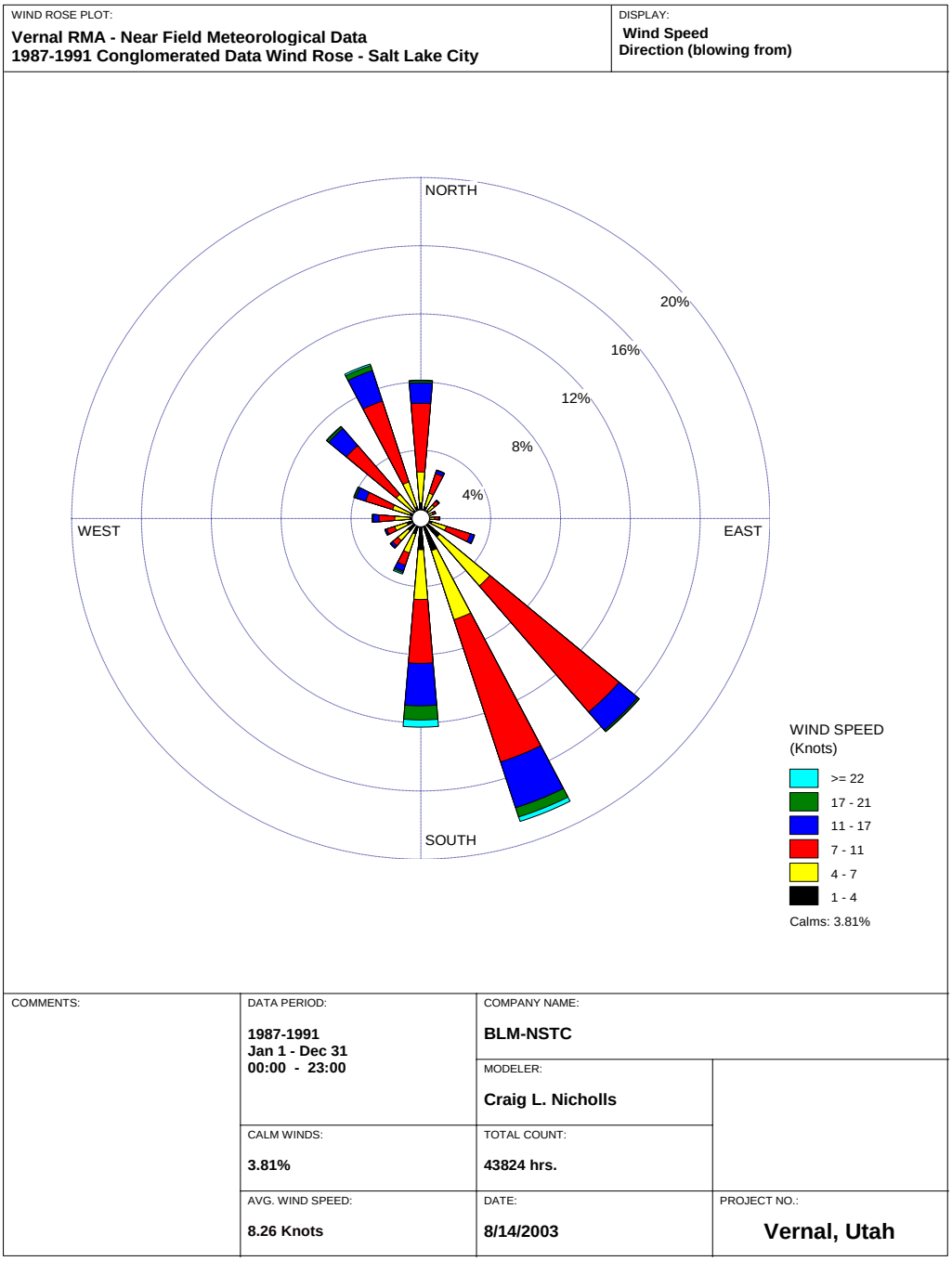
Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	1987-1991 **Jan 1 - Dec 31** **00:00 - 23:00**	**BLM-NSTC**	
		MODELER: **Craig L. Nicholls**	
	CALM WINDS: **4.03%**	TOTAL COUNT: **43824 hrs.**	
	AVG. WIND SPEED: **7.22 Knots**	DATE: **8/14/2003**	PROJECT NO.: **Glenwood Springs**

WRPLOT View - Lakes Environmental Software

FIGURE 3-4 SALT LAKE CITY, UT METEOROLOGICAL WIND ROSE



3.11.3 MODEL RECEPTORS

Receptors were placed according to the scheme outlined in Table 3-23 below.

TABLE 3-23. RECEPTOR SPACING FOR NEAR-FIELD MODELING

Pollutant(s)	Source Type(s)	Receptor Ranges (m)	Receptor Spacing (m)
PM_{10}, $PM_{2.5}$	Roads	50-1,500	50
	Pad Construction	50-1,700	50
All other criteria pollutants	Pad Construction, Compressors, Glycol Dehydrators	100-4,000	100
		4,000-10,000	2,000
HAPs	Compressors, Glycol Dehydrators	100-4000	100
		4000-10,000	2,000

This receptor spacing differed somewhat from that used in the 1998 Glenwood Springs analysis, but in all cases the changes meant including more receptors and/or tighter spacing to insure that the maximum modeled concentration was captured and occurred within the receptor domain.

3.11.4 FLARE MODELING

A separate modeling analysis was conducted for potential near-field flaring emissions. As suggested at a meeting of the air quality stakeholders for this project (BLM, 2003), flare modeling was performed using the SCREEN3 model (EPA, 1995c). The SCREEN3 model is a simple, single-source screening model that assumes a constant wind direction for an entire hour and reports a 1-hour concentration. A pre-determined matrix of wind speeds and atmospheric stabilities is processed to find the maximum concentration.

The model was run with a unit concentration (1.0 grams/second) and the unit results were then multiplied by the actual estimated emission rate for each pollutant. The source parameters are listed in Table 3-24 and the emissions are listed in Table 3-25. The results of the flare modeling are presented in Section 5.5.3.

TABLE 3-24. FLARE INPUT PARAMETERS [a]

Source Name	Release Height (m)	Exit Velocity (m/s)	Exit Temperature (K)	Inside Stack Diameter (m)
Natural Gas Flare	1.50	499.9	1000	0.305

[a] All source parameters from NPS (1998)

TABLE 3-25. FLARE EMISSIONS[A]

Source Name	Pollutant	Emission Rate (gram/sec)
Natural Gas Flare	Carbon Monoxide (CO)	0.0532
	Oxides of Nitrogen (NOx)	0.0098
	PM_{10}	0.00089
	$PM_{2.5}$	0.00089

[a] All emission rates from NPS, 1998

4.1 METEOROLOGICAL OBSERVATION DATA

Surface meteorological data, upper air meteorological data, and precipitation data were obtained from the National Climatic Data Center (NCDC) for the selected time period. A search of meteorological stations using Trinity's Met Wizard database showed that 28 surface and 68 precipitation meteorological stations were within the modeling domain or near the domain boundary. From these stations 14 surface stations and 38 precipitation stations were selected based on data count of at least 6,000 hours and their distance from the RMP areas. Data from four upper air stations were used. The observation stations are listed in Table 4-1 to 4-3 and their locations are shown in Figures A-29 through A-31 of Appendix A.

All observed data were prepared and processed following the procedures outlined in the CALMET User's Guide and accompanying data extraction utilities. Data were manually reviewed to assure completeness of the data set for each station, though manual revision was typically unnecessary for edited NCDC data sets. A table summarizing the CALMET variable values is provided in Appendix F. All CALMET input and output list files are provided on CD in Appendix F.

4.1.1 SURFACE METEOROLOGICAL DATA

The use of multiple stations for meteorological observations in CALMET/CALPUFF provided a substantial enhancement over the steady-state treatment of observations from a single meteorological station in the ISC model. Parameters affecting turbulent dispersion that were observed hourly at surface stations included wind speed and direction, temperature, cloud cover and ceiling, relative humidity, and precipitation type. The surface stations from which 1996 data were extracted in this analysis are listed in Table 4-1 and illustrated in Figure A-29 of Appendix A. Raw observations from these stations were obtained from the NCDC and quality assured by Trinity's staff of meteorologists. After review, these data were merged using the SMERGE pre-processor to create a single assimilated data file of surface observations.

TABLE 4-1. SURFACE METEOROLOGICAL STATIONS

Surface Station	Call Sign	State	Station ID	Latitude	Longitude	Data Count
Aspen/Sardy Field	ASE	CO	93073	39.22	106.87	6,106
Broomfield/ Jefferson County	BJC	CO	93068	39.92	105.12	6,235
Craig	CAG	CO	24046	40.52	107.55	13,870
Eagle Co. Regional	EGE	CO	23063	39.65	106.92	8,295
Fort Collins	FNL	CO	94035	40.45	105.02	8,455
Grand Junction	GJT	CO	23066	39.12	108.53	8,616
Gunnison Co	GUC	CO	93007	38.53	106.93	8,505
Hayden/Yampa	HDN	CO	94025	40.48	107.22	8,381
Montrose Co. Airport	MTJ	CO	93013	38.50	107.90	7,128
Price/Carbon	PUC	UT	93141	39.62	110.75	8,262
Provo Municipal Airport	PVU	UT	72572	40.22	111.72	8,398
Rock Springs	RKS	WY	24027	41.60	109.07	8,745
Alamosa San Luis Valley	ALS	CO	72462	37.43	105.87	7,924
Salt Lake City Int'l Airport	SLC	UT	24127	40.78	111.97	7,805

4.1.2 PRECIPITATION DATA

This modeling analysis considered the effects of chemical transformations and deposition processes on ambient pollutant concentrations. Therefore, it was necessary to include observations of precipitation in the CALMET analysis. Precipitation data were collected from selected surface meteorological data stations included in the analysis, plus Cooperative Observation Network (COOP) stations near or within the domain. The precipitation stations from which 1996 data were extracted in this analysis are listed in Table 4-2 and illustrated in Figure A-30 of Appendix A. These sources were selected from the available data inventory to optimize spatial coverage and representation of the domain. Raw observations from these stations were obtained from the NCDC and quality assured by Trinity's staff of meteorologists. After review, these data were merged using the PMERGE pre-processor to create a single assimilated data file of precipitation observations. The inverse-distance-squared interpolation scheme was used to generate a gridded precipitation field with hourly precipitation data. The radius of influence for the interpolation method was set to 70 km.

TABLE 4-2. PRECIPITATION METEOROLOGICAL STATIONS

Precipitation Stations	Call Sign	State	Station ID	Latitude	Longitude
Cochetopa Creek	COC	CO	051713	38.45	106.77
Crested Butte	CRB	CO	051959	38.88	106.98
Dinosaur	DIN	CO	052286	40.25	108.97
Grand Junction/ Walker	GJT	CO	053488	39.13	108.53
Grand Lake	GRL	CO	053500	40.18	105.87
Lawson	LAW	CO	054877	39.77	105.62
Ouray	OUR	CO	056203	38.02	107.67
Rifle	RIF	CO	057031	39.53	107.80
Saguache	SAG	CO	057337	38.08	106.13
Sugarloaf Reservoir	SUG	CO	058064	39.25	106.37
Telluride	TEL	CO	058204	37.95	107.87
Arches	ARC	UT	420336	38.62	109.62
Ephraim Sorensens	EPH	UT	422578	39.37	111.58
Fairview	FAI	UT	422702	39.75	111.42
Flaming Gorge	FLG	UT	422864	40.93	109.42
Green River Aviation	GRR	UT	423418	38.98	110.15
Hanksville	HAN	UT	423611	38.37	110.72
Neola	NEO	UT	426127	40.53	110.07
Park City	PRC	UT	426648	40.67	111.52
Price	PUC	UT	427026	39.60	110.82
Encampment	ENC	WY	483050	41.22	106.78
Evanston	EVA	WY	483100	41.27	110.95
Laramie	LAR	WY	485420	41.30	105.63
Mountains View	MTV	WY	486555	41.28	110.32
Mud Springs	MUD	WY	486597	41.32	108.92
Alamosa San Louis	ASL	CO	50130	37.43	105.87
Antero Reservoir	ANR	CO	050263	39.00	105.90
Aspen	ASP	CO	050372	39.18	106.83
Meeker	MEE	CO	055484	40.02	107.97
Northgate	NGT	CO	055982	40.93	106.33
Logan	LOG	UT	425194	41.67	111.88
Oakley	OAK	UT	426374	40.73	111.23
Perry	PER	UT	426757	41.45	112.03
Salt Lake City	SLC	UT	427598	40.78	111.97
Santaquin	SAN	UT	427690	39.98	111.78
Scofield-Skyline Mine	SCO	UT	427729	39.68	111.20
Strawberry	STR	UT	428371	40.25	111.15
Rock Springs	RKS	WY	487845	41.60	109.07

4.1.3 UPPER AIR DATA

Observations of meteorological conditions in the upper atmosphere provided a profile of turbulence from the surface through the depth of the boundary layer in which dispersion occurred. Upper air data were obtained from twice-daily soundings of the atmosphere. Sensors observe pressure, wind speed and direction, and temperature (among other parameters) as the balloon rises through the atmosphere. The upper air observation network is less dense than surface observation points since upper air conditions vary less and are generally not as affected by local factors (e.g., terrain or bodies of water). The upper air stations from which 1996 data were extracted in this analysis are listed in Table 4-3 and illustrated in Figure A-31 of Appendix A.

Upper air data were manually inspected and edited as warranted to complete each station's data set. CALMET requires only sounding data at the surface and 500 mb levels; however, absent measurements at multiple levels (including mandatory levels) are indicative of poor data quality and suggest that the particular sounding should be revised. Revision of other upper air data included application of physical principles. For example, certain revisions included extrapolation of the ambient lapse rate and wind profile trends to complete data records, or complete replacement of a sounding for missing or obviously poor observations. A Trinity meteorologist applied professional judgment based on extensive meteorological knowledge in applying these principles to complete the upper air data sets.

TABLE 4-3. UPPER AIR METEOROLOGICAL STATIONS

Upper Air Stations	Call Sign	State	Station ID	Latitude	Longitude
Denver Stapleton Int'l Airport	DEN	CO	23062	39.77	104.87
Grand Junction Walker Field	GJT	CO	23066	39.13	108.53
Riverton Regional Airport	RIW	WY	24061	43.07	108.47
Salt Lake City Int'l Airport	SLC	UT	24127	40.78	111.97

4.2 MM5 DATA

A Mesoscale Meteorological Model (MM5; version 2.12, with modifications) data set was used in conjunction with the actual surface and upper air stations observations (UCAR 2002). MM5 data from the 1996 national data set were used (EPA 1996). The MM5 data had a 36 km resolution.

4.3 GEOPHYSICAL DATA

Terrain heights in Digital Elevation Model (DEM) and land use parameters throughout the modeling domain were incorporated into the CALMET model using pre-processors as specified in the CALMET User's Guide.[8] These parameters were calculated with a 4 km grid spacing for the modeling domain.

[8] Scire, J.S., Robe, F.R., Fernau, M.E., Yamartino, R.J., *A User's Guide for the CALMET Meteorological Model (Version 5)*. (Concord, MA: Earth Tech, Inc., 2000).

For the CALMET analysis, 1-degree DEM data with a of 90 meter resolution were used (USDI-USGS 2002a). These DEM data for the modeling domain were purchased from Micropath Corporation, a partner of the U.S. Geological Survey (USGS). Figure A-32 in Appendix A shows the elevation contours calculated within the model domain.

The land use data were obtained in Composite Theme Grid format from the USGS File Transfer Protocol (FTP) site with a resolution of 200 meters (USDI-USGS 2002b). Missing data within the USGS land use data files were filled using the global data set, with a resolution of 1 km. After processing, the data were quality checked to ensure land use was accurately represented. Land use categories were defined according the default parameters in CALMET pre-processing utilities. The land use data were used to calculate surface properties such as albedo, Bowen ratio, leaf area index, and roughness length used in CALMET.

USGS land use data contains 38 land use categories. These were mapped to 14 categories read by CALMET. The categories for agricultural land (21,22,23,and 24) were mapped to –20 for irrigated land or 20 for unirrigated land. Since most of the land corresponding to land use categories 21 and 22 within the domain are irrigated land, they were mapped to –20. The dry deposition module in CALPUFF uses the negative land use value as a flag to compute the effect of moisture stress on stomatal resistance. If the land was irrigated, it was assumed that the vegetation was not moisture stressed. Plots of the land use data are included in Figures A-33 of Appendix A.

4.4 WIND FIELD MODEL OPTIONS

In general, CALMET involves two steps in developing the final wind field. First, the prognostic wind field (such as MM5) is introduced into CALMET as the initial guess field. CALMET then adjusts this field by accounting for the kinematic terrain effects, slope flows, blocking effects, and three-dimensional divergence minimization. The wind field resulting from this step is called the Step 1 wind field. Second, CALMET further adjusts the Step 1 wind field by applying an objective analysis procedure with observational data from selected surface, upper air, and precipitation stations. This step generates the final (Step 2) wind field. The "Diagnostic Wind Module" (DWM) option follows this two-step procedure.

In this study, the DWM option was chosen in order to reflect the terrain effects in the wind field. Since several mountain ranges occur within the modeling domain, it was expected that terrain effects would be significant. The MM5 data were used as the initial guess wind field. Similarity theory was used for vertical extrapolation of surface winds. Layer 1 of the upper air stations was ignored and data from the surface stations were always extrapolated vertically.

Since the "horizontally and vertically varying winds" option was chosen, observations were horizontally interpolated with the inverse-distance-squared scheme (illustrated at left) at each vertical level to create a horizontally and vertically varying initial guess field. This means that as grid points move farther away from a given surface meteorological station, they are influenced less and less by that surface station. This weighting is used in the horizontal to interpolate the prognostic model wind field to the CALMET grid points.

$$\frac{1}{R^2}$$

The bias for each layer was set to represent the relative weight given to the vertically extrapolated surface observations versus the upper air sounding data in the computation of the initial guess field. For example, a bias of -0.1 decreases the weight of all upper air stations by 10% while a bias of 0.1 decreases the weight of all surface observations by 10%. The bias settings and vertical grid structure for this study are shown in Table 4-4.

TABLE 4-4. SUMMARY OF VERTICAL GRID STRUCTURE AND BIAS

Level	Height (meters)	Bias Parameter [a]
0	0	--
1	20	-1
2	40	-0.8
3	80	-0.4
4	160	-0.2
5	320	0
6	640	0
7	1,000	0
8	1,500	0
9	2,000	0.2
10	2,500	0.4
11	3,000	0.8
12	3,500	1

[a] The bias parameter corresponds to the cell layer below the cell face height. The –1 indicates no influence of upper air stations, while +1 indicates no influence of surface observations.

Wind speed and wind direction data from observation stations were only allowed to influence the Step 1 wind field at a distance determined by setting the radius-of-influence parameter. The radius of influence for surface and upper air stations was set to 50 km and 200 km, respectively. The distance from an observation station at which the observations and Step 1 wind field were equally weighted was set to 25 km for both upper air and surface observations. Radius of influence for terrain features was set to 10 km.

4.5 CALMET EVALUATION

After running CALMET, the resulting data fields were analyzed using the PRTMET utility to illustrate the assimilated wind and temperature fields within the domain for quality assurance purposes. PRTMET enables the user to extract meteorological data fields such as wind speed and direction, temperature, and mixing height on an hourly "snapshot" or average basis. PRTMET quality assurance efforts are summarized in Appendix B for the 4 km grid to demonstrate that the selection of CALMET control options resulted in a reasonable simulation of the meteorology within the domain.

Hourly snapshot vector plots for wind fields at several times are presented in Figures B-1 through B-8 of Appendix B for the 4 km grid. The time for each snapshot was arbitrarily chosen for one day in summer

(July 10, 1996) and one day in winter (January 10, 1996). Two hours on each day were plotted: 0300 Mountain Standard Time (MST) and 1500 MST. Furthermore, for each time period a surface wind field, corresponding to Level 1, and an upper air wind field, corresponding to Level 8, was plotted. The list of plots developed in this study is documented in Table 4-5. These wind fields appeared to accurately capture terrain, slope, and seasonal effects expected within the modeling domain, and demonstrated generally smooth transitions and continuous Mesoscale flow. These characteristics validated the spatial behavior of the meteorological data set throughout the modeling domain.

TABLE 4-5. LIST OF WIND VECTOR PLOTS

Date	**June 10, 1996**	**January 10, 1996**
Hour	3, 15	3, 15
Vertical Layer	1, 8	1, 8

Additionally, windroses from the CALMET model output and the surface observation station data sets indicated general agreement in wind directions, frequencies, and speeds. These windroses are included in Figures B-9 through B-20 of Appendix B.

The large number of figures were prepared as part of quality assurance procedures, and were intended to validate the CALMET development. Given the complexity of Mesoscale meteorological modeling and the importance of the predicted meteorology in CALPUFF dispersion algorithms, such efforts are an important component of a refined CALPUFF analysis.

The following air quality impact assessment was conducted using the methods described in previous sections. Air quality thresholds, background concentrations, and results are discussed below. Modeling results that were above the applicable threshold are shown in bold type. Detailed modeling results including the location and date of each maximum impact are provided in Appendix E. Plots showing the receptor grid, terrain, and approximate location of each maximum impact are provided in Figures A-4 through A-27 of Appendix A. The output input and list files for the post-processing are provided on CD in Appendix F.

5.1 AMBIENT AIR QUALITY STANDARDS

The concentrations of criteria pollutants predicted by the CALPUFF analysis were compared with applicable National Ambient Air Quality Standards (NAAQS) and to all state Ambient Air Quality Standards which were more stringent than the NAAQS. Applicable states include Utah, Wyoming, and Colorado. The NAAQS were established for NO_2, SO_2, PM_{10}, O_3, CO, and lead. Given the relatively insignificant levels of potential volatile organic compound (VOC) and lead emissions, neither O_3 nor lead standards were addressed in this analysis. The NAAQS and state standards addressed in this study are listed in Table 5-1.

TABLE 5-1. APPLICABLE AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Period	National Ambient Air Quality Standards (μg/m3)	State Ambient Air Quality Standards (μg/m3)
CO	1-Hour [b]	40,000	
	8-Hour [b]	10,000	
PM_{10}	24-Hour [b]	150	
	Annual [a]	50	
$PM_{2.5}$	24-Hour [b]	65	
	Annual [a]	15	
SO_2	3-Hour [b]	1,300	700 [d]
	24-Hour [b]	365	260 [c]
	Annual [a]	80	60 [c]
NO_2	Annual [a]	100	

[a] Annual arithmetic mean not to be exceeded.

[b] Not to be exceeded more than once per year.

[c] Wyoming standard, more stringent than the NAAQS.

[d] Colorado standard, more stringent than the NAAQS.

5.1.1 AMBIENT AIR QUALITY BACKGROUND CONCENTRATION

The best available air quality monitoring data near the Vernal and Glenwood Springs areas were used to compare air quality changes contributed by air pollutants emission sources. Existing monitoring stations for various pollutants are located in the vicinity of the Vernal RMP area and the Glenwood Springs RMP area. These air quality data were obtained from the state air quality regulatory agencies.

Representative background concentrations were added to the modeled results for comparison to the appropriate ambient air quality standards. Tables 5-2 and 5-3 provide background concentrations for criteria pollutants.

TABLE 5-2. BACKGROUND CONCENTRATIONS FOR VERNAL RMP AREA

Pollutant	Annual ($\mu g/m^3$)	24-Hour ($\mu g/m^3$)	8-Hour ($\mu g/m^3$)	3-Hour ($\mu g/m^3$)	1-Hour ($\mu g/m^3$)	Monitoring Station Location Description
NO_2	10	-	-	-	-	Recommended by the Utah Department of Environmental Quality.[a]
SO_2[b]	5	10	-	20	-	Estimates based on the 1993 PSD application for Bonanza Power Plant, Deseret Generation and Transmission.
PM_{10}	10	28	-	-	-	Recommended by the Utah Department of Environmental Quality.[a]
$PM_{2.5}$			-	-	-	Recommended by the Utah Department of Environmental Quality.[a]
CO[c]	-	-	4,236	-	6,984	Grand Junction, Mesa County, Colorado. (Highest monitored concentrations in 2001.)[d]

[a] Background concentrations recommended by the Utah Department of Environmental Quality in memorandum No. DAQP-003-03, dated on January 17, 2003 from Richard W. Sprott to Yu Shan Huang.

[b] The SO_2 background concentrations are provided by Tom Orth, Utah DEQ. (Orth 2002)

[c] The CO concentrations are reported in ppm: 8-hr, 3.7 ppm; 1-hr, 6.1 ppm.

[d] Monitoring station was nearest to the Vernal RMP area. This background concentration is a conservatively high estimate for the Vernal RMP area since it was measured in an urban area.

TABLE 5-3. BACKGROUND CONCENTRATIONS FOR GLENWOOD SPRINGS RMP AREA

Pollutant	Annual ($\mu g/m^3$)	24-Hour ($\mu g/m^3$)	8-Hour ($\mu g/m^3$)	3-Hour ($\mu g/m^3$)	1-Hour ($\mu g/m^3$)	Monitoring Station Location Description
PM_{10}	24	54	-	-	-	Rifle, Garfield County. (1998-2000 data collected by CDPHE)[a]
$PM_{2.5}$	7	19	-	-	-	Grand Junction, Mesa County. (1999-2001 data collected by CDPHE)[a]
NO_2[b]	34	-	-	-	-	Woodmen and Colorado College stations, Colorado Springs, El Paso County. (1998-2000 data)[a]
CO[c]	-	-	4,444	-	8,000	Grand Junction, Mesa County. (Average of 1999-2001)[a]
SO_2[d]	11	39	-	110	-	Colorado College, Colorado Springs, El Paso County. (1998-2000)[a]

[a] Background concentration recommended by CDPHE in the review comments provided by Nancy Chick, dated on December 20, 2002. (Chick 2002)

[b] The NO_2 concentration recommended by CDPHE is originally stated in 0.018 ppm, annual average. (Chick 2002)

[c] The CO concentrations recommended by CDPHE are based on three years average and are originally stated in ppm: 8-hr, 4 ppm; 1-hr, 7 ppm. (Chick 2002)

[d] The SO_2 concentrations recommended by CDPHE are originally stated in ppm: annual, 0.004 ppm; 3-hour, 0.042 ppm; 24-hour, 0.015 ppm. (Chick 2002)

As discussed in Section 3.3.1, the monitoring date of the background concentrations was used to determine whether an emission source should be included in the analysis. If an emission source was in operation before the monitoring date, it was assumed that its emissions were part of the background. Therefore, the source was excluded from the modeling of inventory sources. The proposed baseline date for these background concentrations is summarized in Table 5-4.[9]

TABLE 5-4. BASELINE DATE FOR BACKGROUND CONCENTRATIONS

Pollutant	PM_{10}	$PM_{2.5}$	NO_2	CO	SO_2
Proposed Baseline Date	2000	2001	2000	2001	2000

[9] The monitoring date is a project-related concept to filter inventory sources. It is not related to Prevention of Significant Deterioration (PSD) baseline dates.

5.1.2 NAAQS ANALYSIS RESULTS BY ALTERNATIVE

Results for each development scenario are presented in Tables 5-5 through 5-9 below. The NAAQS were not exceeded for any pollutant or averaging period. All listed concentrations include background. In the titles for these tables, the Glenwood Springs alternative name is presented first.

TABLE 5-5. NAAQS ANALYSIS RESULTS FOR ALT. V/ALT. B

Pollutant	Averaging Period	Total Concentration ($\mu g/m^3$)		
		Inventory Only	GMA BLM Sources Only	GMA + Inventory Sources
Glenwood Springs MA				
CO	1-hour	8,058	8,026	8,059
CO	8-hour	4,457	4,458	4,460
PM_{10}	24-hour	55.6	66.6	67.3
PM_{10}	Annual	24.2	25.5	25.6
$PM_{2.5}$	24-hour	19.9	22.7	22.8
$PM_{2.5}$	Annual	7.1	7.5	7.5
SO_2	3-hour	126.7	110.0	126.6
SO_2	24-hour	41.5	39.0	41.5
SO_2	Annual	11.3	11.0	11.3
NO_x	Annual	34.5	34.3	34.7
Pollutant	**Averaging Period**	**Inventory Only**	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Vernal MA				
CO	1-hour	7,015	7,027	7,027
CO	8-hour	4,244	4,245	4,245
PM_{10}	24-hour	28.5	31.3	31.3
PM_{10}	Annual	10.1	10.3	10.3
$PM_{2.5}$	24-hour	19.4	19.7	19.7
$PM_{2.5}$	Annual	7.1	7.1	7.1
SO_2	3-hour	34.9	20.0	20.0
SO_2	24-hour	13.1	10.0	10.0
SO_2	Annual	5.2	5.0	5.0
NO_x	Annual	10.6	10.2	10.2

TABLE 5-6. NAAQS ANALYSIS RESULTS FOR ALT. IV/ALT. A

		Total Concentration ($\mu g/m^3$)		
Pollutant	**Averaging Period**	**Inventory Only**	**GMA BLM Sources Only**	**GMA + Inventory Sources**
Glenwood Springs MA				
CO	1-hour	8,058	8,026	8,059
CO	8-hour	4,457	4,458	4,460
PM_{10}	24-hour	55.6	66.0	66.7
PM_{10}	Annual	24.2	25.4	25.5
$PM_{2.5}$	24-hour	19.9	22.7	22.7
$PM_{2.5}$	Annual	7.1	7.4	7.5
SO_2	3-hour	126.7	110.0	126.6
SO_2	24-hour	41.5	39.0	41.5
SO_2	Annual	11.3	11.0	11.3
NO_x	Annual	34.5	34.3	34.7
Pollutant	**Averaging Period**	**Inventory Only**	**VMA BLM Sources Only**	**VMA + Inventory All Sources**
Vernal MA				
CO	1-hour	7,015	7,027	7,028
CO	8-hour	4,244	4,245	4,246
PM_{10}	24-hour	28.5	31.5	31.6
PM_{10}	Annual	10.1	10.3	10.4
$PM_{2.5}$	24-hour	19.4	19.7	19.8
$PM_{2.5}$	Annual	7.1	7.1	7.1
SO_2	3-hour	34.9	20.0	34.9
SO_2	24-hour	13.1	10.0	13.1
SO_2	Annual	5.2	5.0	5.2
NO_x	Annual	10.6	10.2	10.7

TABLE 5-7. NAAQS ANALYSIS RESULTS FOR GLENWOOD ALT. III (PREFERRED)

Pollutant	Averaging Period	Total Concentration ($\mu g/m^3$)		
		Inventory Only	GMA BLM Sources Only	GMA + Inventory Sources
Glenwood Springs MA				
CO	1-hour	8,058	8,026	8,059
CO	8-hour	4,457	4,458	4,460
PM_{10}	24-hour	55.6	66.0	66.7
PM_{10}	Annual	24.2	25.4	25.5
$PM_{2.5}$	24-hour	19.9	22.7	22.7
$PM_{2.5}$	Annual	7.1	7.4	7.5
SO_2	3-hour	126.7	110.0	126.6
SO_2	24-hour	41.5	39.0	41.5
SO_2	Annual	11.3	11.0	11.3
NO_x	Annual	34.5	34.3	34.7

TABLE 5-8. NAAQS ANALYSIS RESULTS FOR ALT. II/ALT. C

		Total Concentration ($\mu g/m^3$)		
Pollutant	**Averaging Period**	**Inventory Only**	**GMA BLM Sources Only**	**GMA + Inventory Sources**
Glenwood Springs MA				
CO	1-hour	8,058	8,026	8,059
CO	8-hour	4,457	4,457	4,460
PM_{10}	24-hour	55.6	64.6	65.3
PM_{10}	Annual	24.2	25.2	25.3
$PM_{2.5}$	24-hour	19.9	22.5	22.6
$PM_{2.5}$	Annual	7.1	7.4	7.4
SO_2	3-hour	126.7	110.0	126.6
SO_2	24-hour	41.5	39.0	41.5
SO_2	Annual	11.3	11.0	11.3
NO_x	Annual	34.5	34.3	34.7
Pollutant	**Averaging Period**	**Inventory Only**	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Vernal MA				
CO	1-hour	7,015	7,027	7,028
CO	8-hour	4,244	4,245	4,245
PM_{10}	24-hour	28.5	31.5	31.6
PM_{10}	Annual	10.1	10.3	10.4
$PM_{2.5}$	24-hour	19.4	19.7	19.8
$PM_{2.5}$	Annual	7.1	7.1	7.1
SO_2	3-hour	34.9	20.0	34.9
SO_2	24-hour	13.1	10.0	13.1
SO_2	Annual	5.2	5.0	5.2
NO_x	Annual	10.6	10.2	10.7

TABLE 5-9. NAAQS ANALYSIS RESULTS FOR ALT. I/ALT. D

		Total Concentration ($\mu g/m^3$)		
Pollutant	**Averaging Period**	**Inventory Only**	**GMA BLM Sources Only**	**GMA + Inventory Sources**
Glenwood Springs MA				
CO	1-hour	8,058	8,026	8,059
CO	8-hour	4,457	4,457	4,460
PM_{10}	24-hour	55.6	62.4	63.1
PM_{10}	Annual	24.2	25.0	25.0
$PM_{2.5}$	24-hour	19.9	21.8	21.9
$PM_{2.5}$	Annual	7.1	7.3	7.4
SO_2	3-hour	126.7	110.0	126.6
SO_2	24-hour	41.5	39.0	41.5
SO_2	Annual	11.3	11.0	11.3
NO_x	Annual	34.5	34.3	34.7
Pollutant	**Averaging Period**	**Inventory Only**	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Vernal MA				
CO	1-hour	7,015	7,027	7,028
CO	8-hour	4,244	4,245	4,245
PM_{10}	24-hour	28.5	31.3	31.4
PM_{10}	Annual	10.1	10.3	10.3
$PM_{2.5}$	24-hour	19.4	19.7	19.7
$PM_{2.5}$	Annual	7.1	7.1	7.1
SO_2	3-hour	34.9	20.0	34.9
SO_2	24-hour	13.1	10.0	13.1
SO_2	Annual	5.2	5.0	5.2
NO_x	Annual	10.6	10.2	10.7

5.1.3 NAAQS ANALYSIS RESULTS FOR ALL SOURCES (CUMULATIVE)

Results for the cumulative analysis are presented in Table 5-10 below. NAAQS were not exceeded for any pollutant or averaging period. All listed concentrations include background. The cumulative results below are the maximum from the alternatives modeled.

TABLE 5-10. NAAQS ANALYSIS RESULTS FOR ALL SOURCES (CUMULATIVE)[A]

Pollutant	Averaging Period	Total Concentration ($\mu g/m^3$)		
		Inventory Only	All BLM Sources	All BLM + Inventory Sources
Glenwood Springs MA				
CO	1-hour	8,058	8,026	8,059
CO	8-hour	4,457	4,458	4,460
PM_{10}	24-hour	55.6	66.6	67.3
PM_{10}	Annual	24.2	25.5	25.6
$PM_{2.5}$	24-hour	19.9	22.7	22.8
$PM_{2.5}$	Annual	7.1	7.5	7.5
SO_2	3-hour	126.7	110.0	126.6
SO_2	24-hour	41.5	39.0	41.5
SO_2	Annual	11.3	11.0	11.3
NO_x	Annual	34.5	34.3	34.7
Pollutant	**Averaging Period**	**Inventory Only**	**All BLM Sources**	**All BLM + Inventory Sources**
Vernal MA				
CO	1-hour	7,015	7,027	7,028
CO	8-hour	4,244	4,245	4,246
PM_{10}	24-hour	28.5	31.4	31.5
PM_{10}	Annual	10.1	10.3	10.4
$PM_{2.5}$	24-hour	19.4	19.7	19.8
$PM_{2.5}$	Annual	7.1	7.1	7.1
SO_2	3-hour	34.9	20.0	34.9
SO_2	24-hour	13.1	10.0	13.1
SO_2	Annual	5.2	5.0	5.2
NO_x	Annual	10.6	10.2	10.7

a-Results reflect maximum concentration from all alternatives.

5.2 PSD INCREMENT COMPARISON

The concentration results from each modeled scenario were compared to PSD Increments standards. A PSD Increment is the maximum increase in ambient concentrations that is allowed to occur above a baseline concentration for a pollutant. The increments were evaluated for both Class I and Class II areas. PSD Increments are not yet established for $PM_{2.5}$ and were not addressed in the increments analysis.

This NEPA analysis compared potential air quality impacts from the proposed Alternatives to applicable ambient air quality standards and PSD increments. The comparisons to the PSD Class I and II increments were intended to evaluate a threshold of concern for potential impacts, and does not represent a regulatory PSD Increment Consumption Analysis. Such a regulatory analysis is the responsibility of the State air quality agency (under EPA oversight) and would be conducted during permitting process.

Several Class II areas in Colorado had the same protection as Class I areas for sulfur dioxide. These Class II areas were Colorado National Monument and Dinosaur National Monument. The SO_2 increment results for these Class II areas were compared with the Class I increments. The Increment standards addressed in this study are listed in Table 5-11.

TABLE 5-11. INCREMENT STANDARDS FOR CLASS I AND CLASS II AREAS

Pollutant	Averaging Period	Class I Concentration ($\mu g/m^3$)	Class II Concentration ($\mu g/m^3$)
PM_{10}	24-Hour	8	30
	Annual	4	17
SO_2	3-Hour	25	512
	24-Hour	5	91
	Annual	2	20
NO_2	Annual	2.5	25

5.2.1 PSD INCREMENT COMPARISON RESULTS BY ALTERNATIVE

Results for each development scenario are presented in Tables 5-12 through 5-31 below. The PSD Increments were not exceeded for any pollutant or averaging period. Although these results are compared to the PSD increment consumption thresholds, they do not, nor are they intended to, represent a true PSD increment consumption analysis.

TABLE 5-12. INCREMENT COMPARISON RESULTS FOR ALT. V/ALT. B

Pollutant	Averaging Period	Total Concentration ($\mu g/m^3$)		
		Inventory Only	GMA BLM Sources Only	GMA + Inventory Sources
Glenwood Springs MA				
PM_{10}	24-hour	1.6	12.6	13.3
PM_{10}	Annual	0.2	1.5	1.6
SO_2	3-hour	16.6	0.02	16.6
SO_2	24-hour	2.5	0.005	2.5
SO_2	Annual	0.3	0.0004	0.3
NO_x	Annual	0.6	0.3	0.7
Pollutant	**Averaging Period**	**Inventory Only**	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Vernal MA				
PM_{10}	24-hour	0.5	3.3	3.5
PM_{10}	Annual	0.08	0.3	0.4
SO_2	3-hour	14.9	0.02	14.9
SO_2	24-hour	3.1	0.003	3.1
SO_2	Annual	0.2	0.0006	0.2
NO_x	Annual	0.6	0.2	0.7

TABLE 5-13. INCREMENT COMPARISON RESULTS FOR ALT. IV/ALT. A

		Total Concentration ($\mu g/m^3$)		
Pollutant	**Averaging Period**	**Inventory Only**	**GMA BLM Sources Only**	**GMA + Inventory Sources**
Glenwood Springs MA				
PM_{10}	24-hour	1.6	12.0	12.7
PM_{10}	Annual	0.2	1.4	1.5
SO_2	3-hour	16.6	0.02	16.6
SO_2	24-hour	2.5	0.005	2.5
SO_2	Annual	0.3	0.0004	0.3
NO_x	Annual	0.6	0.3	0.7
Pollutant	**Averaging Period**	**Inventory Only**	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Vernal MA				
PM_{10}	24-hour	0.5	3.5	3.6
PM_{10}	Annual	0.08	0.3	0.4
SO_2	3-hour	14.9	0.02	14.9
SO_2	24-hour	3.1	0.003	3.1
SO_2	Annual	0.2	0.0006	0.2
NO_x	Annual	0.6	0.2	0.7

TABLE 5-14. INCREMENT COMPARISON RESULTS FOR ALT. III (PREFERRED)

Pollutant	Averaging Period	Total Concentration ($\mu g/m^3$)		
		Inventory Only	GMA BLM Sources Only	GMA + Inventory Sources
Glenwood Springs MA				
PM_{10}	24-hour	1.6	12.0	12.7
PM_{10}	Annual	0.2	1.4	1.5
SO_2	3-hour	16.6	0.02	16.6
SO_2	24-hour	2.5	0.005	2.5
SO_2	Annual	0.3	0.0004	0.3
NO_x	Annual	0.6	0.3	0.7

TABLE 5-15. INCREMENT COMPARISON RESULTS FOR ALT. II/ALT. C

Pollutant	Averaging Period	Total Concentration ($\mu g/m^3$)		
		Inventory Only	GMA BLM Sources Only	GMA + Inventory All Sources
Glenwood Springs MA				
PM_{10}	24-hour	1.6	10.6	11.3
PM_{10}	Annual	0.2	1.2	1.3
SO_2	3-hour	16.6	0.02	16.6
SO_2	24-hour	2.5	0.005	2.5
SO_2	Annual	0.3	0.0004	0.3
NO_x	Annual	0.6	0.3	0.7
Pollutant	**Averaging Period**	**Inventory Only**	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Vernal MA				
PM_{10}	24-hour	0.5	3.5	3.6
PM_{10}	Annual	0.08	0.3	0.4
SO_2	3-hour	14.9	0.02	14.9
SO_2	24-hour	3.1	0.003	3.1
SO_2	Annual	0.2	0.0006	0.2
NO_x	Annual	0.6	0.2	0.7

TABLE 5-16. INCREMENT COMPARISON RESULTS FOR ALT. I/ALT. D

Pollutant	Averaging Period	Total Concentration ($\mu g/m^3$)		
		Inventory Only	GMA BLM Sources Only	GMA + Inventory Sources
Glenwood Springs MA				
PM_{10}	24-hour	1.6	8.4	9.1
PM_{10}	Annual	0.2	1.0	1.0
SO_2	3-hour	16.6	0.02	16.6
SO_2	24-hour	2.5	0.005	2.5
SO_2	Annual	0.3	0.0004	0.3
NO_x	Annual	0.6	0.3	0.7
Pollutant	**Averaging Period**	**Inventory Only**	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Vernal MA				
PM_{10}	24-hour	0.5	3.3	3.4
PM_{10}	Annual	0.08	0.3	0.3
SO_2	3-hour	14.9	0.02	14.9
SO_2	24-hour	3.1	0.003	3.1
SO_2	Annual	0.2	0.0006	0.2
NO_x	Annual	0.6	0.2	0.7

TABLE 5-17. SO_2 INCREMENT COMPARISON FOR ALT. V/ALT. B

		Total Concentration ($\mu g/m^3$)								
		Inventory Only			GMA BLM Sources Only			GMA + Inventory Sources		
Class	**Area**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**
I	Black Canyon	1.5	0.5	0.03	0.0006	0.0002	0.000005	1.5	0.5	0.03
II	Colorado NM	7.7	1.7	0.07	0.0004	0.0001	0.000007	7.7	1.7	0.07
I	Eagle's Nest	0.3	0.08	0.01	0.0004	0.0001	0.000008	0.3	0.08	0.01
I	Flat Tops	2.2	0.3	0.02	0.0007	0.0002	0.00002	2.2	0.3	0.02
II	Holy Cross	0.3	0.09	0.01	0.0002	0.00009	0.00001	0.3	0.09	0.01
II	Hunter-Frying	0.3	0.09	0.008	0.0002	0.00006	0.000007	0.3	0.09	0.008
I	La Garita	0.4	0.1	0.005	0.00009	0.00003	0.000001	0.4	0.1	0.005
I	Maroon Bells	0.8	0.3	0.02	0.0004	0.0002	0.00001	0.8	0.3	0.02
I	Mt. Zirkel	4.3	1.0	0.08	0.0002	0.00006	0.000005	4.3	1.0	0.08
II	Raggeds	0.8	0.2	0.02	0.0003	0.00008	0.000007	0.8	0.2	0.02
I	Rawah	0.3	0.09	0.01	0.00008	0.00003	0.000003	0.3	0.09	0.01
I	Weminuche	0.4	0.09	0.004	0.0001	0.00003	0.0000009	0.4	0.009	0.004
I	West Elk	0.6	0.2	0.02	0.0003	0.00009	0.000005	0.6	0.2	0.02
		Inventory Only			**VMA BLM Sources Only**			**VMA + Inventory Sources**		
Class	**Area**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**
I	Arches	0.6	0.3	0.008	0.0002	0.00008	0.000008	0.6	0.3	0.008
II	Browns Park	0.5	0.1	0.006	0.0002	0.0002	0.00002	0.5	0.1	0.006
I	Canyonlands	0.3	0.1	0.006	0.0002	0.00008	0.000005	0.3	0.1	0.006
I	Capitol Reef	0.1	0.08	0.002	0.0002	0.00004	0.000001	0.1	0.08	0.002
II	Dinosaur NM	0.8	0.2	0.01	0.002	0.0004	0.00009	0.4	0.2	0.01
II	Flaming Gorge	0.4	0.1	0.004	0.0003	0.0001	0.00001	0.4	0.1	0.004
II	High Uintas	0.2	0.05	0.003	0.0003	0.0002	0.000005	0.2	0.05	0.003
II	Ouray	0.5	0.1	0.01	0.002	0.0005	0.0002	0.5	0.1	0.01
II	USFS Request[a]	0.7	0.2	0.003	0.0001	0.00006	0.000002	0.7	0.2	0.003

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-18. SO_2 INCREMENT COMPARISON FOR ALT. IV/ALT. A

		Total Concentration ($\mu g/m^3$)								
		Inventory Only			GMA BLM Sources Only			GMA + Inventory Sources		
Class	**Area**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**
I	Black Canyon	1.5	0.5	0.03	0.0005	0.0002	0.000004	1.5	0.5	0.03
II	Colorado NM	7.7	1.7	0.07	0.0005	0.0001	0.000006	7.7	1.7	0.07
I	Eagle's Nest	0.3	0.08	0.01	0.0003	0.00009	0.000008	0.3	0.08	0.01
I	Flat Tops	2.2	0.3	0.02	0.0006	0.0002	0.00002	2.2	0.3	0.02
II	Holy Cross	0.3	0.09	0.01	0.0002	0.00008	0.00001	0.3	0.09	0.01
II	Hunter-Frying	0.3	0.09	0.008	0.0002	0.00005	0.000006	0.3	0.09	0.008
I	La Garita	0.4	0.1	0.005	0.00009	0.00002	0.000001	0.4	0.1	0.005
I	Maroon Bells	0.8	0.3	0.02	0.0004	0.0001	0.00001	0.8	0.3	0.02
I	Mt. Zirkel	4.3	1.0	0.08	0.0001	0.00005	0.000005	4.3	1.0	0.08
II	Raggeds	0.8	0.2	0.02	0.0002	0.00007	0.000006	0.8	0.2	0.02
I	Rawah	0.3	0.09	0.01	0.00007	0.00002	0.000002	0.3	0.09	0.01
I	Weminuche	0.4	0.09	0.004	0.00009	0.00002	0.0000008	0.4	0.09	0.004
I	West Elk	0.6	0.2	0.02	0.0002	0.00008	0.000004	0.6	0.2	0.02
		Inventory Only			VMA BLM Sources Only			VMA + Inventory Sources		
Class	**Area**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**
I	Arches	0.6	0.3	0.008	0.0002	0.00008	0.000008	0.6	0.3	0.008
II	Browns Park	0.5	0.1	0.006	0.0002	0.0002	0.00002	0.5	0.1	0.006
I	Canyonlands	0.3	0.1	0.006	0.0002	0.00008	0.000005	0.3	0.1	0.006
I	Capitol Reef	0.1	0.08	0.002	0.0002	0.00004	0.000001	0.1	0.08	0.002
II	Dinosaur NM	0.8	0.2	0.01	0.001	0.0004	0.00008	0.8	0.2	0.01
II	Flaming Gorge	0.4	0.1	0.004	0.0003	0.0001	0.00001	0.4	0.1	0.004
II	High Uintas	0.2	0.05	0.003	0.0003	0.0002	0.000005	0.2	0.05	0.003
II	Ouray	0.5	0.1	0.01	0.002	0.0004	0.0002	0.5	0.1	0.01
II	USFS Request[a]	0.7	0.2	0.003	0.0001	0.00006	0.000002	0.7	0.2	0.003

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-19. SO_2 INCREMENT COMPARISON FOR GMA ALT. III (PREFERRED)

		Total Concentration ($\mu g/m^3$)								
		Inventory Only			GMA BLM Sources Only			GMA + Inventory Sources		
Class	**Area**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**
I	Black Canyon	1.5	0.5	0.03	0.0005	0.0002	0.000004	1.5	0.5	0.03
II	Colorado NM	7.7	1.7	0.07	0.0005	0.0001	0.000006	7.7	1.7	0.07
I	Eagle's Nest	0.3	0.08	0.01	0.0003	0.00009	0.000008	0.3	0.08	0.01
I	Flat Tops	2.2	0.3	0.02	0.0006	0.0002	0.00002	2.2	0.3	0.02
II	Holy Cross	0.3	0.09	0.01	0.0002	0.00008	0.00001	0.3	0.09	0.01
II	Hunter-Frying	0.3	0.09	0.008	0.0002	0.00005	0.000006	0.3	0.09	0.008
I	La Garita	0.4	0.1	0.005	0.00009	0.00002	0.000001	0.4	0.1	0.005
I	Maroon Bells	0.8	0.3	0.02	0.0004	0.0001	0.00001	0.8	0.3	0.02
I	Mt. Zirkel	4.3	1.0	0.08	0.0001	0.00005	0.000005	4.3	1.0	0.08
II	Raggeds	0.8	0.2	0.02	0.0002	0.00007	0.000006	0.8	0.2	0.02
I	Rawah	0.3	0.09	0.01	0.00007	0.00002	0.000002	0.3	0.09	0.01
I	Weminuche	0.4	0.09	0.004	0.00009	0.00002	0.0000008	0.4	0.09	0.004
I	West Elk	0.6	0.2	0.02	0.0002	0.00008	0.000004	0.6	0.2	0.02

TABLE 5-20. SO_2 INCREMENT COMPARISON FOR ALT. II/ALT. C

		Total Concentration ($\mu g/m^3$)								
		Inventory Only			GMA BLM Sources Only			GMA + Inventory Sources		
Class	**Area**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**
I	Black Canyon	1.5	0.5	0.03	0.0004	0.0002	0.000004	1.5	0.5	0.03
II	Colorado NM	7.7	1.7	0.07	0.0004	0.0001	0.000006	7.7	1.7	0.07
I	Eagle's Nest	0.3	0.08	0.01	0.0003	0.00008	0.000007	0.3	0.08	0.01
I	Flat Tops	2.2	0.3	0.02	0.0005	0.0002	0.00002	2.2	0.3	0.02
II	Holy Cross	0.3	0.09	0.01	0.0002	0.00007	0.000008	0.3	0.09	0.01
II	Hunter-Frying	0.3	0.09	0.008	0.0002	0.00005	0.000005	0.3	0.09	0.008
I	La Garita	0.4	0.1	0.005	0.00008	0.00002	0.000001	0.4	0.1	0.005
I	Maroon Bells	0.8	0.3	0.02	0.0004	0.0001	0.000009	0.8	0.3	0.02
I	Mt. Zirkel	4.3	1.0	0.08	0.0001	0.00004	0.000004	4.3	1.0	0.08
II	Raggeds	0.8	0.2	0.02	0.0002	0.00006	0.000005	0.8	0.2	0.02
I	Rawah	0.3	0.09	0.01	0.00006	0.00002	0.000002	0.3	0.09	0.01
I	Weminuche	0.4	0.09	0.004	0.00008	0.00002	0.0000007	0.4	0.09	0.004
I	West Elk	0.6	0.2	0.02	0.0002	0.00007	0.000004	0.6	0.2	0.02
		Inventory Only			VMA BLM Sources Only			VMA + Inventory Sources		
Class	**Area**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**
I	Arches	0.6	0.3	0.008	0.0002	0.00007	0.000007	0.6	0.3	0.008
II	Browns Park	0.5	0.1	0.006	0.0002	0.0001	0.00002	0.5	0.1	0.006
I	Canyonlands	0.3	0.1	0.006	0.0002	0.00008	0.000005	0.3	0.1	0.006
I	Capitol Reef	0.1	0.08	0.002	0.0001	0.00004	0.000001	0.1	0.08	0.002
II	Dinosaur NM	0.8	0.2	0.01	0.001	0.0004	0.00007	0.8	0.2	0.01
II	Flaming Gorge	0.4	0.1	0.004	0.0003	0.0001	0.00001	0.4	0.1	0.004
II	High Uintas	0.2	0.05	0.003	0.0003	0.0002	0.000005	0.2	0.05	0.003
II	Ouray	0.5	0.1	0.01	0.002	0.0004	0.0002	0.5	0.1	0.01
II	USFS Request[a]	0.7	0.2	0.003	0.0001	0.00006	0.000002	0.7	0.2	0.003

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-21. SO_2 INCREMENT COMPARISON FOR ALT. I/ALT. D

		Total Concentration ($\mu g/m^3$)								
		Inventory Only			GMA BLM Sources Only			GMA + Inventory Sources		
Class	**Area**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**
I	Black Canyon	1.5	0.5	0.03	0.0004	0.0002	0.000004	1.5	0.5	0.03
II	Colorado NM	7.7	1.7	0.07	0.0004	0.0001	0.000006	7.7	1.7	0.07
I	Eagle's Nest	0.3	0.08	0.01	0.0003	0.00008	0.000006	0.3	0.08	0.01
I	Flat Tops	2.2	0.3	0.02	0.0005	0.0002	0.00002	2.2	0.3	0.02
II	Holy Cross	0.3	0.09	0.01	0.0002	0.00007	0.000008	0.3	0.09	0.01
II	Hunter-Frying	0.3	0.09	0.008	0.0002	0.00004	0.000005	0.3	0.09	0.008
I	La Garita	0.4	0.1	0.005	0.00008	0.00002	0.000001	0.4	0.1	0.005
I	Maroon Bells	0.8	0.3	0.02	0.0004	0.0001	0.000009	0.8	0.3	0.02
I	Mt. Zirkel	4.3	1.0	0.08	0.0001	0.00004	0.000004	4.3	1.0	0.08
II	Raggeds	0.8	0.2	0.02	0.0002	0.00006	0.000005	0.8	0.2	0.02
I	Rawah	0.3	0.09	0.01	0.00006	0.00002	0.000002	0.3	0.09	0.01
I	Weminuche	0.4	0.09	0.004	0.00008	0.00002	0.0000007	0.4	0.09	0.004
I	West Elk	0.6	0.2	0.02	0.0002	0.00007	0.000004	0.6	0.2	0.02
		Inventory Only			VMA BLM Sources Only			VMA + Inventory Sources		
Class	**Area**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**
I	Arches	0.6	0.3	0.008	0.0002	0.00008	0.000008	0.6	0.3	0.008
II	Browns Park	0.5	0.1	0.006	0.0002	0.0002	0.00002	0.5	0.1	0.006
I	Canyonlands	0.3	0.1	0.006	0.0002	0.00008	0.000005	0.3	0.1	0.006
I	Capitol Reef	0.1	0.08	0.002	0.0002	0.00004	0.000001	0.1	0.08	0.002
II	Dinosaur NM	0.8	0.2	0.01	0.002	0.0004	0.00009	0.8	0.2	0.01
II	Flaming Gorge	0.4	0.1	0.004	0.0003	0.0001	0.00001	0.4	0.1	0.004
II	High Uintas	0.2	0.05	0.003	0.0003	0.0002	0.000005	0.2	0.05	0.003
II	Ouray	0.5	0.1	0.01	0.002	0.0005	0.0002	0.5	0.1	0.01
II	USFS Request[a]	0.7	0.2	0.003	0.0001	0.00006	0.000002	0.7	0.2	0.003

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-22. PM_{10} INCREMENT COMPARISON FOR ALT. V/ALT. B

		Total Concentration ($\mu g/m^3$)					
		Inventory Only		GMA BLM Sources Only		GMA + Inventory Sources	
Class	**Area**	**24-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
I	Black Canyon	0.4	0.03	0.6	0.02	1.0	0.4
II	Colorado NM	0.4	0.05	0.4	0.02	0.6	0.06
I	Eagle's Nest	0.4	0.03	0.2	0.03	0.4	0.05
I	Flat Tops	0.2	0.02	0.6	0.09	0.7	0.1
II	Holy Cross	0.1	0.02	0.3	0.03	0.4	0.05
II	Hunter-Frying	0.08	0.01	0.0.3	0.02	0.3	0.04
I	La Garita	0.1	0.005	0.1	0.05	0.2	0.01
I	Maroon Bells	0.1	0.02	0.4	0.05	0.5	0.06
I	Mt. Zirkel	0.5	0.04	0.1	0.01	0.5	0.06
II	Raggeds	0.1	0.01	0.3	0.03	0.4	0.04
I	Rawah	0.1	0.02	0.09	0.008	0.2	0.02
I	Weminuche	0.07	0.004	0.1	0.004	0.2	0.008
I	West Elk	0.2	0.01	0.3	0.02	0.5	0.03
		Inventory Only		VMA BLM Sources Only		VMA + Inventory Sources	
Class	**Area**	**24-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
I	Arches	0.2	0.02	0.05	0.003	0.2	0.02
II	Browns Park	0.1	0.01	0.07	0.01	0.1	0.02
I	Canyonlands	0.1	0.01	0.04	0.002	0.1	0.02
I	Capitol Reef	0.06	0.002	0.02	0.0007	0.06	0.003
II	Dinosaur NM	0.6	0.05	0.2	0.04	0.6	0.06
II	Flaming Gorge	0.1	0.007	0.1	0.01	0.1	0.02
II	High Uintas	0.1	0.004	0.07	0.006	0.2	0.01
II	Ouray	0.3	0.03	0.4	0.07	0.7	0.09
II	USFS Request[a]	0.05	0.002	0.03	0.0008	0.07	0.003

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-23. PM10 INCREMENT COMPARISON FOR ALT. IV/ALT. A

		Total Concentration (μg/m³)					
		Inventory Only		GMA BLM Sources Only		GMA + Inventory Sources	
Class	**Area**	**24-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
I	Black Canyon	0.4	0.03	0.6	0.01	0.9	0.04
II	Colorado NM	0.4	0.05	0.4	0.02	0.6	0.06
I	Eagle's Nest	0.4	0.03	0.2	0.02	0.4	0.05
I	Flat Tops	0.2	0.02	0.6	0.08	0.6	0.1
II	Holy Cross	0.1	0.02	0.3	0.03	0.4	0.05
II	Hunter-Frying	0.08	0.01	0.3	0.02	0.3	0.03
I	La Garita	0.1	0.005	0.1	0.004	0.2	0.01
I	Maroon Bells	0.1	0.02	0.4	0.04	0.5	0.06
I	Mt. Zirkel	0.5	0.04	0.1	0.01	0.5	0.05
II	Raggeds	0.1	0.01	0.3	0.02	0.4	0.04
I	Rawah	0.1	0.02	0.09	0.007	0.2	0.02
I	Weminuche	0.07	0.004	0.1	0.004	0.2	0.008
I	West Elk	0.2	0.01	0.3	0.01	0.5	0.03
		Inventory Only		VMA BLM Sources Only		VMA + Inventory Sources	
Class	**Area**	**24-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
I	Arches	0.2	0.02	0.04	0.003	0.2	0.02
II	Browns Park	0.1	0.01	0.06	0.009	0.1	0.02
I	Canyonlands	0.1	0.01	0.04	0.002	0.1	0.02
I	Capitol Reef	0.06	0.002	0.02	0.0007	0.06	0.003
II	Dinosaur NM	0.6	0.05	0.2	0.03	0.6	0.06
II	Flaming Gorge	0.1	0.007	0.1	0.01	0.1	0.02
II	High Uintas	0.1	0.004	0.06	0.005	0.2	0.009
II	Ouray	0.3	0.03	0.4	0.06	0.7	0.09
II	USFS Request[a]	0.05	0.002	0.03	0.0007	0.07	0.003

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-24. PM10 INCREMENT COMPARISON FOR GMA ALT. III (PREFERRED)

		Total Concentration (μg/m^3)					
		Inventory Only		GMA BLM Sources Only		GMA + Inventory Sources	
Class	**Area**	**24-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
I	Black Canyon	0.4	0.03	0.6	0.01	0.9	0.04
II	Colorado NM	0.4	0.05	0.4	0.02	0.6	0.06
I	Eagle's Nest	0.4	0.03	0.2	0.02	0.4	0.05
I	Flat Tops	0.2	0.02	0.6	0.08	0.6	0.1
II	Holy Cross	0.1	0.02	0.3	0.03	0.4	0.05
II	Hunter-Frying	0.08	0.01	0.3	0.02	0.3	0.03
I	La Garita	0.1	0.005	0.1	0.004	0.2	0.01
I	Maroon Bells	0.1	0.02	0.4	0.04	0.5	0.06
I	Mt. Zirkel	0.5	0.04	0.1	0.01	0.5	0.05
II	Raggeds	0.1	0.01	0.3	0.02	0.4	0.04
I	Rawah	0.1	0.02	0.09	0.007	0.2	0.02
I	Weminuche	0.07	0.004	0.1	0.004	0.2	0.008
I	West Elk	0.2	0.01	0.3	0.01	0.5	0.03

TABLE 5-25. PM10 INCREMENT COMPARISON FOR ALT. II/ALT. C

		Total Concentration (μg/m³)					
		Inventory Only		GMA BLM Sources Only		GMA + Inventory Sources	
Class	**Area**	**24-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
I	Black Canyon	0.4	0.03	0.5	0.01	0.8	0.04
II	Colorado NM	0.4	0.05	0.3	0.01	0.5	0.06
I	Eagle's Nest	0.4	0.03	0.2	0.02	0.4	0.04
I	Flat Tops	0.2	0.02	0.4	0.06	0.5	0.09
II	Holy Cross	0.1	0.02	0.3	0.02	0.3	0.04
II	Hunter-Frying	0.08	0.01	0.2	0.02	0.3	0.03
I	La Garita	0.1	0.005	0.08	0.004	0.2	0.009
I	Maroon Bells	0.1	0.02	0.3	0.04	0.4	0.05
I	Mt. Zirkel	0.5	0.04	0.09	0.01	0.5	0.05
II	Raggeds	0.1	0.01	0.3	0.02	0.4	0.03
I	Rawah	0.1	0.02	0.07	0.006	0.2	0.02
I	Weminuche	0.07	0.004	0.1	0.003	0.1	0.007
I	West Elk	0.2	0.01	0.3	0.01	0.5	0.02
		Inventory Only		VMA BLM Sources Only		VMA + Inventory Sources	
Class	**Area**	**24-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
I	Arches	0.2	0.02	0.04	0.003	0.2	0.02
II	Browns Park	0.1	0.01	0.6	0.008	0.1	0.02
I	Canyonlands	0.1	0.01	0.03	0.002	0.1	0.02
I	Capitol Reef	0.06	0.002	0.02	0.0006	0.06	0.003
II	Dinosaur NM	0.6	0.05	0.2	0.03	0.6	0.06
II	Flaming Gorge	0.1	0.007	0.04	0.006	0.1	0.01
II	High Uintas	0.1	0.004	0.06	0.004	0.1	0.008
II	Ouray	0.3	0.03	0.4	0.06	0.7	0.09
II	USFS Request[a]	0.05	0.002	0.03	0.0006	0.07	0.003

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-26. PM_{10} INCREMENT COMPARISON FOR ALT. I/ALT. D

		Total Concentration ($\mu g/m^3$)					
		Inventory Only		GMA BLM Sources Only		GMA + Inventory Sources	
Class	**Area**	**24-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
I	Black Canyon	0.4	0.03	0.4	0.009	0.8	0.03
II	Colorado NM	0.4	0.05	0.2	0.01	0.5	0.06
I	Eagle's Nest	0.4	0.03	0.1	0.02	0.4	0.04
I	Flat Tops	0.2	0.02	0.4	0.05	0.4	0.07
II	Holy Cross	0.1	0.02	0.2	0.02	0.3	0.04
II	Hunter-Frying	0.08	0.01	0.2	0.01	0.2	0.03
I	La Garita	0.1	0.005	0.07	0.003	0.2	0.008
I	Maroon Bells	0.1	0.02	0.3	0.03	0.3	0.04
I	Mt. Zirkel	0.5	0.04	0.07	0.008	0.5	0.05
II	Raggeds	0.1	0.01	0.2	0.02	0.3	0.03
I	Rawah	0.1	0.02	0.06	0.005	0.2	0.02
I	Weminuche	0.07	0.004	0.08	0.002	0.1	0.006
I	West Elk	0.2	0.01	0.2	0.01	0.4	0.02
		Inventory Only		VMA BLM Sources Only		VMA + Inventory Sources	
Class	**Area**	**24-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
I	Arches	0.2	0.02	0.04	0.003	0.2	0.02
II	Browns Park	0.1	0.01	0.07	0.009	0.1	0.02
I	Canyonlands	0.1	0.01	0.04	0.002	0.1	0.02
I	Capitol Reef	0.06	0.002	0.2	0.0007	0.06	0.003
II	Dinosaur NM	0.6	0.05	0.2	0.04	0.6	0.06
II	Flaming Gorge	0.1	0.007	0.04	0.006	0.1	0.01
II	High Uintas	0.1	0.004	0.06	0.003	0.1	0.08
II	Ouray	0.3	0.03	0.4	0.06	0.6	0.09
II	USFS Request[a]	0.05	0.002	0.03	0.0007	0.07	0.003

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-27. NO_X INCREMENT COMPARISON FOR ALT. V/ALT. B

		Total Concentration ($\mu g/m^3$)		
		Inventory Only	**GMA BLM Sources Only**	**GMA + Inventory Sources**
Class	**Area**	**Annual**	**Annual**	**Annual**
I	Black Canyon	0.003	0.0009	0.004
II	Colorado NM	0.04	0.002	0.04
I	Eagle's Nest	0.008	0.02	0.01
I	Flat Tops	0.001	0.007	0.02
II	Holy Cross	0.006	0.003	0.009
II	Hunter-Frying	0.003	0.002	0.004
I	La Garita	0.0004	0.00009	0.0004
I	Maroon Bells	0.005	0.003	0.007
I	Mt. Zirkel	0.2	0.001	0.2
II	Raggeds	0.003	0.001	0.005
I	Rawah	0.02	0.0005	0.02
I	Weminuche	0.0005	0.00005	0.0005
I	West Elk	0.002	0.0008	0.003
		Inventory Only	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Class	**Area**	**Annual**	**Annual**	**Annual**
I	Arches	0.02	0.0009	0.02
II	Browns Park	0.006	0.002	0.009
I	Canyonlands	0.02	0.0005	0.02
I	Capitol Reef	0.0004	0.00006	0.0005
II	Dinosaur NM	0.02	0.02	0.03
II	Flaming Gorge	0.004	0.002	0.006
II	High Uintas	0.01	0.0005	0.01
II	Ouray	0.06	0.03	0.1
II	USFS Request[a]	0.002	0.0003	0.002

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-28. NO_x INCREMENT COMPARISON FOR ALT. IV/ALT. A

		Total Concentration ($\mu g/m^3$)		
		Inventory Only	**GMA BLM Sources Only**	**GMA + Inventory Sources**
Class	**Area**	**Annual**	**Annual**	**Annual**
I	Black Canyon	0.003	0.0009	0.004
II	Colorado NM	0.04	0.002	0.04
I	Eagle's Nest	0.008	0.02	0.01
I	Flat Tops	0.001	0.007	0.02
II	Holy Cross	0.006	0.003	0.009
II	Hunter-Frying	0.003	0.002	0.004
I	La Garita	0.0004	0.00009	0.0004
I	Maroon Bells	0.005	0.003	0.007
I	Mt. Zirkel	0.2	0.001	0.2
II	Raggeds	0.003	0.001	0.005
I	Rawah	0.02	0.0005	0.02
I	Weminuche	0.0005	0.00005	0.0005
I	West Elk	0.002	0.0008	0.003
		Inventory Only	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Class	**Area**	**Annual**	**Annual**	**Annual**
I	Arches	0.02	0.0009	0.02
II	Browns Park	0.006	0.002	0.009
I	Canyonlands	0.02	0.0005	0.02
I	Capitol Reef	0.0004	0.00006	0.0005
II	Dinosaur NM	0.02	0.02	0.03
II	Flaming Gorge	0.004	0.002	0.006
II	High Uintas	0.01	0.0005	0.01
II	Ouray	0.06	0.03	0.1
II	USFS Request[a]	0.002	0.0003	0.002

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-29. NOX INCREMENT COMPARISON FOR GMA ALT. III (PREFERRED)

		Total Concentration ($\mu g/m^3$)		
		Inventory Only	GMA BLM Sources Only	GMA + Inventory Sources
Class	**Area**	**Annual**	**Annual**	**Annual**
I	Black Canyon	0.003	0.0009	0.004
II	Colorado NM	0.04	0.002	0.04
I	Eagle's Nest	0.008	0.002	0.01
I	Flat Tops	0.001	0.006	0.02
II	Holy Cross	0.006	0.002	0.009
II	Hunter-Frying	0.003	0.001	0.004
I	La Garita	0.0004	0.00008	0.0004
I	Maroon Bells	0.005	0.002	0.007
I	Mt. Zirkel	0.2	0.001	0.2
II	Raggeds	0.003	0.001	0.004
I	Rawah	0.02	0.0005	0.02
I	Weminuche	0.0005	0.00005	0.0005
I	West Elk	0.002	0.0007	0.003

TABLE 5-30. NO_X INCREMENT COMPARISON FOR ALT. II/ALT. C

		Total Concentration ($\mu g/m^3$)		
		Inventory Only	**GMA BLM Sources Only**	**GMA + Inventory Sources**
Class	**Area**	**Annual**	**Annual**	**Annual**
I	Black Canyon	0.003	0.0007	0.004
II	Colorado NM	0.04	0.002	0.04
I	Eagle's Nest	0.008	0.002	0.01
I	Flat Tops	0.001	0.005	0.02
II	Holy Cross	0.006	0.002	0.008
II	Hunter-Frying	0.003	0.001	0.004
I	La Garita	0.0004	0.00007	0.0004
I	Maroon Bells	0.005	0.002	0.007
I	Mt. Zirkel	0.2	0.0009	0.2
II	Raggeds	0.003	0.001	0.004
I	Rawah	0.02	0.0004	0.02
I	Weminuche	0.0005	0.00004	0.0005
I	West Elk	0.002	0.0006	0.002
		Inventory Only	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Class	**Area**	**Annual**	**Annual**	**Annual**
I	Arches	0.02	0.0009	0.02
II	Browns Park	0.006	0.002	0.008
I	Canyonlands	0.02	0.0005	0.02
I	Capitol Reef	0.0004	0.00006	0.0005
II	Dinosaur NM	0.02	0.02	0.03
II	Flaming Gorge	0.004	0.002	0.006
II	High Uintas	0.01	0.0005	0.01
II	Ouray	0.06	0.03	0.1
II	USFS Request[a]	0.002	0.0002	0.002

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-31. NO_X INCREMENT COMPARISON FOR ALT. I/ALT. D

		Total Concentration ($\mu g/m^3$)		
		Inventory Only	**GMA BLM Sources Only**	**GMA + Inventory Sources**
Class	**Area**	**Annual**	**Annual**	**Annual**
I	Black Canyon	0.003	0.0007	0.004
II	Colorado NM	0.04	0.002	0.04
I	Eagle's Nest	0.008	0.002	0.01
I	Flat Tops	0.001	0.005	0.02
II	Holy Cross	0.006	0.002	0.008
II	Hunter-Frying	0.003	0.001	0.004
I	La Garita	0.0004	0.00007	0.0004
I	Maroon Bells	0.005	0.002	0.007
I	Mt. Zirkel	0.2	0.0009	0.2
II	Raggeds	0.003	0.001	0.004
I	Rawah	0.02	0.0004	0.02
I	Weminuche	0.0005	0.00004	0.0005
I	West Elk	0.002	0.0006	0.002
		Inventory Only	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Class	**Area**	**Annual**	**Annual**	**Annual**
I	Arches	0.02	0.001	0.02
II	Browns Park	0.006	0.003	0.009
I	Canyonlands	0.02	0.0006	0.02
I	Capitol Reef	0.0004	0.00007	0.0005
II	Dinosaur NM	0.02	0.02	0.04
II	Flaming Gorge	0.004	0.002	0.006
II	High Uintas	0.01	0.0005	0.01
II	Ouray	0.06	0.04	0.1
II	USFS Request[a]	0.002	0.0003	0.002

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

5.2.2 PSD INCREMENT RESULTS FOR ALL SOURCES (CUMULATIVE)

Results for the cumulative PSD increment analysis are presented in Table 5-32 through 5-35 below. The PSD Increments were not exceeded for any pollutant or averaging period. The cumulative results below are the maximum from the alternatives modeled. Although these results are compared to the PSD increment consumption thresholds, they do not represent a true PSD increment consumption analysis.

TABLE 5-32. INCREMENT COMPARISON FOR CUMULATIVE ANALYSIS (ALL SOURCES)[A]

		Total Concentration ($\mu g/m^3$)		
Pollutant	**Averaging Period**	**Inventory Only**	**All BLM Sources**	**All BLM + Inventory Sources**
Glenwood Springs MA				
PM_{10}	24-hour	1.6	12.6	13.3
PM_{10}	Annual	0.2	1.5	1.6
SO_2	3-hour	16.6	0.2	16.6
SO_2	24-hour	2.5	0.05	2.5
SO_2	Annual	0.3	0.0004	0.3
NO_x	Annual	0.6	0.3	0.7
Pollutant	**Averaging Period**	**Inventory Only**	**All BLM Sources**	**All BLM + Inventory Sources**
Vernal MA				
PM_{10}	24-hour	0.5	3.4	3.6
PM_{10}	Annual	0.08	0.3	0.4
SO_2	3-hour	14.9	0.02	14.9
SO_2	24-hour	3.1	0.003	3.1
SO_2	Annual	0.2	0.0006	0.2
NO_x	Annual	0.6	0.2	0.7

a-Results reflect maximum concentration from all alternatives.

TABLE 5-33. SO_2 INCREMENT COMPARISON FOR ALL SOURCES (CUMULATIVE)[A]

		Total Concentration (μg/m³)								
		Inventory Only			All BLM Sources			All BLM + Inventory Sources		
Class	**Area**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**
I	Black Canyon	1.5	0.5	0.03	0.0006	0.0002	0.000007	1.5	0.5	0.03
II	Colorado NM	7.7	1.7	0.07	0.0005	0.0001	0.00001	7.7	1.7	0.07
I	Eagle's Nest	0.3	0.08	0.01	0.0004	0.0001	0.00001	0.3	0.08	0.01
I	Flat Tops	2.2	0.3	0.02	0.0007	0.0003	0.00003	2.2	0.3	0.02
II	Holy Cross	0.3	0.09	0.01	0.0003	0.0001	0.00001	0.3	0.09	0.01
II	Hunter-Frying	0.3	0.09	0.008	0.0002	0.00007	0.000008	0.3	0.09	0.008
I	La Garita	0.4	0.1	0.005	0.0001	0.00003	0.000002	0.4	0.1	0.005
I	Maroon Bells	0.8	0.3	0.02	0.0005	0.0002	0.00001	0.8	0.3	0.02
I	Mt. Zirkel	4.3	1.0	0.08	0.0002	0.00006	0.000008	4.3	1.0	0.08
II	Raggeds	0.8	0.2	0.02	0.0003	0.00009	0.000009	0.8	0.2	0.02
I	Rawah	0.3	0.09	0.01	0.00008	0.00004	0.000005	0.3	0.09	0.01
I	Weminuche	0.4	0.09	0.004	0.0002	0.00004	0.000002	0.4	0.09	0.004
I	West Elk	0.6	0.2	0.02	0.0003	0.0001	0.000006	0.6	0.2	0.02
		Inventory Only			**All BLM Sources**			**All BLM + Inventory Sources**		
Class	**Area**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**	**3-hour**	**24-hour**	**Annual**
I	Arches	0.6	0.3	0.008	0.0002	0.00008	0.000009	0.6	0.3	0.008
II	Browns Park	0.5	0.1	0.006	0.0002	0.0002	0.00002	0.5	0.1	0.006
I	Canyonlands	0.3	0.1	0.006	0.0003	0.00008	0.000006	0.3	0.1	0.006
I	Capitol Reef	0.1	0.08	0.002	0.0002	0.00005	0.000001	0.1	0.08	0.002
II	Dinosaur NM	0.8	0.2	0.01	0.002	0.0004	0.00009	0.8	0.2	0.01
II	Flaming Gorge	0.4	0.1	0.004	0.0003	0.0001	0.00002	0.4	0.1	0.004
II	High Uintas	0.2	0.05	0.003	0.0003	0.0002	0.000006	0.2	0.05	0.003
II	Ouray	0.5	0.1	0.01	0.002	0.0005	0.0002	0.5	0.1	0.01
II	USFS Request[b]	0.7	0.2	0.003	0.0001	0.00006	0.000002	0.7	0.2	0.003

[a] -Results reflect maximum concentration from all alternatives.

[b] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-34. PM10 INCREMENT COMPARISON FOR ALL SOURCES (CUMULATIVE)[A]

		Total Concentration ($\mu g/m^3$)					
		Inventory Only		All BLM Sources		All BLM + Inventory Sources	
Class	**Area**	**24-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
I	Black Canyon	0.4	0.03	0.6	0.02	1.0	0.04
II	Colorado NM	0.4	0.05	0.4	0.02	0.6	0.07
I	Eagle's Nest	0.4	0.03	0.2	0.03	0.4	0.05
I	Flat Tops	0.2	0.02	0.6	0.09	0.7	0.1
II	Holy Cross	0.1	0.02	0.3	0.03	0.4	0.05
II	Hunter-Frying	0.08	0.01	0.3	0.02	0.3	0.04
I	La Garita	0.1	0.005	0.1	0.006	0.2	0.01
I	Maroon Bells	0.1	0.02	0.4	0.05	0.5	0.06
I	Mt. Zirkel	0.5	0.04	0.1	0.02	0.5	0.06
II	Raggeds	0.1	0.01	0.3	0.03	0.4	0.04
I	Rawah	0.1	0.02	0.09	0.009	0.2	0.03
I	Weminuche	0.07	0.004	0.1	0.004	0.2	0.008
I	West Elk	0.2	0.01	0.3	0.02	0.5	0.03
		Inventory Only		**All BLM Sources**		**All BLM + Inventory Sources**	
Class	**Area**	**24-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
I	Arches	0.2	0.02	0.2	0.008	0.3	0.02
II	Browns Park	0.1	0.01	0.1	0.01	0.2	0.02
I	Canyonlands	0.1	0.01	0.2	0.005	0.3	0.02
I	Capitol Reef	0.06	0.002	0.09	0.002	0.2	0.004
II	Dinosaur NM	0.6	0.05	0.3	0.04	0.9	0.08
II	Flaming Gorge	0.1	0.007	0.1	0.01	0.2	0.02
II	High Uintas	0.1	0.004	0.2	0.007	0.2	0.01
II	Ouray	0.3	0.03	0.4	0.07	0.7	0.1
II	USFS Request[b]	0.05	0.002	0.07	0.001	0.1	0.003

[a] -Results reflect maximum concentration from all alternatives.

[b] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-35. NOX INCREMENT COMPARISON FOR ALL SOURCES (CUMULATIVE)[A]

		Total Concentration (μg/m³)		
Class	**Area**	**Inventory Only**	**All BLM Sources**	**All BLM + Inventory Sources**
I	Black Canyon	0.003	0.001	0.004
II	Colorado NM	0.04	0.003	0.04
I	Eagle's Nest	0.008	0.002	0.01
I	Flat Tops	0.001	0.007	0.002
II	Holy Cross	0.006	0.003	0.009
II	Hunter-Frying	0.003	0.002	0.004
I	La Garita	0.0004	0.0001	0.0004
I	Maroon Bells	0.005	0.003	0.007
I	Mt. Zirkel	0.2	0.001	0.2
II	Raggeds	0.003	0.002	0.005
I	Rawah	0.02	0.0006	0.02
I	Weminuche	0.0005	0.00006	0.0005
I	West Elk	0.002	0.0008	0.003
Class	**Area**	**Inventory Only**	**All BLM Sources**	**All BLM + Inventory Sources**
I	Arches	0.02	0.001	0.02
II	Browns Park	0.006	0.003	0.009
I	Canyonlands	0.02	0.0006	0.02
I	Capitol Reef	0.0004	0.00008	0.0005
II	Dinosaur NM	0.02	0.02	0.03
II	Flaming Gorge	0.004	0.002	0.006
II	High Uintas	0.01	0.0005	0.01
II	Ouray	0.06	0.03	0.1
II	USFS Request[b]	0.002	0.0003	0.002

[a] -Results reflect maximum concentration from all alternatives.

[b] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

5.3 HAZARDOUS AIR POLLUTANTS ANALYSIS

A dispersion modeling analysis was performed to evaluate the potential ambient concentrations of potential hazardous air pollutants (HAPs) in the area, including BTEX (benzene, toluene, ethylbenzene, and xylenes), hydrogen sulfide, and formaldehyde. Applicable Federal ambient air quality standards do not exist for these hazardous air pollutants; therefore, the modeled 24-hour and annual concentrations were compared with other acceptable ambient concentration levels (AACLs) from the States or other sources (EPA 1997 and Archer 2001b). Table 5-36 summarizes the acceptable HAPs ambient levels for comparisons.

TABLE 5-36. SUMMARY OF STATE HAZARDOUS AIR POLLUTANT AACLS

Benzene ($\mu g/m^3$)	Ethylbenzene ($\mu g/m^3$)	Formaldehyde ($\mu g/m^3$)	Hydrogen sulfide ($\mu g/m^3$)	Toluene ($\mu g/m^3$)	Xylenes ($\mu g/m^3$)	Agency
0.12 annual	1,000 24-hour	0.077 annual	0.9 24-hour	400 24-hour	1,500 24-hour	Washington Department of Ecology, WAC 176-460-150
53 24-hour	14,467 24-hour	-	467 24-hour	6,267 24-hour	14,467 24-hour	Utah DEQ Toxic Screening Level [b]
-	-	-	140 24-hour	-	-	North Dakota Department of Health, Division of Environmental Engineering, 33-15-02 or Air Toxics Policy
13-45 [c] annual	-	8 [c] annual	-	-	-	EPA IRIS Database 1/10000 Risk Level
-	1,000 24-hour	-	1 24-hour	400 24-hour	100 24-hour	EPA IRIS Database RfC [a]

[a] U.S. EPA's Integrated Risk Information System (IRIS) contains information on reference concentration for chronic inhalation exposure (RfC). (EPA 1997)

[b] The Toxic Screening Level (TSL) for Utah can be found in Utah Administrative Code R307-410-4

[c] The values shown here represents the air unit risk of 1 in 10,000 taken from EPA's IRIS database.

The Colorado Department of Health and Environmental Quality recommended using the data from EPA Urban Air Toxics Pilot Project as the background concentration for the HAP analysis. (Chick 2002) These concentrations were collected in the City of Grand Junction between May 2001 and April 2002. Recommended concentration estimates are summarized in Table 5-37 below.

TABLE 5-37. RECOMMENDED HAPS BACKGROUND CONCENTRATION

Agency	Benzene	Ethylbenzene	Formaldehyde	Toluene	Xylenes
Annual Mean (ppbv)	0.90	0.84	5.78	3.70	3.63 [a]
24-hour Maximum (ppbv)	2.72	10.68	14.00	33.26	43.66 [a]
Annual Mean ($\mu g/m^3$)	2.87	3.65	7.11	13.95	15.75
24-hour Maximum ($\mu g/m^3$)	8.68	46.35	17.22	125.39	189.48

[a] The xylenes concentration represents the sum of m-,p-, and o-xylene.

5.3.1 HAP ANALYSIS RESULTS BY ALTERNATIVE

Results for each development scenario are presented in Tables 5-38 through 5-42 below. The total 24-hour xylenes, and annual benzene and formaldehyde concentrations, exceeded one or more of the State AACLs. The maximum modeled xylenes concentration also exceeded the level from the EPA IRIS Database RfC (100 $\mu g/m^3$) for the 24-hour average. However, note that the background concentration for xylenes was greater than 100 $\mu g/m^3$ for the 24-hour average.

TABLE 5-38. HAP ANALYSIS RESULTS FOR ALT. V/ALT. B

Pollutant	Averaging Period	Total Concentration ($\mu g/m^3$)		
		Inventory Only	BLM Sources Only	All Sources
Glenwood Springs MA				
Benzene	24-hour	9.0	8.7	9.0
Benzene	Annual	**2.9**	**2.9**	**2.9**
Ethylbenzene	24-hour	46.4	46.4	46.4
Formaldehyde	Annual	**7.2**	**7.1**	**7.2**
H2S	24-hour	0.7	0.000000003	0.7
Toluene	24-hour	125	125	125
Xylenes	24-hour	**191**	**190**	**191**
Vernal MA				
Benzene	24-hour	9.4	9.4	9.4
Benzene	Annual	**3.1**	**2.9**	**3.1**
Ethylbenzene	24-hour	46.4	46.5	46.5
Formaldehyde	Annual	**7.3**	**7.2**	**7.3**
H2S	24-hour	0.1	0.000003	0.1
Toluene	24-hour	125	127	127
Xylenes	24-hour	**190**	**192**	**192**

TABLE 5-39. HAP ANALYSIS RESULTS FOR ALT. IV/ALT. A

Pollutant	Averaging Period	Total Concentration (μg/m³)		
		Inventory Only	BLM Sources Only	All Sources
Glenwood Springs MA				
Benzene	24-hour	9.0	8.7	9.0
Benzene	Annual	**2.9**	**2.9**	**2.9**
Ethylbenzene	24-hour	46.4	46.4	46.4
Formaldehyde	Annual	**7.2**	**7.1**	**7.2**
H2S	24-hour	0.7	0.000000003	0.7
Toluene	24-hour	125	125	125
Xylenes	24-hour	**191**	**190**	**191**
Vernal MA				
Benzene	24-hour	9.4	9.4	9.4
Benzene	Annual	**3.1**	**2.9**	**3.1**
Ethylbenzene	24-hour	46.4	46.5	46.5
Formaldehyde	Annual	**7.3**	**7.2**	**7.3**
H2S	24-hour	0.1	0.000003	0.1
Toluene	24-hour	125	127	127
Xylenes	24-hour	**190**	**192**	**192**

TABLE 5-40. HAP ANALYSIS RESULTS FOR GMA ALT. III (PREFERRED)

Pollutant	Averaging Period	Total Concentration (μg/m³)		
		Inventory Only	BLM Sources Only	All Sources
Glenwood Springs MA				
Benzene	24-hour	9.0	8.7	9.0
Benzene	Annual	**2.9**	**2.9**	**2.9**
Ethylbenzene	24-hour	46.4	46.4	46.4
Formaldehyde	Annual	**7.2**	**7.1**	**7.2**
H2S	24-hour	0.7	0.000000003	0.7
Toluene	24-hour	125	125	125
Xylenes	24-hour	**191**	**190**	**191**

TABLE 5-41. HAP ANALYSIS RESULTS FOR ALT. II/ALT. C

Pollutant	Averaging Period	Total Concentration (μg/m³)		
		Inventory Only	BLM Sources Only	All Sources
Glenwood Springs MA				
Benzene	24-hour	9.0	8.7	9.0
Benzene	Annual	**2.9**	**2.9**	**2.9**
Ethylbenzene	24-hour	46.4	46.4	46.4
Formaldehyde	Annual	**7.2**	**7.1**	**7.2**
H2S	24-hour	0.7	0.000000003	0.7
Toluene	24-hour	125	125	125
Xylenes	24-hour	**191**	**190**	**191**
Vernal MA				
Benzene	24-hour	9.4	8.8	9.4
Benzene	Annual	**3.1**	**2.9**	**3.1**
Ethylbenzene	24-hour	46.4	46.4	46.4
Formaldehyde	Annual	**7.3**	**7.2**	**7.3**
H2S	24-hour	0.1	0.0000005	0.1
Toluene	24-hour	125	126	126
Xylenes	24-hour	**190**	**190**	**190**

TABLE 5-42. HAP ANALYSIS RESULTS FOR ALT. I/ALT. A

Pollutant	Averaging Period	Total Concentration (μg/m³)		
		Inventory Only	BLM Sources Only	All Sources
Glenwood Springs MA				
Benzene	24-hour	9.0	8.7	9.0
Benzene	Annual	**2.9**	**2.9**	**2.9**
Ethylbenzene	24-hour	46.4	46.4	46.4
Formaldehyde	Annual	**7.2**	**7.1**	**7.2**
H2S	24-hour	0.7	0.000000003	0.7
Toluene	24-hour	125	125	125
Xylenes	24-hour	**191**	**190**	**191**
Vernal MA				
Benzene	24-hour	9.4	8.8	9.4
Benzene	Annual	**3.1**	**2.9**	**3.1**
Ethylbenzene	24-hour	46.4	46.4	46.4
Formaldehyde	Annual	**7.3**	**7.2**	**7.3**
H2S	24-hour	0.1	0.0000005	0.1
Toluene	24-hour	125	126	126
Xylenes	24-hour	**190**	**190**	**190**

Where predicted impacts of carcinogenic compounds (including background concentrations exceeded the States' AACLs (with background concentrations included), two incremental cancer risk assessments were performed: Most Likely Exposure (MLE) and Maximally Exposed Individual (MEI). The possible incremental cancer risks were evaluated over a 70-year lifetime for MLE to residents, and to MEIs, such as compressor station workers. These cancer risks were calculated based on the maximum predicted annual concentrations from BLM sources only (excluding background), EPA's unit risk factors for carcinogenic compounds (EPA 1997b), and an adjustment for time spent at home or on the job.

This analysis assumed residential exposure over 20 years (well over the national nine-year average duration a family lives at a residence) and worker exposure over 20 years, the full Life of Project (LOP). In addition, it assumed that family members were exposed to the maximum concentrations 64 percent of the day, and to one-quarter of this concentration for the remaining 36 percent of the day. The results of this analysis are presented in Table 5-43 below. It should also noted that the modeled concentrations used in these calculations do not include the background concentrations listed in Table 5-37 (Xylenes are not considered carcinogenic according to EPA's IRIS database [EPA 2003c]; see http://www.epa.gov/iris/subst/0270.htm for further information).

TABLE 5-43. INCREMENTAL RISK ASSESSMENT RESULTS BY ALTERNATIVE

Alter-native	Pollutant	Maximum Modeled Annual Concentration (BLM Sources Only; µg/m^3)	Unit Risk (UR) Factor (1/(µg/m^3))[a,b]	MEI/MLE Multiplier[c,d]	Final MEI Incremental Cancer Risk (BLM Sources Only)	Final MLE Incremental Cancer Risk (BLM Sources Only)
Glenwood Springs MA						
I	Benzene	0.0004	2.20E-06 – 7.80E-06	0.286/0.209	2.51E-10 – 8.91E-10	1.84E-10 – 6.51E-10
	Formaldehyde	0.034	1.30E-05	0.286/0.209	1.27E-07	9.30E-08
II	Benzene	0.0004	2.20E-06 – 7.80E-06	0.286/0.209	2.51E-10 – 8.91E-10	1.84E-10 – 6.51E-10
	Formaldehyde	0.034	1.30E-05	0.286/0.209	1.28E-07	9.33E-08
III	Benzene	0.0004	2.20E-06 – 7.80E-06	0.286/0.209	2.51E-10 – 8.91E-10	1.84E-10 – 6.51E-10
	Formaldehyde	0.037	1.30E-05	0.286/0.209	1.36E-07	9.95E-08
IV	Benzene	0.0004	2.20E-06 – 7.80E-06	0.286/0.209	2.51E-10 – 8.91E-10	1.84E-10 – 6.51E-10
	Formaldehyde	0.037	1.30E-05	0.286/0.209	1.36E-07	9.95E-08
V	Benzene	0.0004	2.20E-06 – 7.80E-06	0.286/0.209	2.51E-10 – 8.91E-10	1.84E-10 – 6.51E-10
	Formaldehyde	0.039	1.30E-05	0.286/0.209	1.46E-07	1.07E-07
Vernal MA						
I	Benzene	0.038	2.20E-06 – 7.80E-06	0.286/0.209	3.52E-09 – 1.25E-08	2.57E-09 – 9.11E-09
	Formaldehyde	0.056	1.30E-05	0.286/0.209	2.08E-07	1.52E-07
II	Benzene	0.038	2.20E-06 – 7.80E-06	0.286/0.209	3.52E-09 – 1.25E-08	2.57E-09 – 9.11E-09
	Formaldehyde	0.056	1.30E-05	0.286/0.209	2.06E-07	1.50E-07
III	Benzene	0.038	2.20E-06 – 7.80E-06	0.286/0.209	2.36E-08 – 8.36E-08	1.72E-08 – 6.10E-09
	Formaldehyde	0.056	1.30E-05	0.286/0.209	2.07E-07	1.51E-07
IV	Benzene	0.038	2.20E-06 – 7.80E-06	0.286/0.209	2.36E-08 – 8.38E-08	1.73E-08 – 6.12E-09
	Formaldehyde	0.056	1.30E-05	0.286/0.209	2.08E-07	1.52E-07

[a] Values from EPA IRIS Website (EPA, 2003c).

[b] The IRIS web site presents a range of values for benzene

[c] MEI multiplier = (20/70)

[d] MLE multiplier = (20/70)*((0.64*1.0)+(.36*.25))

5.3.2 HAP ANALYSIS RESULTS FOR ALL SOURCES (CUMULATIVE)

Results for the cumulative HAPs analysis are presented in Table 5-44 below. One or more of the State AACLs listed were exceeded for some pollutants (benzene, formaldehyde, xylenes). It should be noted that the background concentrations provided by the CDPHE were collected in an urban environment and are possibly overestimates of actual rural background concentrations. Also, without these elevated background concentrations, none of the modeled concentrations would exceed the State AACLs. The cumulative results below are the maximum from the alternatives modeled.

TABLE 5-44. HAP ANALYSIS RESULTS FOR ALL SOURCES (CUMULATIVE)[A]

Pollutant	Averaging Period	Total Concentration ($\mu g/m^3$)		
		Inventory Only	BLM Sources Only	All Sources
Glenwood Springs MA				
Benzene	24-hour	9.0	8.7	9.0
Benzene	Annual	**2.9**	**2.9**	**2.9**
Ethylbenzene	24-hour	46.4	46.4	46.4
Formaldehyde	Annual	**7.2**	**7.1**	**7.2**
H2S	24-hour	0.7	0.000000003	0.7
Toluene	24-hour	125	125	125
Xylenes	24-hour	**191**	**190**	**191**
Vernal MA				
Benzene	24-hour	9.4	9.4	9.4
Benzene	Annual	**3.1**	**2.9**	**3.1**
Ethylbenzene	24-hour	46.4	46.5	46.5
Formaldehyde	Annual	**7.3**	**7.2**	**7.3**
H2S	24-hour	0.1	0.000003	0.1
Toluene	24-hour	125	127	127
Xylenes	24-hour	**190**	**192**	**192**

[a] -Results reflect maximum concentration from all alternatives.

5.3.3 HAP CUMULATIVE INCREMENTAL RISK ANALYSIS RESULTS

Where predicted impacts of carcinogenic compounds exceeded the States' AACLs (with background concentrations included), both MLE and MEI incremental cancer risk assessments were performed. The possible incremental cancer-risk over a 70-year lifetime for MLE to residents, and to MEIs such as compressor station workers, was evaluated. These cancer risks were calculated based on the maximum predicted annual concentrations from BLM sources only, EPA's unit risk factors for carcinogenic compounds (EPA 1997b), and an adjustment for time spent at home or on the job. This analysis assumed residential exposure over 20 years (well over the national nine-year average duration a family lives at a residence) and worker exposure over 20 years (the full LOP). In addition, it assumed that family members were exposed to the maximum concentrations 64 percent of the day, and to one-quarter of this

concentration for the remaining 36 percent of the day. The results of this analysis are presented in Table 5-45 below. It should also be noted that these are the highest concentrations from all of the alternatives for BLM sources only (Xylenes are not considered carcinogenic according to EPA's IRIS database [EPA 2003c]; see http://www.epa.gov/iris/subst/0270.htm for further information).

TABLE 5-45. INCREMENTAL CUMULATIVE RISK ASSESSMENT RESULTS

Pollutant	Maximum Modeled Annual Concentration ($\mu g/m^3$)	Unit Risk (UR) Factor ($1/(\mu g/m^3)$)[a,b]	MEI/MLE Multiplier[c,d]	Final MEI Incremental Cancer Risk	Final MLE Incremental Cancer Risk
Glenwood Springs MA					
Benzene	2.9324	2.20E-06 – 7.80E-06	0.286/0.209	1.84E-06 - 6.54E-06	1.35E-06 – 4.77E-06
Formaldehyde	7.1837	1.30E-05	0.286/0.209	2.67E-05	1.95E-05
Vernal MA					
Benzene	3.1139	2.20E-06 – 7.80E-06	0.286/0.209	1.96E-06 - 6.94E-06	1.43E-06 – 5.07E-06
Formaldehyde	7.2735	1.30E-05	0.286/0.209	2.70E-05	1.97E-05

[a] Values from EPA IRIS Website (EPA, 2003c).

[b] The IRIS web site presents a range of values for benzene

[c] MEI multiplier = (20/70)

[d] MLE multiplier = (20/70)*((0.64*1.0)+(.36*.25))

5.4 AIR QUALITY RELATED VALUES

Federal Class I areas, which include certain National Wilderness Areas, National Memorial Parks, and National Parks, are afforded the highest level of protection in the Clean Air Act. Ambient air (PSD) increments that apply within Class I areas are more stringent than those applied to other areas (i.e., Class II areas). In addition to more stringent ambient air increments, Class I areas are also protected by the regulation of air quality related values (AQRVs) within their borders. Federal Land Managers (FLMs), those individuals responsible for the management of Class I areas, defined an AQRV as:

> *"…a resource, as identified by the FLM for one or more Federal areas, that may be adversely affected by a change in air quality. The resource may include visibility or a specific scenic, cultural, physical, biological, ecological, or recreational resource identified by the FLM for a particular area."*[10]

Typically, three quantifiable impacts are used by FLMs to assess AQRVs: visibility, the deposition of acidic species (e.g., nitrogen and sulfur), and changes to the acid neutralizing capacity of selected lakes.

5.4.1 TOTAL SULFUR AND NITROGEN DEPOSITION CRITERIA

As described in Section 3.9 (Dry and Wet Deposition Analysis) above, potential total (wet + dry) sulfur and nitrogen deposition were calculated. These values were compared to the USDA-Forest Service (Fox *et al* 1989) threshold values of 3 kilograms per hectare per year (kg/ha/yr) for total sulfur and 5 kg/ha/yr for total nitrogen. Results of the deposition analysis are presented in Tables 5-46 to 5-55 below.

5.4.2 VISIBILITY CRITERIA

As described in Section 3.10 (Visibility Analysis) above, potential 24-hour primary PM_{10}, and secondary sulfate and nitrate particulate matter concentrations were calculated within mandatory Federal Class I areas and at specific Class II areas of concern.

The Class II areas included in this analysis were included at the request of some of the members of the stakeholder group (National Park Service, US Forest Service, etc.). These Class II areas have no visibility protection under local, State, or Federal laws. These areas are included in the analysis strictly to meet the disclosure requirements under NEPA and to provide decision-makers with sufficient information.

This value was first compared to "natural" background conditions as recommended in the FLAG (2000) Guideline document. Since the analysis was conducted for multiple emission sources simultaneously, the FLAG 10-percent change in extinction (1.0 deciview) "just noticeable change" threshold was used to assess the significance of potential impacts. Results of the screening visibility analysis are presented in Tables 5-56 to 5-60 below. If the seasonal screening analysis indicated that predicted changes in visibility exceeded the 1.0 deciview LAC,

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[10] U.S. Forest Service – Air Quality Program, National Park Service – Air Resources Division, U.S. Fish and Wildlife Service – Air Quality Branch, *Phase I Report of the Federal Land Managers' Air Quality Related Values Workgroup (FLAG)*, December 2000.

a daily refined analysis was conducted based on hourly IMPROVE (2002) optical monitoring data measured at Canyonlands National Park for 1987 through 2001. The daily optical values were calculated based upon at least six hours of valid data (data code = 0) each day.[11] (Archer 2002b) Also, the maximum relative humidity was limited to no more than 90 percent. Aerosol growth was limited at 90 percent relative humidity because direct optical monitoring devices were not reliable at humidity values above this level, and measurements above 90 percent were not reported as "valid" by the IMPROVE data contractor. Air Resource Specialists, Inc. (2002) states that these data were not labeled as valid because "small random temperature or absolute humidity fluctuations along the path could lead to condensation of water vapor causing meteorological interferences. Thus, in accordance with the conservative philosophy expressed above, the 90-percent relative humidity limit was selected for this test."[12] Therefore, the maximum relative humidity was limited to 90 percent for optical data comparison.

5.4.3 ACID NEUTRALIZATION CAPACITY

Where background lake chemistry data were available, an analysis of potential changes to Acid Neutralizing Capacity (ANC) was performed using the procedure recommended by the USDA - Forest Service (2000). These values were first compared to a 10-percent change in ANC for lakes with background ANC values equal to or greater than 25 microequivalents per liter (μeq/l). For lakes with background ANC values less than 25 μeq/l, the threshold was no more than one μeq/l total change in ANC. Results of the ANC analysis are presented in Tables 5-61 and 5-62 below.

5.4.4 AQRV ANALYSIS RESULTS BY ALTERNATIVE

Total sulfur and nitrogen deposition results were below the thresholds for all development scenarios. Visibility results for BLM sources only showed no impacts > 1.0 deciview for any sensitive area. Some sensitive areas exceeded the 1.0 deciview threshold for inventory sources only and inventory plus BLM sources. Time series plots showing the percent change in extinction for each Class I area (maximum predicted development scenario) for the modeled year are provided in Appendix E.

The ANC thresholds were not exceeded for any of the lakes considered in the analysis for BLM (Vernal or Glenwood Springs) sources only.

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[11] Scott Archer of National Science and Technology Center recommends an analysis based on at least 6 hours of valid data.

[12] The refined visibility analysis methodology was chosen by National Science and Technology Center of BLM, based on the IMPROVE program monitoring data processed by Air Resources Specialist, Inc., and analysis procedures recommended in the Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Final Phase I Report.

TABLE 5-46. SULFUR DEPOSITION RESULTS FOR ALT. V/ALT. B

		Sulfur Deposition (kg/ha/year)		
Class	**Area**	**Inventory Only**	**GMA BLM Sources Only**	**GMA + Inventory Sources**
Glenwood Springs MA				
I	Black Canyon	0.01	0.000002	0.01
II	Colorado NM	0.03	0.000003	0.03
I	Eagle's Nest	0.009	0.000005	0.009
I	Flat Tops	0.01	0.000020	0.01
II	Holy Cross	0.007	0.000006	0.007
II	Hunter-Frying	0.007	0.000005	0.07
I	La Garita	0.004	0.000001	0.004
I	Maroon Bells	0.01	0.000006	0.01
I	Mt. Zirkel	0.04	0.000004	0.004
II	Raggeds	0.01	0.000004	0.01
I	Rawah	0.01	0.000004	0.01
I	Weminuche	0.003	0.0000008	0.003
I	West Elk	0.009	0.000003	0.009
Class	**Area**	**Inventory Only**	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Vernal MA				
I	Arches	0.003	0.000002	0.003
II	Browns Park	0.005	0.000001	0.005
I	Canyonlands	0.003	0.000002	0.003
I	Capitol Reef	0.0006	0.0000003	0.0006
II	Dinosaur NM	0.01	0.00003	0.01
II	Flaming Gorge	0.003	0.000008	0.003
II	High Uintas	0.003	0.000003	0.003
II	Ouray	0.005	0.00004	0.005
II	USFS Request[a]	0.002	0.0000008	0.002

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-47. SULFUR DEPOSITION RESULTS FOR ALT. IV/ ALT. A

		Sulfur Deposition (kg/ha/year)		
Class	**Area**	**Inventory Only**	**GMA BLM Sources Only**	**GMA + Inventory Sources**
Glenwood Springs MA				
I	Black Canyon	0.01	0.000002	0.01
II	Colorado NM	0.03	0.000003	0.03
I	Eagle's Nest	0.009	0.000005	0.009
I	Flat Tops	0.01	0.00002	0.01
II	Holy Cross	0.007	0.000005	0.007
II	Hunter-Frying	0.007	0.000004	0.07
I	La Garita	0.004	0.000001	0.004
I	Maroon Bells	0.01	0.000005	0.01
I	Mt. Zirkel	0.04	0.000004	0.004
II	Raggeds	0.01	0.000003	0.01
I	Rawah	0.01	0.000003	0.01
I	Weminuche	0.003	0.0000008	0.003
I	West Elk	0.009	0.000002	0.009
Class	**Area**	**Inventory Only**	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Vernal MA				
I	Arches	0.003	0.000002	0.003
II	Browns Park	0.005	0.000001	0.005
I	Canyonlands	0.003	0.000002	0.003
I	Capitol Reef	0.0006	0.0000003	0.0006
II	Dinosaur NM	0.01	0.00003	0.01
II	Flaming Gorge	0.003	0.000008	0.003
II	High Uintas	0.003	0.000003	0.003
II	Ouray	0.005	0.00004	0.005
II	USFS Request[a]	0.002	0.0000008	0.002

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-48. SULFUR DEPOSITION RESULTS FOR GMA ALT. III (PREFERRED)

		Sulfur Deposition (kg/ha/year)		
Class	**Area**	**Inventory Only**	**GMA BLM Sources Only**	**GMA + Inventory Sources**
Glenwood Springs MA				
I	Black Canyon	0.01	0.000002	0.01
II	Colorado NM	0.03	0.000003	0.03
I	Eagle's Nest	0.009	0.000005	0.009
I	Flat Tops	0.01	0.00002	0.01
II	Holy Cross	0.007	0.000005	0.007
II	Hunter-Frying	0.007	0.000004	0.07
I	La Garita	0.004	0.000001	0.004
I	Maroon Bells	0.01	0.000005	0.01
I	Mt. Zirkel	0.04	0.000004	0.004
II	Raggeds	0.01	0.000003	0.01
I	Rawah	0.01	0.000003	0.01
I	Weminuche	0.003	0.0000008	0.003
I	West Elk	0.009	0.000002	0.009

TABLE 5-49. SULFUR DEPOSITION RESULTS FOR ALT. II/ALT. C

		Sulfur Deposition (kg/ha/year)		
Class	**Area**	**Inventory Only**	**GMA BLM Sources Only**	**GMA + Inventory Sources**
Glenwood Springs MA				
I	Black Canyon	0.01	0.000002	0.01
II	Colorado NM	0.03	0.000002	0.03
I	Eagle's Nest	0.009	0.000004	0.009
I	Flat Tops	0.01	0.00001	0.01
II	Holy Cross	0.007	0.000004	0.007
II	Hunter-Frying	0.007	0.000004	0.07
I	La Garita	0.004	0.0000009	0.004
I	Maroon Bells	0.01	0.000004	0.01
I	Mt. Zirkel	0.04	0.000003	0.004
II	Raggeds	0.01	0.000003	0.01
I	Rawah	0.01	0.000003	0.01
I	Weminuche	0.003	0.0000007	0.003
I	West Elk	0.009	0.000002	0.009
Class	**Area**	**Inventory Only**	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Vernal MA				
I	Arches	0.003	0.000002	0.003
II	Browns Park	0.005	0.000001	0.005
I	Canyonlands	0.003	0.000001	0.003
I	Capitol Reef	0.0006	0.0000003	0.0006
II	Dinosaur NM	0.01	0.00003	0.01
II	Flaming Gorge	0.003	0.000008	0.003
II	High Uintas	0.003	0.000003	0.003
II	Ouray	0.005	0.00004	0.005
II	USFS Request[a]	0.002	0.0000007	0.002

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-50. SULFUR DEPOSITION RESULTS FOR ALT. I/ALT. D

		Sulfur Deposition (kg/ha/year)		
Class	**Area**	**Inventory Only**	**GMA BLM Sources Only**	**GMA + Inventory Sources**
Glenwood Springs MA				
I	Black Canyon	0.01	0.000002	0.01
II	Colorado NM	0.03	0.000002	0.03
I	Eagle's Nest	0.009	0.000004	0.009
I	Flat Tops	0.01	0.00001	0.01
II	Holy Cross	0.007	0.000004	0.007
II	Hunter-Frying	0.007	0.000004	0.07
I	La Garita	0.004	0.0000009	0.004
I	Maroon Bells	0.01	0.000004	0.01
I	Mt. Zirkel	0.04	0.000003	0.004
II	Raggeds	0.01	0.000003	0.01
I	Rawah	0.01	0.000003	0.01
I	Weminuche	0.003	0.0000007	0.003
I	West Elk	0.009	0.000002	0.009
Class	**Area**	**Inventory Only**	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Vernal MA				
I	Arches	0.003	0.000002	0.003
II	Browns Park	0.005	0.000001	0.005
I	Canyonlands	0.003	0.000002	0.003
I	Capitol Reef	0.0006	0.0000003	0.0006
II	Dinosaur NM	0.01	0.00003	0.01
II	Flaming Gorge	0.003	0.000008	0.003
II	High Uintas	0.003	0.000003	0.003
II	Ouray	0.005	0.00004	0.005
II	USFS Request[a]	0.002	0.0000008	0.002

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-51. NITROGEN DEPOSITION RESULTS FOR ALT. V/ ALT. B

		Nitrogen Deposition (kg/ha/year)		
Class	**Area**	**Inventory Only**	**GMA BLM Sources Only**	**GMA + Inventory Sources**
Glenwood Springs MA				
I	Black Canyon	0.003	0.0006	0.003
II	Colorado NM	0.008	0.0007	0.009
I	Eagle's Nest	0.007	0.001	0.008
I	Flat Tops	0.008	0.005	0.01
II	Holy Cross	0.004	0.001	0.006
II	Hunter-Frying	0.003	0.001	0.005
I	La Garita	0.002	0.0003	0.002
I	Maroon Bells	0.004	0.001	0.005
I	Mt. Zirkel	0.06	0.001	0.06
II	Raggeds	0.003	0.0007	0.004
I	Rawah	0.01	0.0009	0.01
I	Weminuche	0.001	0.0002	0.002
I	West Elk	0.002	0.0005	0.003
Class	**Area**	**Inventory Only**	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Vernal MA				
I	Arches	0.004	0.0003	0.004
II	Browns Park	0.004	0.002	0.005
I	Canyonlands	0.003	0.002	0.004
I	Capitol Reef	0.0002	0.00003	0.0003
II	Dinosaur NM	0.009	0.005	0.01
II	Flaming Gorge	0.003	0.001	0.004
II	High Uintas	0.004	0.0004	0.004
II	Ouray	0.01	0.006	0.02
II	USFS Request[a]	0.001	0.0001	0.001

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-52. NITROGEN DEPOSITION RESULTS FOR ALT. IV/ALT. A

		Sulfur Deposition (kg/ha/year)		
Class	**Area**	**Inventory Only**	**GMA BLM Sources Only**	**GMA + Inventory Sources**
I	Black Canyon	0.003	0.0006	0.003
II	Colorado NM	0.008	0.0007	0.008
I	Eagle's Nest	0.007	0.001	0.008
I	Flat Tops	0.008	0.005	0.01
II	Holy Cross	0.004	0.001	0.006
II	Hunter-Frying	0.003	0.001	0.005
I	La Garita	0.002	0.0003	0.002
I	Maroon Bells	0.004	0.001	0.005
I	Mt. Zirkel	0.06	0.001	0.06
II	Raggeds	0.003	0.0007	0.004
I	Rawah	0.01	0.0009	0.01
I	Weminuche	0.001	0.0002	0.002
I	West Elk	0.002	0.0005	0.003
Class	**Area**	**Inventory Only**	**VMA BLM Sources Only**	**VMA + Inventory Sources**
I	Arches	0.004	0.0003	0.004
II	Browns Park	0.004	0.002	0.005
I	Canyonlands	0.003	0.002	0.004
I	Capitol Reef	0.0002	0.00003	0.0003
II	Dinosaur NM	0.009	0.005	0.01
II	Flaming Gorge	0.003	0.001	0.004
II	High Uintas	0.004	0.0004	0.004
II	Ouray	0.01	0.006	0.02
II	USFS Request[a]	0.001	0.0001	0.001

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-53. NITROGEN DEPOSITION RESULTS FOR GMS ALT. III (PREFERRED)

		Nitrogen Deposition (kg/ha/year)		
Class	**Area**	**Inventory Only**	**GMA BLM Sources Only**	**GMA + Inventory Sources**
Glenwood Springs MA				
I	Black Canyon	0.003	0.0006	0.003
II	Colorado NM	0.008	0.0007	0.008
I	Eagle's Nest	0.007	0.001	0.008
I	Flat Tops	0.008	0.005	0.01
II	Holy Cross	0.004	0.001	0.006
II	Hunter-Frying	0.003	0.001	0.005
I	La Garita	0.002	0.0003	0.002
I	Maroon Bells	0.004	0.001	0.005
I	Mt. Zirkel	0.06	0.001	0.06
II	Raggeds	0.003	0.0007	0.004
I	Rawah	0.01	0.0009	0.01
I	Weminuche	0.001	0.0002	0.002
I	West Elk	0.002	0.0005	0.003

TABLE 5-54. NITROGEN DEPOSITION RESULTS FOR ALT. II/ALT. C

		Nitrogen Deposition (kg/ha/year)		
Class	**Area**	**Inventory Only**	**GMA BLM Sources Only**	**GMA + Inventory Sources**
Glenwood Springs MA				
I	Black Canyon	0.003	0.0004	0.003
II	Colorado NM	0.008	0.0006	0.008
I	Eagle's Nest	0.007	0.001	0.008
I	Flat Tops	0.008	0.003	0.01
II	Holy Cross	0.004	0.001	0.006
II	Hunter-Frying	0.003	0.001	0.004
I	La Garita	0.002	0.0003	0.002
I	Maroon Bells	0.004	0.001	0.005
I	Mt. Zirkel	0.06	0.0009	0.06
II	Raggeds	0.003	0.0006	0.004
I	Rawah	0.01	0.0007	0.01
I	Weminuche	0.001	0.0002	0.002
I	West Elk	0.002	0.0004	0.003
Class	**Area**	**Inventory Only**	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Vernal MA				
I	Arches	0.004	0.0003	0.004
II	Browns Park	0.004	0.001	0.005
I	Canyonlands	0.003	0.002	0.004
I	Capitol Reef	0.0002	0.00003	0.0003
II	Dinosaur NM	0.009	0.004	0.01
II	Flaming Gorge	0.003	0.001	0.004
II	High Uintas	0.004	0.0004	0.004
II	Ouray	0.01	0.006	0.02
II	USFS Request[a]	0.001	0.0001	0.001

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-55. NITROGEN DEPOSITION RESULTS FOR ALT. I/ALT. D

		Nitrogen Deposition (kg/ha/year)		
Class	**Area**	**Inventory Only**	**GMA BLM Sources Only**	**GMA + Inventory Sources**
Glenwood Springs MA				
I	Black Canyon	0.003	0.0004	0.003
II	Colorado NM	0.008	0.0005	0.008
I	Eagle's Nest	0.007	0.001	0.008
I	Flat Tops	0.008	0.003	0.01
II	Holy Cross	0.004	0.001	0.006
II	Hunter-Frying	0.003	0.001	0.004
I	La Garita	0.002	0.0002	0.002
I	Maroon Bells	0.004	0.0009	0.005
I	Mt. Zirkel	0.06	0.0008	0.06
II	Raggeds	0.003	0.0006	0.004
I	Rawah	0.01	0.0007	0.01
I	Weminuche	0.001	0.0002	0.002
I	West Elk	0.002	0.0004	0.003
Class	**Area**	**Inventory Only**	**VMA BLM Sources Only**	**VMA + Inventory Sources**
Vernal MA				
I	Arches	0.004	0.0003	0.004
II	Browns Park	0.004	0.002	0.006
I	Canyonlands	0.003	0.002	0.004
I	Capitol Reef	0.0002	0.00004	0.0003
II	Dinosaur NM	0.009	0.005	0.01
II	Flaming Gorge	0.003	0.001	0.004
II	High Uintas	0.004	0.0004	0.004
II	Ouray	0.01	0.007	0.02
II	USFS Request[a]	0.001	0.0001	0.001

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-56. SCREENING VISIBILITY MODELING RESULTS FOR ALT. V/ALT. B

		Inventory Only			GMA BLM Sources Only			GMA + Inventory Sources		
Class	**Area**	**Maximum Impact (%)**	**Days >10%**	**Days >5%**	**Maximum Impact (%)**	**Days >10%**	**Days >5%**	**Maximum Impact (%)**	**Days >10%**	**Days >5%**
Glenwood Springs MA										
I	Black Canyon	**22.06**	**1**	3	7.04	0	2	**29.09**	**2**	3
II	Colorado NM	**21.04**	**2**	7	6.36	0	1	**24.19**	**3**	10
I	Eagle's Nest	5.81	0	1	1.78	0	0	6.08	0	1
I	Flat Tops	**11.57**	**1**	3	5.00	0	1	**11.58**	**1**	14
II	Holy Cross	4.58	0	0	2.73	0	0	5.04	0	1
II	Hunter-Frying	2.71	0	0	1.90	0	0	4.13	0	0
I	La Garita	2.89	0	0	0.85	0	0	3.73	0	0
I	Maroon Bells	4.74	0	0	3.35	0	0	7.38	0	7
I	Mt. Zirkel	**13.51**	**1**	9	0.95	0	0	**13.51**	**1**	11
II	Raggeds	5.58	0	1	3.02	0	0	8.56	0	3
I	Rawah	4.60	0	0	1.14	0	0	5.38	0	1
I	Weminuche	3.90	0	0	0.83	0	0	4.72	0	0
I	West Elk	9.76	0	1	4.40	0	0	**14.14**	**1**	2
Class	**Area**	**Inventory Only**			**VMA BLM Sources Only**			**VMA + Inventory Sources**		
Vernal MA										
I	Arches	**10.48**	**1**	1	1.04	0	0	**10.70**	**1**	1
II	Browns Park	3.54	0	0	1.31	0	0	3.57	0	0
I	Canyonlands	7.54	0	4	1.08	0	0	7.54	0	4
I	Capitol Reef	1.84	0	0	0.38	0	0	1.98	0	0
II	Dinosaur NM	**10.61**	**2**	8	2.37	0	0	**11.71**	**2**	8
II	Flaming Gorge	4.68	0	0	0.78	0	0	4.71	0	0
II	High Uintas	4.47	0	0	0.79	0	0	5.09	0	1
II	Ouray	9.28	0	6	3.81	0	0	**12.75**	**3**	19
II	USFS Request[a]	2.79	0	0	0.70	0	0	3.18	0	0

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-57. SCREENING VISIBILITY MODELING RESULTS FOR ALT. IV/ALT. A

Class	Area	Inventory Only			GMA BLM Sources Only			GMA + Inventory Sources		
		Maximum Impact (%)	Days >10%	Days >5%	Maximum Impact (%)	Days >10%	Days >5%	Maximum Impact (%)	Days >10%	Days >5%
Glenwood Springs MA										
I	Black Canyon	**22.06**	**1**	3	6.49	0	2	**28.54**	**2**	3
II	Colorado NM	**21.04**	**2**	7	5.74	0	1	**23.89**	**3**	10
I	Eagle's Nest	5.81	0	1	1.63	0	0	6.06	0	1
I	Flat Tops	**11.57**	**1**	3	4.48	0	0	**11.58**	**1**	12
II	Holy Cross	4.58	0	0	2.51	0	0	4.82	0	0
II	Hunter-Frying	2.71	0	0	1.73	0	0	3.99	0	0
I	La Garita	2.89	0	0	0.78	0	0	3.65	0	0
I	Maroon Bells	4.74	0	0	3.09	0	0	7.16	0	6
I	Mt. Zirkel	**13.51**	**1**	9	0.88	0	0	**13.51**	**1**	11
II	Raggeds	5.58	0	1	2.81	0	0	8.35	0	1
I	Rawah	4.60	0	0	1.05	0	0	5.20	0	1
I	Weminuche	3.90	0	0	0.76	0	0	4.65	0	0
I	West Elk	9.76	0	1	4.06	0	0	**13.80**	**1**	2
Class	**Area**	**Inventory Only**			**VMA BLM Sources Only**			**VMA + Inventory Sources**		
Vernal MA										
I	Arches	**10.48**	**1**	1	1.03	0	0	**10.69**	**1**	1
II	Browns Park	3.54	0	0	1.24	0	0	3.57	0	0
I	Canyonlands	7.54	0	4	1.07	0	0	7.54	0	4
I	Capitol Reef	1.84	0	0	0.38	0	0	1.98	0	0
II	Dinosaur NM	**10.61**	**2**	8	2.27	0	0	**11.68**	**2**	8
II	Flaming Gorge	4.68	0	0	0.75	0	0	4.71	0	0
II	High Uintas	4.47	0	0	0.76	0	0	5.02	0	1
II	Ouray	9.28	0	6	3.74	0	0	**12.71**	**3**	19
II	USFS Request[a]	2.79	0	0	0.68	0	0	3.16	0	0

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-58. SCREENING VISIBILITY MODELING RESULTS FOR GMA ALT. III (PREFERRED)

Class	Area	Inventory Only			GMA BLM Sources Only			GMA + Inventory Sources		
		Maximum Impact (%)	Days >10%	Days >5%	Maximum Impact (%)	Days >10%	Days >5%	Maximum Impact (%)	Days >10%	Days >5%
Glenwood Springs MA										
I	Black Canyon	**22.06**	**1**	3	6.49	0	2	**28.54**	**2**	3
II	Colorado NM	**21.04**	**2**	7	5.74	0	1	**23.89**	**3**	10
I	Eagle's Nest	5.81	0	1	1.63	0	0	6.06	0	1
I	Flat Tops	**11.57**	**1**	3	4.48	0	0	**11.58**	**1**	12
II	Holy Cross	4.58	0	0	2.51	0	0	4.82	0	0
II	Hunter-Frying	2.71	0	0	1.73	0	0	3.99	0	0
I	La Garita	2.89	0	0	0.78	0	0	3.65	0	0
I	Maroon Bells	4.74	0	0	3.09	0	0	7.16	0	6
I	Mt. Zirkel	**13.51**	**1**	9	0.88	0	0	**13.51**	**1**	11
II	Raggeds	5.58	0	1	2.81	0	0	8.35	0	1
I	Rawah	4.60	0	0	1.05	0	0	5.20	0	1
I	Weminuche	3.90	0	0	0.76	0	0	4.65	0	0
I	West Elk	9.76	0	1	4.06	0	0	**13.80**	**1**	2

TABLE 5-59. SCREENING VISIBILITY MODELING RESULTS FOR ALT. II/ALT. C

Class	Area	Inventory Only			GMA BLM Sources Only			GMA + Inventory Sources		
		Maximum Impact (%)	Days >10%	Days >5%	Maximum Impact (%)	Days >10%	Days >5%	Maximum Impact (%)	Days >10%	Days >5%
Glenwood Springs MA										
I	Black Canyon	**22.06**	**1**	3	5.56	0	2	**27.60**	**2**	3
II	Colorado NM	**21.04**	**2**	7	4.83	0	0	**23.40**	**3**	10
I	Eagle's Nest	5.81	0	1	1.38	0	0	6.03	0	1
I	Flat Tops	**11.57**	**1**	3	3.71	0	0	**11.58**	**1**	11
II	Holy Cross	4.58	0	0	2.12	0	0	4.69	0	0
II	Hunter-Frying	2.71	0	0	1.45	0	0	3.72	0	0
I	La Garita	2.89	0	0	0.64	0	0	3.52	0	0
I	Maroon Bells	4.74	0	0	2.62	0	0	6.81	0	6
I	Mt. Zirkel	**13.51**	**1**	9	0.74	0	0	**13.51**	**1**	11
II	Raggeds	5.58	0	1	2.45	0	0	7.99	0	1
I	Rawah	4.60	0	0	0.89	0	0	5.20	0	1
I	Weminuche	3.90	0	0	0.63	0	0	4.52	0	0
I	West Elk	9.76	0	1	3.49	0	0	**13.24**	**1**	2
Class	**Area**	**Inventory Only**			**VMA BLM Sources Only**			**VMA + Inventory Sources**		
Vernal MA										
I	Arches	**10.48**	**1**	1	0.99	0	0	**10.69**	**1**	1
II	Browns Park	3.54	0	0	1.17	0	0	3.56	0	0
I	Canyonlands	7.54	0	4	1.04	0	0	7.54	0	4
I	Capitol Reef	1.84	0	0	0.37	0	0	1.98	0	0
II	Dinosaur NM	**10.61**	**2**	8	2.18	0	0	**11.65**	**2**	8
II	Flaming Gorge	4.68	0	0	0.73	0	0	4.70	0	0
II	High Uintas	4.47	0	0	0.73	0	0	4.99	0	0
II	Ouray	9.28	0	6	3.64	0	0	**12.62**	**2**	18
II	USFS Request[a]	2.79	0	0	0.64	0	0	3.13	0	0

[a] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-60. SCREENING VISIBILITY MODELING RESULTS FOR ALT. I/ALT. D

Class	Area	Inventory Only			GMA BLM Sources Only			GMA + Inventory Sources		
		Maximum Impact (%)	Days >10%	Days >5%	Maximum Impact (%)	Days >10%	Days >5%	Maximum Impact (%)	Days >10%	Days >5%
Glenwood Springs MA										
I	Black Canyon	**22.06**	**1**	3	5.13	0	2	**27.19**	**2**	3
II	Colorado NM	**21.04**	**2**	7	4.47	0	0	**23.21**	**3**	9
I	Eagle's Nest	5.81	0	1	1.26	0	0	6.02	0	1
I	Flat Tops	**11.57**	**1**	3	3.38	0	0	**11.58**	**1**	9
II	Holy Cross	4.58	0	0	1.85	0	0	4.69	0	0
II	Hunter-Frying	2.71	0	0	1.34	0	0	3.62	0	0
I	La Garita	2.89	0	0	0.56	0	0	3.45	0	0
I	Maroon Bells	4.74	0	0	2.39	0	0	6.59	0	5
I	Mt. Zirkel	**13.51**	**1**	9	0.72	0	0	**13.51**	**1**	10
II	Raggeds	5.58	0	1	2.21	0	0	7.75	0	1
I	Rawah	4.60	0	0	0.86	0	0	5.19	0	1
I	Weminuche	3.90	0	0	0.56	0	0	4.45	0	0
I	West Elk	9.76	0	1	3.23	0	0	**12.98**	**1**	2
Class	**Area**	**Inventory Only**			**VMA BLM Sources Only**			**VMA + Inventory Sources**		
Vernal MA										
I	Arches	**10.48**	**1**	1	1.15	0	0	**10.72**	**1**	1
II	Browns Park	3.54	0	0	1.33	0	0	3.57	0	0
I	Canyonlands	7.54	0	4	1.19	0	0	7.54	0	4
I	Capitol Reef	1.84	0	0	0.42	0	0	2.00	0	0
II	Dinosaur NM	**10.61**	**2**	8	2.50	0	0	**12.25**	**2**	8
II	Flaming Gorge	4.68	0	0	0.80	0	0	4.71	0	0
II	High Uintas	4.47	0	0	0.79	0	0	5.02	0	1
II	Ouray	9.28	0	6	4.64	0	0	**13.48**	**2**	20
II	USFS Request[a]	2.79	0	0	0.70	0	0	3.19	0	0

Because the visibility impacts for BLM sources for all development scenarios was below 10% (1.0 deciview) for all Class I areas, no refined visibility analysis was conducted.

TABLE 5-61. ACID NEUTRALIZATION CAPACITY FOR SELECTED LAKES – GMA SOURCES ONLY

Wilderness Area	Maroon Bells WA		Flat Tops WA			Mt. Zirkel WA	
Lake	Moon Lake	Avalanche	Ned Wilson Lake	Upper Ned Wilson Lake	Trappers Lake	Summit Lake	Seven Lakes
Ds (kg/ha/yr) [b]	3.78E-06	3.14E-06	1.07E-05	1.07E-05	1.02E-05	4.29E-06	3.38E-06
Dn (kg/ha/yr) [b]	7.80E-04	6.27E-04	2.46E-03	2.46E-03	2.32E-03	1.08E-03	9.12E-04
Hs ($eq^2/m^2/yr$)	2.36E-08	1.96E-08	6.68E-08	6.67E-08	6.37E-08	2.68E-08	2.11E-08
Hn ($eq^2/m^2/yr$)	5.57E-06	4.48E-06	1.76E-05	1.76E-05	1.66E-05	7.70E-06	6.52E-06
A (μeq/l)	51.5	169.8	38.5[a]	12.8	646.7	49.2 [a]	36.7 [a]
Watershed area (mi^2)			0.033	0.012		0.033	0.233
Watershed area (ha)	161	390	8.5	3.1	120	8.5	60.35
Precipitation (in)	40	40	40	40	40	40	40
Precipitation (m)	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Et	0.33	0.33	0.33	0.33	0.33	0.33	0.33
ANC(o) (eq)	5.64E+04	4.51E+05	2.24E+03	2.71E+02	5.28E+05	2.86E+03	1.51E+04
Hdep (eq)	9.00	17.53	1.51	0.55	19.96	0.66	3.95
% ANC change	0.02%	0.004%	0.07%	0.026 μeq/l	0.004%	0.02%	0.03%

[a] Provided by Alisa Mast, USGS, in February 28, 2003 facsimile transmission to Elizabeth Carper, Trinity Consultants.

[b] The maximum deposition flux from all alternatives is used.

TABLE 5-62. ACID NEUTRALIZATION CAPACITY FOR SELECTED LAKES – VMA SOURCES ONLY

Wilderness Area	Maroon Bells WA		Flat Tops WA			Mt. Zirkel WA	
Lake	Moon Lake	Avalanche	Ned Wilson Lake	Upper Ned Wilson Lake	Trappers Lake	Summit Lake	Seven Lakes
Ds (kg/ha/yr) [b]	1.16E-06	1.13E-06	2.10E-06	2.10E-06	2.04E-06	2.37E-06	2.46E-06
Dn (kg/ha/yr) [b]	1.23E-04	1.18E-04	2.14E-04	2.14E-04	2.07E-04	2.81E-04	2.78E-04
Hs ($eq^2/m^2/yr$)	7.27E-09	7.09E-09	1.31E-08	1.32E-08	1.27E-08	1.48E-08	1.54E-08
Hn ($eq^2/m^2/yr$)	8.76E-07	8.45E-07	1.53E-06	1.53E-06	1.48E-06	2.00E-06	1.99E-06
A (μeq/l)	51.5	169.8	38.5[a]	12.8 [a]	646.7 [a]	49.2 [a]	36.7 [a]
Watershed area (mi^2)			0.033	0.012		0.033	0.233
Watershed area (ha)	161	390	8.5	3.1	120	8.5	60.35
Precipitation (in)	40	40	40	40	40	40	40
Precipitation (m)	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Et	0.33	0.33	0.33	0.33	0.33	0.33	0.33
ANC(o) (eq)	5.64E+04	4.51E+05	2.24E+03	2.71E+02	5.28E+05	2.86E+03	1.51E+04
Hdep (eq)	1.42	3.32	0.13	0.05	1.79	0.17	1.21
% ANC change	0.003%	0.001%	0.006%	0.0023 μeq/l	0.0003%	0.006%	0.008%

[a] Provided by Alisa Mast, USGS, in February 28, 2003 facsimile transmission to Elizabeth Carper, Trinity Consultants.

[b] The maximum deposition flux from all alternatives and all modeled sources is used.

5.4.5 AQRV ANALYSIS RESULTS FOR ALL SOURCES (CUMULATIVE)

Results for the cumulative AQRV analysis are presented in Table 5-63 through 5-67 below. Total sulfur and nitrogen deposition results were below the thresholds for all sources combined. Visibility results for BLM sources only showed no impacts > 1.0 deciview for any sensitive area. Some sensitive areas exceeded the 1.0 deciview threshold for inventory sources only and inventory plus BLM sources. Time series plots showing the percent change in extinction for each Class I area (maximum predicted development scenario) for the modeled year are provided in appendix E.

TABLE 5-63. SULFUR DEPOSITION RESULTS FOR ALL SOURCES (CUMULATIVE)[A]

		Sulfur Deposition (kg/ha/year)		
Class	**Area**	**Inventory Only**	**All BLM Sources Only**	**All BLM + Inventory Sources**
Glenwood Springs MA				
I	Black Canyon	0.01	0.000004	0.01
II	Colorado NM	0.03	0.000006	0.03
I	Eagle's Nest	0.009	0.000007	0.009
I	Flat Tops	0.01	0.00002	0.01
II	Holy Cross	0.007	0.000007	0.007
II	Hunter-Frying	0.007	0.000006	0.07
I	La Garita	0.004	0.000002	0.004
I	Maroon Bells	0.01	0.000007	0.01
I	Mt. Zirkel	0.04	0.000005	0.004
II	Raggeds	0.01	0.000005	0.01
I	Rawah	0.01	0.000005	0.01
I	Weminuche	0.003	0.000002	0.003
I	West Elk	0.009	0.000004	0.009
Class	**Area**	**Inventory Only**	**All BLM Sources Only**	**All BLM + Inventory Sources**
Vernal MA				
I	Arches	0.003	0.000003	0.003
II	Browns Park	0.005	0.00001	0.005
I	Canyonlands	0.003	0.000002	0.003
I	Capitol Reef	0.0006	0.0000004	0.0006
II	Dinosaur NM	0.01	0.00003	0.01
II	Flaming Gorge	0.003	0.000009	0.003
II	High Uintas	0.003	0.000004	0.003
II	Ouray	0.005	0.00004	0.005
II	USFS Request[b]	0.002	0.0000009	0.002

[a] -Results reflect maximum concentration from all alternatives.

[b] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-64. NITROGEN DEPOSITION RESULTS FOR ALL SOURCES (CUMULATIVE)[A]

		Nitrogen Deposition (kg/ha/year)		
Class	**Area**	**Inventory Only**	**All BLM Sources Only**	**All BLM + Inventory Sources**
Glenwood Springs MA				
I	Black Canyon	0.003	0.0007	0.003
II	Colorado NM	0.008	0.0009	0.009
I	Eagle's Nest	0.007	0.002	0.008
I	Flat Tops	0.008	0.005	0.01
II	Holy Cross	0.004	0.002	0.006
II	Hunter-Frying	0.003	0.001	0.005
I	La Garita	0.002	0.0004	0.002
I	Maroon Bells	0.004	0.001	0.005
I	Mt. Zirkel	0.06	0.001	0.06
II	Raggeds	0.003	0.0008	0.004
I	Rawah	0.01	0.001	0.01
I	Weminuche	0.001	0.0003	0.002
I	West Elk	0.002	0.0007	0.003
Class	**Area**	**Inventory Only**	**All BLM Sources Only**	**All BLM + Inventory Sources**
Vernal MA				
I	Arches	0.004	0.0005	0.004
II	Browns Park	0.004	0.002	0.006
I	Canyonlands	0.003	0.003	0.004
I	Capitol Reef	0.0002	0.00005	0.0003
II	Dinosaur NM	0.009	0.005	0.01
II	Flaming Gorge	0.003	0.001	0.004
II	High Uintas	0.004	0.0005	0.004
II	Ouray	0.01	0.006	0.02
II	USFS Request[b]	0.001	0.0001	0.001

[a] -Results reflect maximum concentration from all alternatives.

[b] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-65. SCREENING VISIBILITY MODELING RESULTS FOR ALL SOURCES (CUMULATIVE)[A]

		Inventory Only			All BLM Sources Only			All BLM + Inventory Sources		
Class	**Area**	**Maximum Impact (%)**	**Days >10%**	**Days >5%**	**Maximum Impact (%)**	**Days >10%**	**Days >5%**	**Maximum Impact (%)**	**Days >10%**	**Days >5%**
Glenwood Springs MA										
I	Black Canyon	**22.06**	**1**	3	7.19	0	2	**29.24**	**2**	4
II	Colorado NM	**21.04**	**2**	7	6.65	0	1	**24.21**	**3**	10
I	Eagle's Nest	5.81	0	1	2.02	0	0	6.21	0	1
I	Flat Tops	**11.57**	**1**	3	5.03	0	1	**11.69**	**1**	14
II	Holy Cross	4.58	0	0	2.86	0	0	5.22	0	1
II	Hunter-Frying	2.71	0	0	2.00	0	0	4.23	0	0
I	La Garita	2.89	0	0	0.90	0	0	3.78	0	0
I	Maroon Bells	4.74	0	0	3.50	0	0	7.44	0	7
I	Mt. Zirkel	**13.51**	**1**	9	1.11	0	0	**13.51**	**1**	11
II	Raggeds	5.58	0	1	3.09	0	0	8.63	0	3
I	Rawah	4.60	0	0	1.22	0	0	5.42	0	1
I	Weminuche	3.90	0	0	0.91	0	0	4.81	0	0
I	West Elk	9.76	0	1	4.49	0	0	**14.23**	**1**	2
Class	**Area**	**Inventory Only**			**All BLM Sources Only**			**All BLM + Inventory Sources**		
Vernal MA										
I	Arches	**10.48**	**1**	1	1.67	0	0	**11.79**	**1**	1
II	Browns Park	3.54	0	0	1.31	0	0	3.90	0	0
I	Canyonlands	7.54	0	4	2.23	0	0	7.54	0	6
I	Capitol Reef	1.84	0	0	0.79	0	0	2.52	0	0
II	Dinosaur NM	**10.61**	**2**	8	4.77	0	0	**14.85**	**3**	10
II	Flaming Gorge	4.68	0	0	0.78	0	0	5.23	0	1
II	High Uintas	4.47	0	0	0.87	0	0	5.12	0	1
II	Ouray	9.28	0	6	4.13	0	0	**13.10**	**3**	19
II	USFS Request[a]	2.79	0	0	0.91	0	0	3.38	0	0

[a] -Results reflect maximum concentration from all alternatives.

[b] Areas near Mount Olympus, Twin Peaks, Lone Peak, Mount Timpanogos, and Mount Nebo

TABLE 5-66. REFINED VISIBILITY ANALYSIS – ALL SOURCES (CUMULATIVE)

		All Sources			
Class	**Area**	**Minimum Days >10%**	Minimum Days >5%	**Maximum Days >10%**	Maximum Days >5%
I	Arches	0	0	0	1(0)
I	Black Canyon	0	0	1(0)	2(1)
II	Colorado NM	0	0	1(0)	3(0)
II	Dinosaur NM	0	0	1(0)	2(0)
I	Flat Tops	0	0	0	2(0)
I	Mt. Zirkel	0	4(0)	1(0)	16(0)
I	West Elk	0	0	0	1(0)

Values in parenthesis reflect all BLM sources. All Class II areas and Class I areas with no impacts from the screening analysis are not included in the refined analysis.

TABLE 5-67. ACID NEUTRALIZATION CAPACITY FOR SELECTED LAKES – ALL SOURCES (CUMULATIVE)

Wilderness Area	**Maroon Bells WA**		**Flat Tops WA**			**Mt. Zirkel WA**	
Lake	**Moon Lake**	**Avalanche**	**Ned Wilson Lake**	**Upper Ned Wilson Lake**	**Trappers Lake**	**Summit Lake**	**Seven Lakes**
Ds (kg/ha/yr) [b]	7.24E-03	7.01E-03	9.87E-03	9.88E-03	9.40E-03	2.98E-02	1.78E-02
Dn (kg/ha/yr) [b]	3.72E-03	3.32E-03	8.16E-03	8.17E-03	7.77E-03	3.80E-02	1.90E-02
Hs ($eq^2/m^2/yr$)	4.52E-05	4.38E-05	6.17E-05	6.17E-05	5.87E-05	1.86E-04	1.11E-04
Hn ($eq^2/m^2/yr$)	2.66E-05	2.37E-05	5.83E-05	5.84E-05	5.55E-05	2.71E-04	1.36E-04
A (μeq/l)	51.5	169.8	38.5 [a]	12.8 [a]	646.7 [a]	49.2 [a]	36.7 [a]
Watershed area (mi^2)			0.033	0.012		0.033	0.233
Watershed area (ha)	161	390	8.5	3.1	120	8.5	60.35
Precipitation (in)	40	40	40	40	40	40	40
Precipitation (m)	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Et	0.33	0.33	0.33	0.33	0.33	0.33	0.33
ANC(o) (eq)	5.64E+04	4.51E+05	2.24E+03	2.71E+02	5.28E+05	2.86E+03	1.51E+04
Hdep (eq)	115.59	263.51	10.26	3.73	137.12	39.09	148.89
% ANC change	0.2%	0.1%	0.5%	0.176 μeq/	0.026%	1.4%	1.0%

a - Provided by Alisa Mast, USGS, in a 02/28/2003 facsimile transmission to Elizabeth Carper, Trinity Consultants.

b - The maximum deposition flux from all alternatives is used.

5.5 NEAR-FIELD ANALYSIS

Results of the near-field air quality analysis are presented in the following section. Detailed modeling results including the location and date of each maximum impact are provided in Appendix E. Plots showing the location of each maximum impact and the wind roses for each year for both stations are provided in Figures A-34 through A-85 of Appendix A. The input files and output list files for the near-field modeling are provided on CD in Appendix F.

5.5.1 CRITERIA POLLUTANTS

The results of the near-field modeling are presented below in tables 5-68 through 5-73. For clarity, particulate matter results are presented in separate tables. It should be noted that the road-only PM_{10} and $PM_{2.5}$ modeling used a different set of receptors than the all-sources scenario. See Figures 3-1 and 3-2 for a graphic representation of these different scenarios.

Additionally, the maximum modeled concentration for NO_2 reflects an adjustment by a factor of 0.75, in accordance with standard EPA methodology (Federal Register 60:153, p. 40469, dated August 9, 1995) to convert from the modeled NO_x concentration to NO_2.

TABLE 5-68 NEAR-FIELD NON-FUGITIVE DUST CRITERIA MODELING RESULTS [a]

Pollutant	Averaging Period	Maximum Modeled Concentration ($\mu g/m^3$) [b]	Background Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)[c]	NAAQS ($\mu g/m^3$)[d]	Percent of Total due to Near-Field Source(s)
Glenwood Springs MA						
CO	1-hour	229.0	8,000	8,229	40,000	2.78%
	8-hour	77.2	4,444	4,521	10,000	1.71%
SO_2	3-hour	0.15	110	110.1	1,300	0.14%
	24-hour	0.04	39	39.0	365	0.10%
	Annual	0.004	11	11.0	80	0.03%
NO_2[e]	Annual	2.16	34	36.2	100	5.97%
PM[f]	24-hour	0.63	54	54.6	150	1.15%
	Annual	0.057	24	24.1	50	0.24%
Vernal MA						
CO	1-hour	233.3	6,984	7,217	40,000	3.23%
	8-hour	114.8	4,236	4,371	10,000	2.63%
SO_2	3-hour	0.16	20	20.2	1,300	0.79%
	24-hour	0.06	10	10.1	365	0.60%
	Annual	0.006	5	5	80	0.12%
NO_2[e]	Annual	1.40	10	11.4	100	12.3%
PM[f]	24-hour	1.02	54	55.0	150	1.85%
	Annual	0.10	24	24.1	50	0.41%

[a] NO_2 concentration = NO_X concentration * 0.75 per Federal Register 60:153, p. 40469, dated August 9, 1995

[b] Source(s) modeled – Natural gas compressors.

[c] Maximum modeled concentration + background

[d] See Section 5.1 for definition of NAAQS

[e] NOx Emission rates as follows: Vernal – 0.7 g/hp-hr ; Roan Plateau – 1.5 g/hp-hr. These values match those in the CALPUFF modeling.

[f] Particulate matter emissions from compressors only. PM_{10} assumed equal to $PM_{2.5}$ for this source.

TABLE 5-69 NEAR-FIELD PM_{10} AND $PM_{2.5}$ FUGITIVE DUST MODELING RESULTS – ROAD ONLY

Pollutant	Averaging Period	Maximum Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)[a]	NAAQS (µg/m³)[b]	Percent of Total due to Near-Field Source(s)
Glenwood Springs MA						
PM_{10}	24-hour	6.6	54	60.6	150	10.9%
	Annual	1.0	24	25.0	50	4.0%
$PM_{2.5}$	24-hour	0.96	19	20.0	65	4.8%
	Annual	0.15	7	7.15	15	2.1%
Vernal MA						
PM_{10}	24-hour	0.29	28	28.3	150	1.0%
	Annual	0.04	10	10.0	50	0.4%
$PM_{2.5}$	24-hour	0.04	19	19.0	65	0.2%
	Annual	0.006	7	7.0	15	0.09%

[a] Maximum modeled concentration + background
[b] See Section 5.1 for definition of NAAQS

TABLE 5-70 NEAR-FIELD PM_{10} AND $PM_{2.5}$ FUGITIVE DUST MODELING RESULTS – ROAD AND OTHER SOURCES[A]

Pollutant	Averaging Period	Maximum Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)[b]	NAAQS (µg/m³)[c]	Percent of Total due to Near-Field Source(s)
Glenwood Springs MA						
PM_{10}	24-hour	57.7	54	112	150	51.5%
	Annual	13.6	24	37.6	50	36.2%
$PM_{2.5}$	24-hour	8.43	19	27.4	65	30.7%
	Annual	1.93	7	8.9	15	21.6%
Vernal MA						
PM_{10}	24-hour	3.8	28	31.8	150	11.9%
	Annual	0.96	10	11.0	50	8.8%
$PM_{2.5}$	24-hour	0.55	19	19.6	65	2.8%
	Annual	0.14	7	7.1	15	2.0%

[a] Source(s) modeled: Road, well pads, and compressors. All emissions combined into well pads
[b] Maximum modeled concentration + background
[c] See Section 5.1 for definition of NAAQS

5.5.2 HAZARDOUS AIR POLLUTANTS

TABLE 5-71 NEAR-FIELD HAPS MODELING RESULTS[A]

Pollutant	Averaging Period	Maximum Modeled Concentration ($\mu g/m^3$)	Low end of AACLs ($\mu g/m^3$)[b]	High end of AACLs ($\mu g/m^3$)[b]
Glenwood Springs MA				
Benzene	24-hour	4.43	53	---
Benzene	Annual	**1.12**	0.12	13-45
Ethylbenzene	24-hour	0.80	1,000	14,467
Formaldehyde	Annual	**0.30**	0.077	8
H_2S	24-hour	1.74E-05	0.9	467
Toluene	24-hour	6.95	400	6,267
Xylenes	24-hour	**13.1**	100	14,467
Vernal MA				
Benzene	24-hour	**62.5**	53	---
Benzene	Annual	**11.0**	0.12	13-45
Ethylbenzene	24-hour	11.4	1,000	14,467
Formaldehyde	Annual	**0.53**	0.077	8
H_2S	24-hour	2.46E-04	0.9	467
Toluene	24-hour	98.2	400	6,267
Xylenes	24-hour	**185.1**	100	14,467

[a] Sources modeled: Glycol dehydrators, compressors; except H2S – Dehydrators only

[b] See Section 5.3 for details on the AACLs

Because one or more of the AACLs were exceeded, an incremental cancer risk analysis was performed for the two carcinogenic compounds emitted from the proposed sources modeled. (Xylenes and toluene are not considered carcinogenic according to EPA's IRIS database [EPA 2003c]; see http://www.epa.gov/iris/ for further information.) The results of this analysis are presented below. The methodology used for these calculations is presented in Section 5.3.

TABLE 5-72. NEAR-FIELD INCREMENTAL RISK ASSESSMENT RESULTS

Pollutant	Maximum Modeled Annual Concentration ($\mu g/m^3$)	Unit Risk (UR) Factor ($1/(\mu g/m^3)$)[a,b]	MEI/MLE Multiplier[c,d]	Final MEI Incremental Cancer Risk	Final MLE Incremental Cancer Risk
Glenwood Springs MA					
Benzene	1.12	2.2E-06 – 7.8E-06	0.29/0.21	2.49E-06/ 7.03E-07	1.82E-06/ 5.13E-07
Formaldehyde	0.30	1.3E-05	0.29/0.21	1.12E-06	8.14E-07
Vernal MA					
Benzene	11.0	2.2E-06 – 7.8E-06	0.29/0.21	2.44E-05/ 6.89E-06	1.78E-05/ 5.03E-06
Formaldehyde	0.53	1.3E-05	0.29/0.21	1.97E-06	1.44E-06

[a] Values from EPA IRIS Website (EPA, 2003c).

[b] The IRIS web site presents a range of values for benzene

[c] MEI multiplier = (20/70)

[d] MLE multiplier = (20/70)*((0.64*1.0)+(.36*.25))

5.5.3 NATURAL GAS FLARE

As described in section 3.11.4, a separate modeling exercise was conducted for potential natural gas flaring emissions. The results of this modeling are shown in Table 5-73 below.

TABLE 5-73. NEAR-FIELD FLARE MODELING RESULTS[A]

Pollutant	Averaging Period	Maximum Modeled Concentration ($\mu g/m^3$)[b,c]	Background Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)[b]	NAAQS ($\mu g/m^3$)[c]	Percent of Total due to Flare Source
Glenwood Springs MA						
CO	1-hour	0.40	8,000	8,000	40,000	0.005%
	8-hour	0.28	4,444	4,444	10,000	0.006%
PM_{10}	24-hour	0.003	54	54	150	0.006%
	Annual	0.0005	24	24	50	0.002%
$PM_{2.5}$	24-hour	0.003	19	19	65	0.016%
	Annual	0.0005	7	7	15	0.007%
NOx	Annual	0.006	34	34	100	0.018%
Vernal MA						
CO	1-hour	0.40	8,000	8,000	40,000	0.005%
	8-hour	0.28	4,444	4,444	10,000	0.006%
PM_{10}	24-hour	0.003	28	28	150	0.011%
	Annual	0.0005	10	10	50	0.005%
$PM_{2.5}$	24-hour	0.003	19	19	65	0.016%
	Annual	0.0005	7	7	15	0.007%
NOx	Annual	0.006	34	34	100	0.018%

[a] Because screening meteorological data were used, the modeled concentrations are equal for both MA's.

[b] Averaging times longer than a 1-hour were computed using conversion factors from EPA, 1992.

[c] PM_{10} assumed equal to $PM_{2.5}$.

5.6 DISCUSSION

The results of the modeling analysis were intended to provide a general overview of cumulative air quality impacts due to potential BLM development. The modeling results showed that the air quality impact of BLM development was well below the regulatory thresholds for most analyses. Analyses of concern are the ANC change in Upper Ned Wilson Lake and visibility within certain sensitive areas. However, this would occur only when inventory sources are included (cumulative analyses); by themselves, BLM sources cause no potential exceedance of any applicable threshold, increment, or standard. These exceedances indicate that some level of concern should be placed on these criteria, but does not necessarily represent an exceedance of the applicable standard.

Exceedances, over-predictions, and under-predictions are caused, in part, by limitations within the model and the input information. The accuracy of these results depends on the representation of sources within the model and accuracy of the State's emission inventory. In long-range transport modeling, particularly in complex terrain, the modeled impacts are highly dependent on source location. One limit of this air quality analysis was the unknown location of some BLM sources. Small changes in source location can cause a change in modeled impacts, especially in the complex terrain of Utah and Colorado. The model assumes most sources were emitting 100 percent of the time throughout the modeled year. In reality, some sources only emit during a portion of any given day or year. These issues and potential

exceedances should be resolved in the air quality analysis conducted during the air permitting process of the potential BLM development sources.

Air Resource Specialists. 2002. Green River Basin Visibility Study. Monitored Air Quality Data. Air Resource Specialists, Fort Collins, Colorado.

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APPENDIX A - MODELING SUPPORT FIGURES

APPENDIX B – CALMET MODEL VALIDATION FIGURES

APPENDIX C – INVENTORY SOURCE REVIEW

APPENDIX D – SELECTED EMISSIONS CALCULATIONS FOR BLM SOURCES

APPENDIX E – DETAILED MODELING RESULTS

APPENDIX F – MODELING AND FUGITIVE DUST CALCULATION FILES AND RELATED TABLES (FILES AVAILABLE FROM BLM-NSTC AIR QUALITY STAFF)

ATTACHMENT 1 – ISC3 INPUT FILES PROVIDED BY CDPHE

ATTACHMENT 2 - MEMO FROM MR. HOWARD GEBHART, AIR RESOURCE SPECIALIST, INC., REGARDING THE TOM BROWN COMPANY'S LISBON, UT GAS PLANT