APPENDIX H
AIR QUALITY ANALYSIS MODELING REPORT

TABLE OF CONTENTS

List of Tables

List of Figures

List of Attachments

List of Acronyms

$\mu g/m^3$	micrograms per cubic meter
AERMOD	American Meteorological Society/EPA Regulatory Model
APCD	Air Pollution Control Division
AQRV	Air Quality-Related Value
ASOS	Automated Surface Observing System
CAAQS	Colorado Ambient Air Quality Standards
CALPUFF	CALPUFF air quality modeling system
CALPUFF-Lite	Screening-mode version of CALPUFF air quality modeling system
CASTNET	Clean Air Status and Trends Network
CDPHE	Colorado Department of Public Health and Environment
CO	carbon monoxide
DAT	Deposition Analysis Threshold
DEM	digital elevation model
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
g/s	grams per second
FLAG	Federal Land Managers' Air Quality Related Values Workgroup
ISCST3	EPA Industrial Source Complex Short Term Model, Version 3
IWAQM	Interagency Workgroup on Air Quality Modeling
K	Kelvin
kg/ha/yr	kilogram per hectare per year
km	Kilometers
m	Meter
m/s	meters per second
NAD83	North American Datum of 1983
NAAQS	National Ambient Air Quality Standards
NO_2	nitrogen dioxide
NO_x	nitrogen oxides (oxides of nitrogen)
NPS	National Park Service
NWS	National Weather Service

PM	particulate matter
$PM_{2.5}$	particulate matter with aerodynamic diameter less than 2.5 micrometers
PM_{10}	particulate matter with an aerodynamic diameter less than 10 micrometers
PSD	Prevention of Significant Deterioration
ROW	right-of-way
SIL	significant impact level
SO_2	sulfur dioxide
SO_x	sulfur oxides (oxides of sulfur)
tpy	tons per year
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTM	Universal Transverse Mercator

1.0 Introduction

This report provides detailed emission estimates and air quality dispersion modeling to support the air quality impact assessments completed for the Red Cliff Mine Environmental Impact Statement (EIS). Construction activities will cause temporary criteria pollutant emission increases, while production activities following the start of mining activities will result in continuous criteria pollutant emission increases from the mine site. Criteria pollutants considered in this analysis include nitrogen dioxide (NO_2), carbon monoxide (CO), sulfur dioxide (SO_2), and particulate matter less than 10 microns and 2.5 microns in diameter (PM_{10} and $PM_{2.5}$).

Both near-field (<1 kilometer from mine site) and far-field (<200 kilometers, or 124 miles from mine site) impacts were analyzed, using the AMS/EPA Regulatory Model (AERMOD) and USEPA-approved CALPUFF models, respectively. The near-field analysis provides a comparison of modeled pollutant concentrations to National Ambient Air Quality Standards (NAAQS) and Colorado Ambient Air Quality Standards (CAAQS). The far-field analysis also compares modeled concentrations to significant impact levels (SILs), also known as increments, established for Class I and Class II areas under the Prevention of Significant Deterioration (PSD) program. In addition, the far-field analysis focuses on Air Quality Related Values (AQRVs), including assessment of visibility impacts and pollutant deposition. Air quality impacts were evaluated for the following areas:

<u>Utah</u>

- Arches National Park (Class I Area)
- Canyonlands National Park (Class I Area)

<u>Colorado</u>

- Black Canyon of the Gunnison Wilderness (Class I area)
- Flat Tops Wilderness (Class I area).
- Maroon Bells – Snowmass Wilderness (Class I area)
- Colorado National Park (sensitive Class II area)
- Dinosaur National Monument (sensitive Class II area)

2.0 Project Description

As described in Chapter 1 of the Red Cliff Mine EIS, CAM-Colorado, LLC (CAM) currently mines approximately 280,000 tons of coal per year from the underground McClane Mine in western Colorado. CAM is proposing to develop the Red Cliff Mine, approximately 3 miles south of the McClane Mine, to produce approximately 8 million tons per year of coal. CAM estimates that Red Cliff coal reserves exist to allow for a 20- to 30-year mine life. Once the Red Cliff Mine becomes operational, CAM plans to cease operations at the McClane Mine.

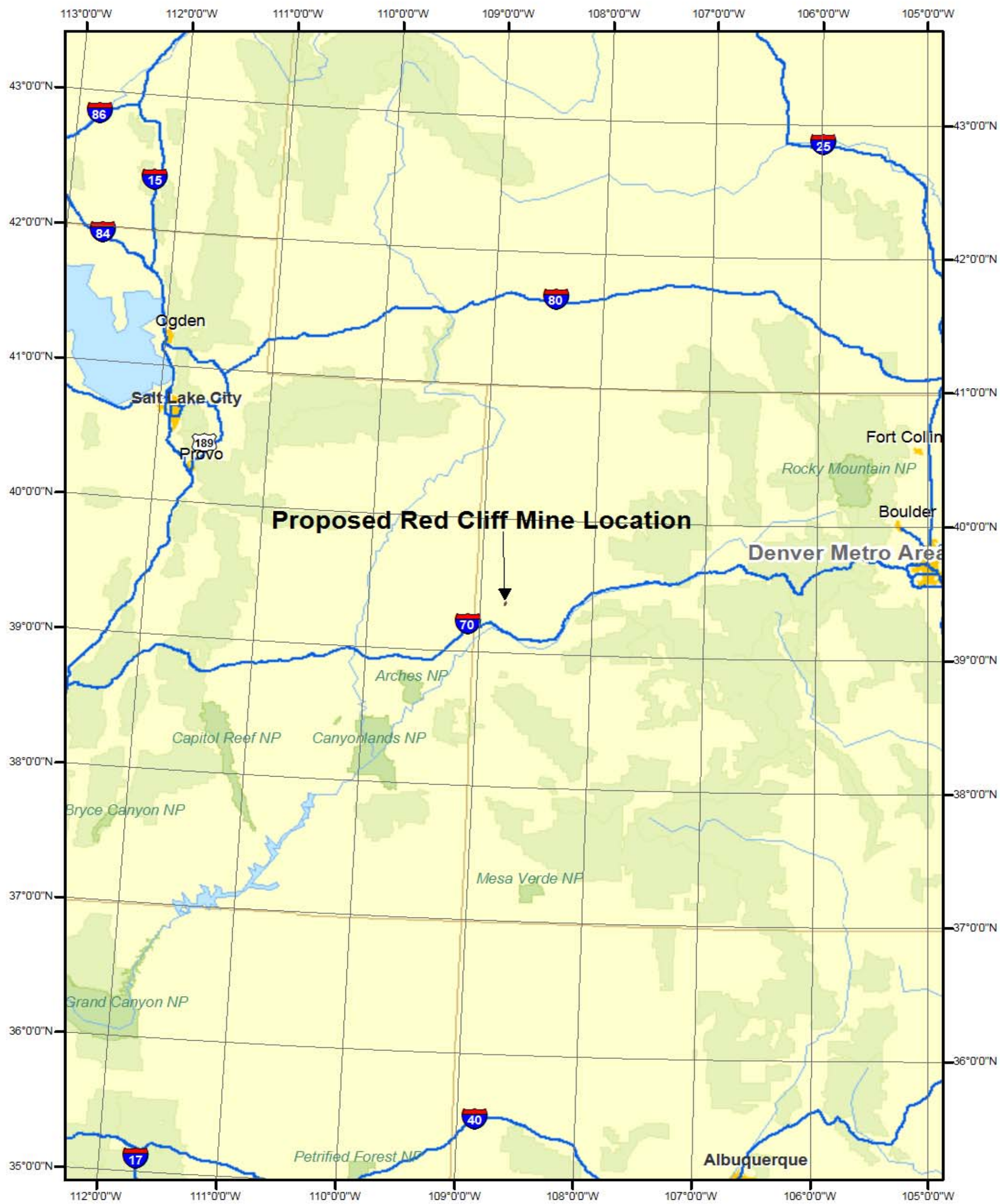
The proposed Red Cliff Mine project area is located in western Colorado in Garfield and Mesa County, 11 miles north of the towns of Mack and Loma, Colorado, and 1.5 miles east of Colorado State Highway (SH) 139, approximately 32.5 kilometers northwest of the Grand Junction airport. The location of the Red Cliff Mine area is shown in Figure 2-1 of this report.

For the Red Cliff Mine, CAM is proposing to construct new mine entries (portals) and associated facilities to extract low-sulfur coal from existing federal coal leases, potential new federal coal leases, and a small amount of private coal. The total future coal leasing area is estimated to be about 23,000 acres. In addition to locating facilities on the existing and potential new coal leases, CAM would locate surface facilities, including a waste rock disposal area, railroad loop, the unit train load out, and a conveyor system, on BLM lands within the boundaries of the proposed right of way and Land Use Application area (approximately 1,140 acres). Mitchell Road (X Road) would be upgraded to serve as the mine access road from SH 139.

A railroad would be constructed from the mine site, connecting to the existing Union Pacific Railroad near Mack, Colorado. The proposed railroad would traverse approximately 9.5 miles of BLM land, crossing of SH 139 once and traversing approximately 5 miles of private land. The proposed railroad would also cross M.8 Road and 10 Road.

Electric power would be provided to the mine through contract with the local power utility. A new 14-mile, 69-kilovolt (kV) transmission line is proposed to supply electrical power from the Unitah Substation to the mine site, with approximately 7 miles on federally managed lands and 7 miles on private lands.

Figure 2-1
LOCATION MAP FOR THE PROPOSED RED CLIFF MINE



3.0 Near-Field Dispersion Modeling Analysis

Near-field impacts within 1 kilometer (km) of the proposed mine's surface facilities (mine site) were assessed by modeling projected emission rates in the AMS/EPA Regulatory Model (AERMOD). AERMOD is a modeling system consisting of three separate modules: AERMET, AERMAP, and AERMOD. AERMET is a meteorological preprocessor and uses hourly surface observations, cloud cover, and upper air parameters from twice-daily vertical sampling of the atmosphere to create two output files consisting of surface and vertical profile data, respectively. The terrain preprocessor AERMAP uses Digital Elevation model (DEM) maps as well as user-generated receptor grids. AERMAP's output file consists of the x,y locations of each receptor, mean sea level (MSL) elevation, and hill profile parameter. The hill profile parameter is used in determining plume flow around elevated terrain.

AERMOD directly reads the three output files created by the pre-processing programs and, along with user-entered source information, predicts ambient air concentrations for a variety of pollutants and averaging periods ranging from 1-hour to annual. AERMOD has a regulatory default option, as well as rural or urban dispersion coefficients, urban population settings, and other features specific to the model. AERMOD also includes the Plume Rise Model Enhancement (PRIME) building downwash algorithm, which calculates directional specific building downwash widths and heights as well as downwash parameters for the cavity region of the building (earlier downwash algorithms ignored the cavity region, and models did not calculate concentrations for receptors located inside this area).

Modeled pollutant concentrations were compared to the applicable NAAQS and CAAQS to determine if emissions from the proposed mine (construction phases and ongoing production) would interfere with attainment and maintenance of those standards in the Class II areas surrounding the Red Cliff Mine area. This section describes the air quality dispersion model options, land use classification, receptor network, meteorological data, emission calculations, and model results for the near-field analysis.

3.1 Model Options

The following regulatory default options were run in AERMOD:

- Stack-tip downwash,
- Elevated terrain effects,
- Use calms processing routine,
- Use missing data processing routine, and
- No exponential decay.

The proposed Red Cliff Mine area has little, if any, heavy industrial, light-moderate industrial, commercial, single-family compact residential, or multi-family compact residential land within 3 km. Based on this, the Red Cliff Mine area is considered a rural area and therefore, the rural option was used.

Building downwash was not considered for this air quality analysis since all emissions sources were modeled as area sources. Neither wet nor dry deposition was included in the near-field analysis.

3.2 Meteorological Data

Five years (1991–1995) of surface meteorology data was obtained from the National Climatic Data Center for the Grand Junction – Walker Field Airport. The same five years of upper air meteorology was obtained from the FSL/NCDC Radiosonde Data Archive. These datasets were processed by AERMET with surface characteristic values obtained from a land use/surface characteristics workbook prepared by the Colorado Department of Public Health and Environment (CDPHE). The AERMET raw meteorology data inputs were determined by CDPHE staff.

Figure 3-1 presents a representative wind rose for this processed meteorology.

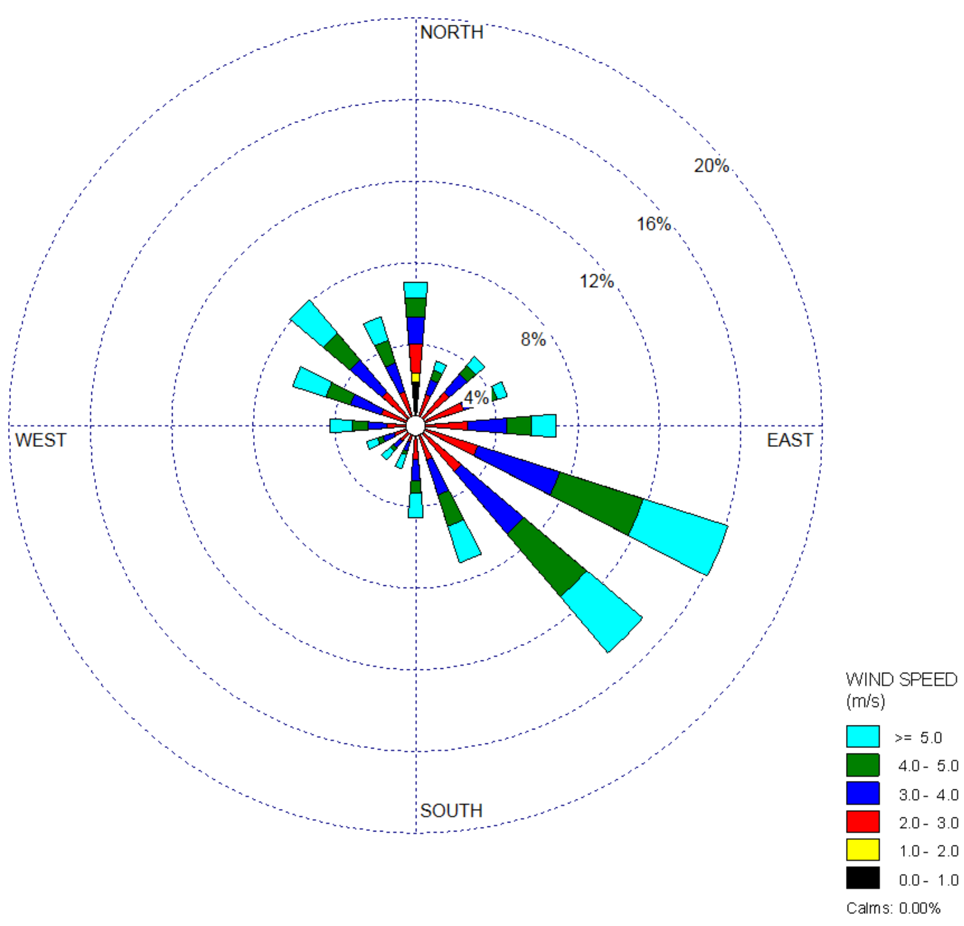
3.3 Receptor Grid

The receptor grid, or network, defines the locations of predicted air concentrations used to assess compliance with the relevant standards or guidelines. The following comprehensive fine and coarse receptor network was used for this analysis:

- 25-meter (m) spaced receptors along the project property boundary (defined as a 50 meter buffer from the area sources)
- 100-m spaced receptors out to 1 km from the property boundary/land use application area boundary

Figure 3-1
WIND ROSE FOR NEAR-FIELD ANALYSIS (AERMOD METEOROLOGY)

WIND ROSE PLOT:	DISPLAY:
Grand Junction Station #23066 **Surface Meteorology (Years 1991 - 1995)**	**Wind Speed** **Direction (blowing from)**

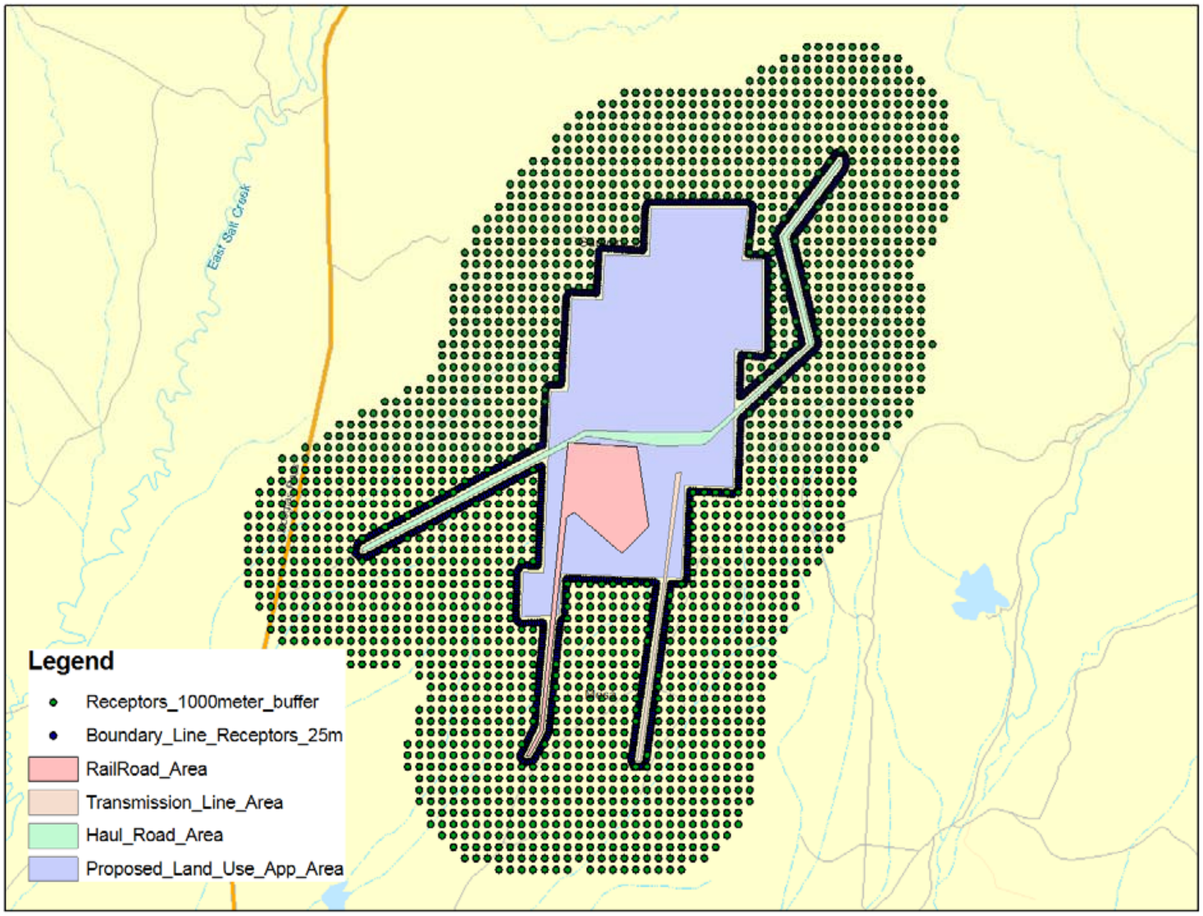


COMMENTS:	DATA PERIOD:		
For Use With AERMOD	**1991-1995** **Jan 1 - Dec 31** **00:00 - 23:00**		
	CALM WINDS: **0.00%**	TOTAL COUNT: **43824 hrs.**	
	AVG. WIND SPEED: **3.81 m/s**	DATE: **2/4/2008**	PROJECT NO.: **22239116**

WRPLOT View - Lakes Environmental Software

This network used Cartesian (X, Y) receptors with UTM NAD83 Zone 13 North coordinates. Base elevation of all the receptors were found using terrain elevations interpolated from U.S. Geological Survey (USGS) 1 degree Digital Elevation Model (DEM) data. The receptor grid is shown in Figure 3-2.

Figure 3-2
RECEPTOR NETWORK AND AREA SOURCES



3.4 Emission Sources and Modeled Emission Rates (Near-Field Analysis)

As discussed in Section 1 of this Appendix, CAM proposes to construct surface facilities over approximately 1,140 acres for the Red Cliff Mine, including portals, benches, railroad loop, unit train load out, conveyor system, storage piles, and a waste rock disposal area. Additionally, transmission lines, a railroad, and haul roads will be constructed from the mine site. Both construction and production activities associated with the Red Cliff Mine will result in emission increases. Specific criteria air pollutant emission sources and activities will include the following.

- Vehicle exhaust and point sources (NOx, CO, SO2, PM10, PM2.5)
  - Worker vehicle emissions during construction and production

  - Construction equipment (fuel combustion)
  - Production equipment (fuel combustion)
  - Locomotive emissions during production, and
- Fugitive particulate matter (PM_{10}, $PM_{2.5}$)
  - Construction of the mine area facilities, portals and benches
  - Construction of the transmission line
  - Construction of the railroad spur
  - Coal production and processing activities
  - Vehicle traffic on non-paved surfaces
  - Wind erosion.

Temporary emission increases of criteria pollutants will occur as a result of construction activities, while ongoing criteria pollutant emission increases will occur from production activities following startup of mining operations. Emissions from all the sources and activities listed above may occur during either the construction phase, production phase, or both.

Railroad construction is anticipated to begin first, followed next by mine area construction, transmission line construction, and road construction. After all construction is complete, ongoing coal production will begin at the mine site. Accordingly, air quality dispersion modeling was conducted for each of these three distinct project phases, as listed below.

- Phase 1: Railroad construction
- Phase 2: Mine area / transmission line / haul roads construction.
- Phase 3: Production

Attachment A to this report is an estimated timeline for expected construction activities and start of coal mining (production). Phase 1 is expected to last 6 months, while Phase 2 is estimated to continue slightly more than a year, followed by the start of Phase 3.

3.4.1 Description of Emission Sources in AERMOD

All emission sources in the near-field analysis were designated as area sources. Table 3-1 provides a summary of the area sources included in each phase of the near-field analysis.

Table 3-1
SUMMARY OF AREA SOURCES INCLUDED IN NEAR-FIELD ANALYSIS, BY PROJECT PHASE

Defined "Area" Source	Phase 1 Railroad Construction	Phase 2 Construction: Mine Area/ Transmission Line/Haul Roads	Phase 3 Production[1]
Area 1: Transmission Line		X	
Area 2: Railroad	X		
Area 3: Haul Roads		X	
Area 4: Mine Area		X	X

[1]Mine area emissions during the production phase include emissions from vehicle traffic on mine area roads.

The transmission line, railroad, and haul road area sources used in the near-field analysis were defined according to the proposed land use application and right of way (ROW) in order to keep the analysis within the "near-field," or in other words, centralized to the area where the most emissions will occur over all project phases. Figure 3-2 illustrates the modeled area sources and the modeling receptor network. Notice in Figure 3-2 that all defined area sources for the analysis are located within the proposed land use area, even though some of the sources (transmission lines, railroad, and haul roads) will extend farther out than the proposed land use area. This approach to defining the near-field area sources provides for a more centralized approach, and is considered to be a conservative review of the highest near-field impacts since the highest emission rates are expected to occur near the mine area. Emissions from construction along the transmission lines, railroad, and haul roads further out than these defined areas are considered in the far-field analysis, discussed in the next section. Detailed area source parameters used in the near-field analysis are provided in Table 3-2.

Table 3-2
AREA SOURCE PARAMETER DETAIL, NEAR-FIELD ANALYSIS (AERMOD)

Parameter → Area Source ↓	Lower Left Corner Easting[1] (m)	Lower Left Corner Northing[1] (m)	Source Base Elevation (m)	Release Height (m)	Initial Z Dimension (Sigma- Z) (m)	GIS Derived Area (m^2)	Percentage of Emissions Modeled[2] (%)
Area Source 1 (Transmission Line)	174192.7	4361281.8	1,560	3	2.8	76,348	11% (89% reduction)
Area Source 2 (Railroad)	173220.2	4361325.3	1,560	3	2.8	619,200	16% (84% reduction)
Area Source 3 (Haul Roads)	171780.7	4363103.5	1,700	3	2.8	309,802	86% (14% reduction)
Area Source 4 (Mine Area)	173193.3	4362935.1	1,700	3	2.8	4,562,020	100% (no reduction)

[1]Projected Coordinate System = UTM NAD83 Zone 13 North
[2]This column is explained in Section 3.4.1 of this Report.

% = percent
GIS = geographic information system
m = meter
m^2 = square meter
NAD83 = North American Datum of 1983
UTM = Universal Transverse Mercator

3.4.2 Emission Rates

Total emissions for each of the proposed mine's emission sources and activities were estimated based on detailed construction and equipment information supplied by CAM or its selected engineering design consultants. Emission factors and methodologies recommended by the USEPA were used in the calculations to the extent possible. For detailed emission calculation summaries, refer to Attachment B of this Report. Table 3-3 is a summary of the total expected emissions for the proposed Red Cliff Mine.

Table 3-3
PROJECTED EMISSION INCREASES FOR PROPOSED RED CLIFF MINE, GROUPED BY PROJECT PHASE (tpy)[1]

Pollutant	Phase 1 Railroad Construction	Phase 2 Construction: Mine Area / Transmission Line / Haul Roads	Phase 3 Production
NO_x	73.16	25.16	80.20
CO	0.05	0.023	0.04
SO_x	23.97	8.36	24.34
PM_{10}	27.71	15.71	9.57
$PM_{2.5}$	84.10	49.54	24.13

[1]tons per year

Emission rates included in the near-field analysis are less than the total project emission rates shown in Table 3-3. Since area sources 1–3 are bounded (as described in the previous section) in order to conduct the near-field analysis, modeled emissions were calculated to represent these bounded areas, rather than the entire areas for railroad construction, transmission line construction, and mine area construction. In order to estimate emissions for the bounded area sources, the total emissions were reduced by the appropriate fraction of the bounded area. For example, the proposed rail spur for this project is estimated to span 14.5 miles; however, for this near-field analysis, the rail spur length was bounded to 2.3 miles, or approximately 16 percent of the expected total length. Accordingly, the total emissions for railroad construction were reduced by 84 percent, so that only 16 percent of the total emissions were modeled for the 2.3 miles of rail spur area source. The amount by which estimated emissions were reduced for each area source is listed in the far right column of Table 3-2.

A summary of emission rates entered into AERMOD for the near-field analysis is provided in Table 3-4. Emission rates are grouped according to the specific area source and are expressed as both the long-term (tons per year, or tpy) and short-term (grams per second, or g/s) emission rates. Note that for Area Source 4 (Mine Area), two sets of data are presented, for the construction and the production phases. Emissions from Area Sources 1, 2, and 3 represent only construction activities.

Table 3-4
NEAR-FIELD ANALYSIS, MODELED EMISSION INCREASES (AERMOD), GROUPED BY AREA SOURCE

	Area Source 1 (Transmission Line)			Area Source 2 (Railroad)			Area Source 3 (Haul Roads)			Area Source 4 (Mine Area, Constr.)			Area Source 4 (Mine Area, Prod.)		
	Long Term[1]		Short Term[2]	Long Term[1]		Short Term[2]	Long Term[1]		Short Term[2]	Long Term[1]		Short Term[2]	Long Term[1]		Short Term[2]
	tpy	g/s	g/s	tpy	g/s	g/s	tpy	g/s	g/s	tpy	g/s	g/s	tpy	g/s	g/s
NO_x	0.7	0.02	0.147	11.5	0.329	0.802	3.5	0.102	2.2	14.7	0.424	3.092	80.2	2.307	1.2
CO	0.2	0.007	0.051	3.8	0.108	0.263	1.2	0.034	0.7	4.8	0.138	1.009	24.3	0.700	0.4
SO_2	0.001	2.5E-5	1.8E-4	0.01	2.0E-4	0.001	0.003	8.6E-5	0.002	0.01	3.3E-4	2.38E-3	0.04	0.001	0.001
PM_{10}	2.5	0.071	0.518	13.2	0.379	1.4	13.9	0.399	8.8	11.1	0.319	2.325	21.1	0.694	1.4
$PM_{2.5}$	0.8	0.022	0.160	4.3	0.125	0.5	4.3	0.123	2.7	3.8	0.110	0.801	9.6	0.275	0.5

Notes

1. "Long term" refers to annual emissions. For railroad construction (Area Source 2), construction is expected to last less than one year. In this case, the emissions were allocated over the projected total time frame (6 months) rather than a full year. Note that several emission sources will operate over the duration of a full year, but will operate less than 8,760 hours over a 12-month period.
2. "Short term" refers to short-term emission rates, such as 1-hour, 3-hour, or 8-hour average time periods. For several emission sources, the short-term emission rate may be higher than the long-term emission rate.

Note that emissions from the various emission sources and activities listed earlier in this section may occur during any of the project phases, in any of the defined area sources. For example, fugitive dust and vehicle exhaust emissions will occur during all construction phases as well as during the production phase. Various construction equipment used in all area sources will similarly generate fugitive dust and vehicle exhaust emissions, and specific construction activities such as road scraping will occur in all area sources during construction. Once coal mining (Phase 3) begins, equipment used to haul coal around the mine site and away from the mine site will result in fugitive dust and vehicle exhaust emissions in the mine area. Ongoing production activities will also generate emissions from coal transfer points, stock piles, and coal processing activities. Emission summary tables are provided in Attachment B of this report and provide additional detail.

Mitigation measures and emissions controls will be implemented to reduce particulate matter/fugitive dust emissions during construction and ongoing production activities. Fugitive emissions from all vehicles traveling on non-paved surfaces during all project phases will be controlled utilizing chemical suppressants applied to non-paved roads. Storage piles will be watered as necessary to limit wind erosion potential and reduce fugitive emissions. Most coal transfer points and processing activities during coal production will be enclosed and therefore will reduce fugitive particulate matter emissions.

With regard to construction-related emissions (Area Sources 1, 2, and 3), modeled emissions are assumed to occur only during certain hours of the day. Information regarding average workday hours was provided by CAM or their selected engineering design consultants.

3.5 Near-Field Analysis (AERMOD) Results

Predicted (modeled) maximum criteria pollutant concentrations are presented in Tables 3-5, 3-6, and 3.7. For each criteria pollutant, the maximum predicted (modeled) concentration is defined as:

- NO_x, SO_2, PM_{10}, and $PM_{2.5}$ annual average — the highest modeled annual averaged values over all 5 years;
- CO and SO_2 short-term averaging (1-hour, 8-hour, 3-hour, 24-hour) — the highest of the first high values (for each receptor) over all 5 years;
- PM_{10} short-term averaging (24-hour) — the highest of the second high values (for each receptor) over all 5 years;
- $PM_{2.5}$ short-term averaging (24-hour) — the highest of the sixth high values (for each receptor) over all 5 years.

Predicted (modeled) maximum criteria pollutant concentrations were added to applicable background concentrations and the total maximum predicted concentrations were compared to the applicable NAAQS and CAAQS. All total maximum predicted concentrations and the corresponding NAAQS/CAAQS values are presented in Tables 3-5, 3-6, and 3-7.

For all project phases, none of the maximum predicted concentrations (modeled maximum concentration plus background concentration) exceed a NAAQS or CAAQS.

Table 3-5
MAXIMUM AERMOD PREDICTED IMPACTS FROM PHASE 1 (RAILROAD CONSTRUCTION)

Pollutant	Averaging Period	Maximum Predicted Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$) [3]	Maximum Predicted + Background Concentration ($\mu g/m^3$)	Primary NAAQS ($\mu g/m^3$)	CAAQS ($\mu g/m^3$)
NO_2 [2]	Annual	1.7	34	36	100	100
CO	1-Hour	93.7	6,869	6,963	10,000	10,000
	8-Hour	28.2	4,579	4,607	40,000	40,000
SO_2	Annual	0.001	11	11.001	80	80
	3-Hour	0.1	110	110.1	365	365
	24-Hour	0.03	39	39.03	1,300	700
PM_{10}	Annual	2	24	26	NA	50
	24-Hour	37.7	54	92	150	150
$PM_{2.5}$	Annual	0.6	9	9.6	15	15
	24-Hour	10.9	22	32.9	35	35

Notes

1. Area Source 1 was included in analysis.
2. Assumes 100 percent conversion of modeled NO_x to NO_2.
3. Background concentrations derived from:

PM_{10} = Rifle, Garfield County. (1998-2000 data collected by CDPHE)
$PM_{2.5}$ = Grand Junction, Mesa County. (1999-2004 data collected by CDPHE)
SO_2. = Colorado College, Colorado Springs, El Paso County. (1998-2000) – recommended by Nancy Chick (CDPHE) for use in the Vernal and Glenwood Springs Resource Management Plans.
NO_2 = Woodmen and Colorado College stations, Colorado Springs, El Paso County (1998-2000 data)
CO = Grand Junction, Mesa County. (Average of 2001-2004)

Table 3-6
MAXIMUM AERMOD PREDICTED IMPACTS FROM PHASE 2 (TRANSMISSION LINE, MINE AREA, AND ROAD CONSTRUCTION)[1]

Pollutant	Averaging Period	Maximum Predicted Concentration (μg/m³)	Background Concentration (μg/m³)[3]	Maximum Predicted + Background Concentration (μg/m³)	Primary NAAQS (μg/m³)	CAAQS (μg/m³)
NO_2[2]	Annual	0.17	34	34.17	100	100
CO	1-Hour	182.12	6,869	7,051.12	10,000	10,000
	8-Hour	30.35	4,579	4,609.35	40,000	40,000
SO_2	Annual	0.0001	11	11.0001	80	80
	3-Hour	0.17	110	110.17	365	365
	24-Hour	0.023	39	39.023	1,300	700
PM_{10}	Annual	0.36	24	24.36	NA	50
	24-Hour	72.21	54	126.21	150	150
$PM_{2.5}$	Annual	0.12	9	9.12	15	15
	24-Hour	12.54	22	34.54	35	35

Notes
1. Area Source 1 included in analysis.
2. Assumes 100 percent conversion of modeled NO_x to NO_2.
3. Background concentrations derived from:

PM_{10} = Rifle, Garfield County. (1998-2000 data collected by CDPHE)
$PM_{2.5}$ = Grand Junction, Mesa County. (1999-2004 data collected by CDPHE)
SO_2 = Colorado College, Colorado Springs, El Paso County. (1998-2000) – recommended by Nancy Chick (CDPHE) for use in the Vernal and Glenwood Springs Resource Management Plans.
NO_2 = Woodmen and Colorado College stations, Colorado Springs, El Paso County (1998-2000 data)
CO = Grand Junction, Mesa County. (Average of 2001-2004)

Table 3-7
MAXIMUM AERMOD PREDICTED IMPACTS FROM PHASE 3 (PRODUCTION)[1]

Pollutant	Averaging Period	Maximum Predicted Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)[3]	Maximum Predicted + Background Concentration ($\mu g/m^3$)	Primary NAAQS ($\mu g/m^3$)	CAAQS ($\mu g/m^3$)
NO_2 [2]	Annual	7.59	34	41.59	100	100
CO	1-Hour	87.97	6,869	6,956.97	10,000	10,000
	8-Hour	19.27	4,579	4,598.27	40,000	40,000
SO_2	Annual	0.003	11	11.003	80	80
	3-Hour	0.05	110	110.05	365	365
	24-Hour	0.01	39	39.01	1,300	700
PM_{10}	Annual	1.84	24	25.84	NA	50
	24-Hour	8.06	54	62.06	150	150
$PM_{2.5}$	Annual	0.81	9	9.81	15	15
	24-Hour	2.78	22	24.78	35	35

Notes
1. Area Source 1 included in analysis.
2. Assumes 100 percent conversion of modeled NO_x to NO_2.
3. Background concentrations derived from:

PM_{10} = Rifle, Garfield County. (1998-2000 data collected by CDPHE)
$PM_{2.5}$ =- Grand Junction, Mesa County. (1999-2004 data collected by CDPHE)
SO_2. = Colorado College, Colorado Springs, El Paso County. (1998-2000) – recommended by Nancy Chick (CDPHE) for use in the Vernal and Glenwood Springs Resource Management Plans.
NO_2 = Woodmen and Colorado College stations, Colorado Springs, El Paso County (1998-2000 data)
CO = Grand Junction, Mesa County. (Average of 2001-2004)

4.0 Far-Field Analysis (Class I Air Quality Related Values Impact)

Far-field impacts up to 200 km from the proposed mine site were assessed by modeling projected emission rates in the USEPA-recommended CALPUFF model. The CALPUFF model is an advanced, integrated Gaussian puff-type modeling system that can incorporate four-dimensional varying wind fields, wet and dry deposition, and atmospheric gas and particle phase chemistry. The three main components are CALMET (a diagnostic 3-dimensional meteorological model), the CALPUFF air dispersion model, and CALPOST (a post processing package). Additionally, the CALPUFF modeling suite includes numerous other processors that may be used to prepare geophysical data, meteorological data, and interfaces to other models. The model is designed to simulate the dispersion of buoyant, puff, or continuous point and area pollution sources as well as the dispersion of buoyant, continuous line sources. It is the only EPA-approved model that can be used for source-receptor distances greater than 50 km.

The far-field analysis compares modeled concentrations to SILs (i.e., PSD increments) and assesses impacts to AQRVs, including evaluation of visibility impacts and deposition. Ambient air quality impacts were evaluated for the following areas.

Utah
- Arches National Park (Class I Area)
- Canyonlands National Park (Class I Area)

Colorado
- Black Canyon of the Gunnison Wilderness (Class I area)
- Flat Tops Wilderness (Class I area).
- Maroon Bells – Snowmass Wilderness (Class I area)
- Colorado National Monument (sensitive Class II area)
- Dinosaur National Monument (sensitive Class II area)

4.1 Meteorological Data

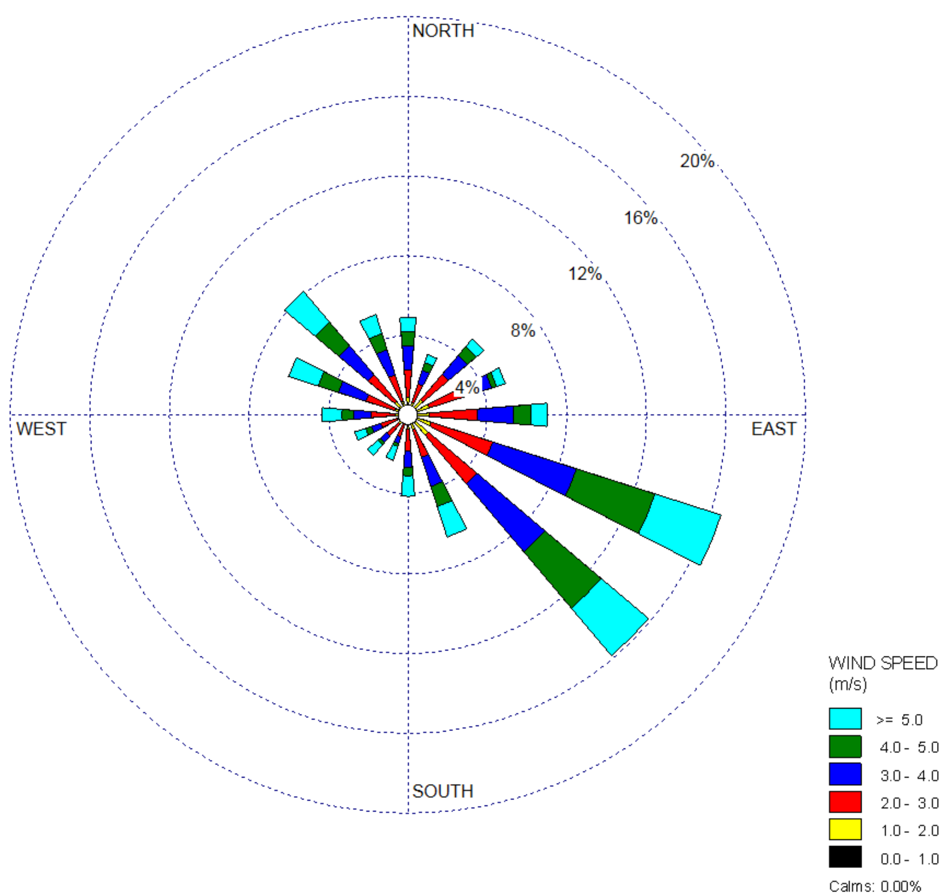
Per recommendation from CDPHE air quality modeling staff, ISCST-3 format meteorological data was obtained from the NCDC. Data from 1986–1990, collected at the Grand Junction NWS, pre Automated Surface Observing System (ASOS), was obtained and processed with 1986–1990 Grand Junction NWS Mixing Height data in the CPRAMMET processor.

Meteorology domain (grid boundary) values are shown in Table 4-14 (CALPUFF/CALPOST Modeling Options). Figure 4-1 is a representative wind rose for this processed meteorology.

Figure 4-1
CALPUFF METEOROLOGY WIND ROSE

WIND ROSE PLOT:
Grand Junction Station #23066
Surface Meteorology (Years 1986 - 1990)

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS: For Use With CALPUFF (Screening Mode)	DATA PERIOD: **1986-1990** **Jan 1 - Dec 31** **00:00 - 23:00**	
	CALM WINDS: **0.00%**	TOTAL COUNT: **43823 hrs.**
	AVG. WIND SPEED: **3.54 m/s**	DATE: **2/4/2008**
		PROJECT NO.: **22239116**

WRPLOT View - Lakes Environmental Software

4.2 Receptor Grid

A receptor grid using receptor rings was created, in accordance with guidance from the Interagency Workgroup on Air Quality Modeling (IWAQM). Receptor grids were created for each Class I area. Receptor rings were positioned so that they coincided with the distances from the source to the Class I area boundaries. Two receptor rings were placed for each Class I and sensitive Class II Area, one at the distance coincident with the nearest Class I area or sensitive Class II boundary, and the other at the farthest Class I area or sensitive Class II boundary. All receptor rings used in this far-field assessment are shown in Figure 4-2, for the five Class I areas and two sensitive Class II areas included in this analysis. Although not shown on Figure 4-2, receptors are spaced at one-degree intervals around each ring, per IWAQM guidance. All receptors are elevated to the average elevation for the area of analysis and from the model's "point of view," the area of analysis is considered to lie along each point of the ring (i.e., each 360 directions). A total of 720 receptors were modeled for each Class I or sensitive Class II area.

The modeling domain was extended approximately 25 km beyond the farthest receptor to allow for puffs to pass the receptor rings and then potentially move back toward the emission source, thereby reducing edge effects.

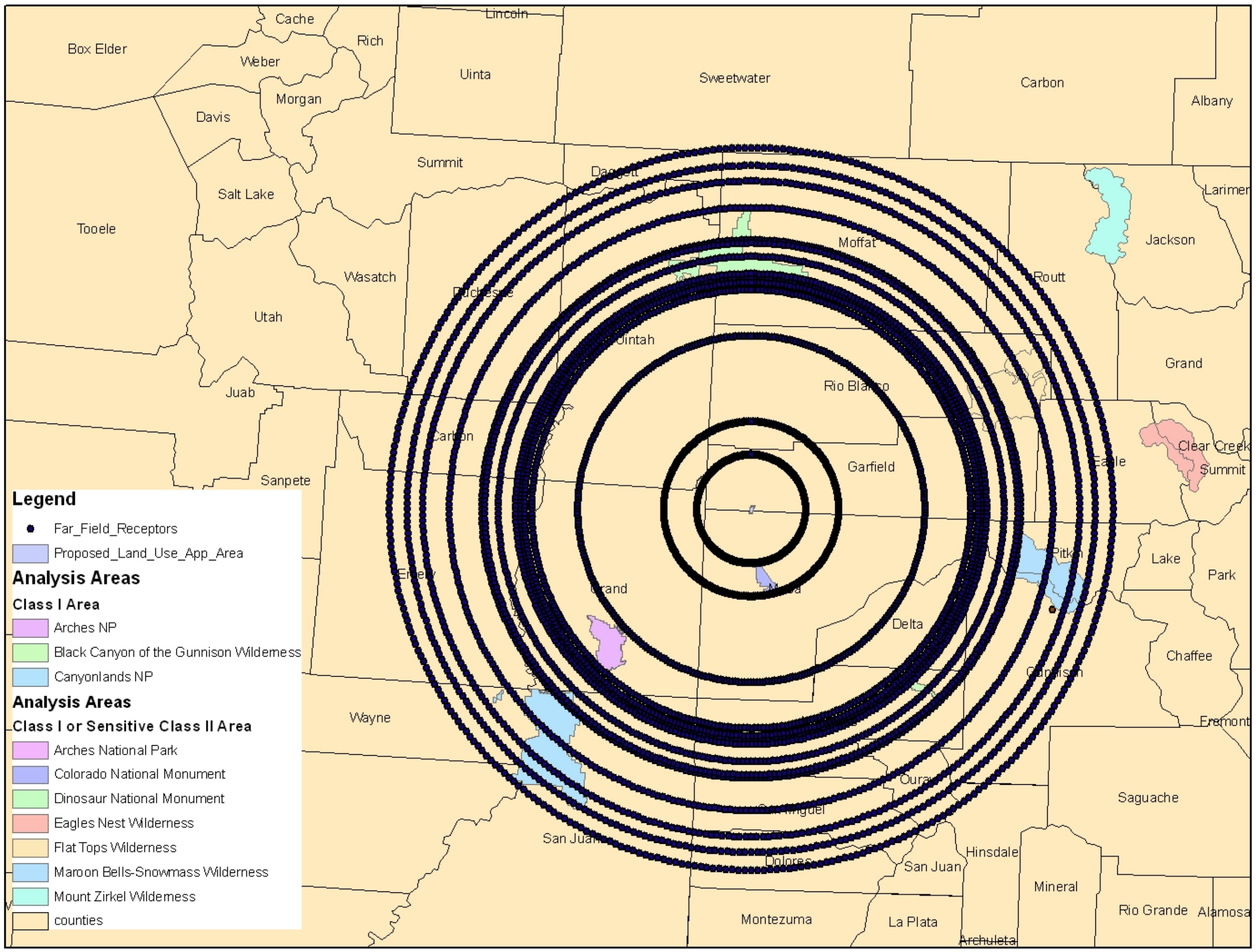
4.3 CALPUFF/CALPOST/POSTUTIL Model Options and Inputs

For this analysis, CALPUFF ran in a screening mode (known as Tier 2 or CALPUFF-Lite) as outlined in the USEPA document *Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts* (USEPA, 1998). This methodology bypasses the need to generate a full three-dimensional wind field with CALMET. Instead, an ISCST3 single-station meteorological field is used. Results from a CALPUFF-Lite analysis are considered to be conservative assessments of air quality impacts, because a number of assumptions are made that tend to over-predict air quality impacts. In some cases, a CALPUFF-Lite analysis can predict much larger impacts than those obtained with a complete CALPUFF analysis (using a three-dimensional wind field generated by CALMET).

Table 4-1 provides a summary of several CALPUFF-Lite and CALPOST modeling options and inputs utilized in this analysis, including:

- The full chemistry option was turned on (MCHEM =1, MESOPUFF II scheme).
- The deposition option was turned on (MWET = 1 and MDRY = 1).
- Method six (6) was selected for estimating light extinction (MVISBK); therefore, monthly relative humidity adjustment factors are needed by CALPOST for each analysis area (Class I or sensitive Class II). The monthly relative humidity adjustment factors (f (RH)) were obtained from FLAG guidance for the sensitive Class II Areas and from the "Seasonal FLAG Screening Analysis Spreadsheet" prepared by the BLM for Class I Areas. The recommended FLAG natural background aerosol concentrations for the western portion of the United States were input to CALPOST. The options and scaling parameters selected for POSTUTIL conformed to the Federal Land Managers (FLM) modeling guidance.

Figure 4-2
RECEPTOR RINGS FOR FAR-FIELD ANALYSIS (CALPUFF)



- Ground-level ozone data for 2006 was obtained from the Clean Air Status and Trends Network (CASTNET), and monthly ozone averages were calculated for the Gothic (GTH161), Canyonlands National Park (CAN407) and Rocky Mountain National Park (ROM206) monitors. Each Class I and sensitive Class II area was assigned the calculated monthly ozone averages from the monitor located closest to that area, as noted below:
  - Arches National Park and Canyonlands National Park (Class I Areas) - Canyonlands National Park monitor monthly average ozone value;
  - Black Canyon of the Gunnison Wilderness and Maroon Bells – Snowmass Wilderness (Class I areas) - Gothic monitor monthly average ozone concentrations;
  - Colorado National Monument (sensitive Class II area) Gothic monitor monthly average ozone concentrations;
  - Flat Tops Wilderness (Class I area) and Dinosaur National Monument (sensitive Class II area) - a Gothic / Rocky Mountain National Park average of the monthly average ozone concentrations.
- Maximum mixing height is established at 5,000 meters rather than the CALPUFF-Lite default value of 3,000 meters, due to the fact that the mixing height in Colorado is much higher during the summer. Typical summertime overland mixing heights in the Denver, Colorado Front Range area are often well in excess of 3,000 meters, at 3,600 to 6,000 meters above sea level. (As an example, a sounding for the evening of July 1, 2002 suggests a mixing height of almost 6,000 meters.)
- Monthly ammonia concentrations input to CALPUFF-Lite were based on the surrounding land use for each area (Class I or sensitive Class II) analyzed. The IWAQM recommendations suggest that typical values are 10 ppb for grasslands, 0.5 ppb for forested lands, and 1 ppb for arid lands at 20 degrees Celsius. Weighted ammonia concentrations were calculated for each sector that contained certain Class I or sensitive Class II Areas.

Only PM_{10} was modeled in CALPUFF-Lite; $PM_{2.5}$ and coarse particulate matter (with diameters between 2.5 and 10 micron) were not modeled. However, impacts are assessed in the model using different light extinction coefficients for the different PM sizes. In order to assess impacts based on contribution from the different PM sizes, a weighted light extinction coefficient was calculated based on the assumption that fugitive $PM_{2.5}$ emissions equal 30 percent of the expected PM_{10} emissions. This weighted coefficient was applied in CALPOST post-processing for all PM concentrations.

Table 4-1
CALPUFF-LITE/CALPOST MODELING OPTIONS

CALPUFF-Lite / CALPOST Variable	Specified Value	Comment
IBTZ	7	Base Time Zone
ISCDAT	ISC Met.File Name	Using ISC-Ready Meteorological Data
MGAUSS	1	Vertical Distribution Used In The Near Field
MCTADJ	3	Terrain Adjustment Method
MCTSG	0	Subgrid-Scale Complex Terrain Flag
MSLUG	0	Near-Field Puffs Modeled As Elongated 0
MTRANS	1	Transitional Plume Rise Modeled
MTIP	1	Stack Tip Downwash
MSHEAR	0	Vertical Wind Shear Modeled Above Stack Top
MSPLIT	0	Puff Splitting Allowed
MCHEM	1	Chemical Mechanism Flag
MWET	1	Wet Removal Modeled
MDRY	1	Dry Deposition Modeled
MDISP	3	Method Used To Compute Dispersion Coefficients
MTURBVW	3	Sigma-V/Sigma-Theta, Sigma-W Measurements Used
MROUGH	0	PG Sigma-Y,Z Adjusted For Roughness
MPARTL	1	Partial Plume Penetration Of Elevated Inversion (per IWAQM)
MTINV	0	Strength Of Temperature Inversion Provided In PROFILE.DAT Extended Records
MPDF	0	PDF Used For Dispersion Under Convective Conditions
MBCON	0	Boundary Conditions (Concentration) Modeled
MBCON	0	Boundary Conditions (Concentration) Modeled
MVISBK	6	Method used for background light extinction
MFRH	2	Particle growth curve f(RH) for hygroscopic species
PMAP	UTM	Map Projection
IUTMZN	13	UTM Zone (not used for LCC except to check O3 file)
UTMHEM	N	Hemisphere For UTM Projection
DATUM	NAR-C	Datum-Region For Output Coordinates
NX	2	No. X Grid Cells
NY	2	No. Y Grid Cells
NZ	1	No. Vertical Layers
DGRIDKM	200	Grid Spacing (km)
XORIGKM	-28.53	Reference Coordinate of Southwest Corner of (1,1)- X Coordinate
YORIGKM	4161.58	Reference Coordinate of Southwest Corner of (1,1)- Y Coordinate
RCUTR	30	Reference Cuticle Resistance
RGR	10	Reference Ground Resistance
REACTR	8	Reference Pollutant Reactivity
NINT	9	Number Of Particle-Size Intervals Used To Evaluate Effective Particle Deposition Velocity
IVEG	1	Vegetation State In Unirrigated Areas
MOZ	0	Ozone Data Input Option
MHFTSZ	0	Switch For Using Heffter Equation For Sigma Z As Above
WSCALM	.5	Minimum Wind Speed (m/s) Allowed For Non-Calm Conditions
XMAXZI	5000m	Maximum Mixing Height (m)
XMINZI	50	Minimum Mixing Height (m)
BCKO3	Varies per area per month	Monthly Background Ozone Concentration (ppb)
BCKNH3	Varies per area per month	Monthly Background Ammonia Concentration (ppb)

4.4 Emission Sources and Modeled Emission Rates (Far-Field Analysis)

Emission sources modeled in CALPUFF-Lite were established similarly to those modeled in AERMOD, as described in Section 3.4 of this Report. All emission sources and activities are the same, and the project is divided into three distinct phases (railroad construction, mine area/transmission line/haul road construction, and production), with distinct timelines for each project phase. However, rather than establishing all emission sources as area sources in the model, the transmission line, railroad, and haul roads were characterized as volume sources in CALPUFF-Lite. Table 4-2 provides a summary of the emission sources included in each phase of the far-field analysis.

Table 4-2
SUMMARY OF EMISSION SOURCES INCLUDED IN FAR-FIELD ANALYSIS, BY PROJECT PHASE

Emission Source	Phase 1 Railroad Construction	Phase 2 Construction: Mine Area / Transmission Line / Haul Roads	Phase 3 Production[1]
Volume 1: Transmission Line		X	
Volume 2: Railroad	X		
Volume 3: Haul Roads		X	
Area: Mine Area		X	X

[1]Mine area emissions during production phase include emissions from vehicle traffic on mine area roads.

The transmission line, railroad, and haul road emission sources used in the far-field (CALPUFF-Lite) analysis are not “bounded,” as they were in the near-field (AERMOD) analysis. The full extent of the proposed transmission line, railroad, and haul road (14.5, 14.5, and 4.6 miles, respectively) are included in the CALPUFF-Lite-defined emission sources. Refer to Figure 3-1 for an illustration of these emission sources, but note that Figure 3-1 does not show the full extent of these emission sources as represented in CALPUFF-Lite. Detailed source parameters used in the far-field analysis are provided in Table 4-3.

Table 4-3
AREA AND VOLUME SOURCE PARAMETER DETAIL, FAR-FIELD ANALYSIS (CALPUFF-LITE)

Parameter → Area Source ↓	Lower Left Corner Easting (m)	Lower Left Corner Northing (m)	Source Base Elevation (m)	Release Height (m)	Sigma – y (m)	Sigma – z (m)	Area (m^2)
Volume Source 1 (Transmission Line)	multiple	multiple	multiple	2	4.65	2.32	N/A
Volume Source 2 (Railroad)	multiple	multiple	multiple	2	4.65	2.32	N/A
Volume Source 3 Haul Roads	multiple	multiple	multiple	2	4.65	2.32	N/A
Area Source Mine Area – Construction	173014	4362500	1655.93	2	N/A	0.0	7366136.15
Area Source Mine Area – Production	173014	4362500	1655.93	5	N/A	4.65	7366136.15

Projected Coordinate System = UTM NAD83 Zone 13 North
m = meter
m2 = square meter
NAD83 = North American Datum of 1983
UTM = Universal Transverse Mercator

An effective release height of 5 meters was chosen for the Mine Area source, to account for the vertical distance above the ground for emission sources associated with production (tall stockpiles, large haul equipment and elevated processing equipment). An initial vertical dimension of 4.65 meters was applied in CALPUFF-Lite.

4.4.1 Emission Rates

As discussed in Section 3.4.1, total emissions for each activity were estimated based on detailed construction and equipment information, utilizing emission factors and calculation methodologies recommended by the USEPA to the extent possible. However, for the far-field analysis, the full amount of estimated project emissions shown in Table 3-3 were modeled for all emission sources, since none of the emission sources were geographically "bounded" in the far-field analysis.

Table 4-4 provides a summary of emission rates modeled in the far-field analysis, grouped according to the specific volume or area source and expressed as both the long-term (tpy) and short-term emission rates (g/s). For each volume or area source, total emissions are distributed equally throughout the associated volume sources or across the associated area. As discussed earlier, total emissions for any volume or area source may include emissions from any of the various sources or activities associated with construction and/or production. Detailed emission summaries are presented in Attachment B to this Report.

As discussed in Section 3, mitigation measures and emission controls such as chemical suppression, watering, and enclosed conveyances will be implemented to reduce particulate matter/fugitive dust emissions during construction and ongoing production activities.

Table 4-4
FAR-FIELD ANALYSIS, MODELED EMISSION INCREASES (CALPUFF-LITE), GROUPED BY AREA SOURCE

	Area Source 1 (Transmission Line)			Area Source 2 (Railroad)			Area Source 3 (Haul Roads)			Area Source 4 (Mine Area, Constr.)			Area Source 4 (Mine Area, Prod.)		
	Long Term[1]		Short Term[2]	Long Term[1]		Short Term[2]	Long Term[1]		Short Term[2]	Long Term[1]		Short Term[2]	Long Term[1]		Short Term[2]
	tpy	g/s	g/s	tpy	g/s	g/s	tpy	g/s	g/s	tpy	g/s	g/s	tpy	g/s	g/s
NO_x	6.3	0.182	1.331	73.2	2.105	5.121	4.1	0.118	2.584	14.7	0.424	3.092	80.2	2.307	2.307
CO	2.2	0.063	0.462	24.0	0.690	1.678	1.4	0.039	0.857	4.8	0.138	1.009	24.3	0.700	0.700
SO_2	0.01	2.3E-4	1.7E-3	0.1	2E-3	3.8E-3	3.5E-3	9.9E-5	2.2E-3	0.01	3.3E-4	2.4E-3	0.04	1.1E-3	1.1E-3
PM_{10}	22.4	0.643	4.697	84.1	2.419	5.887	16.1	0.463	10.143	11.1	0.319	2.325	24.1	0.694	0.694
$PM_{2.5}$	6.9	0.199	1.454	27.7	0.797	1.940	5.0	0.143	3.13	3.8	0.110	0.801	9.6	0.275	0.275

Notes
1. "Long term" refers to annual emissions. For railroad construction (Area Source 2), construction is expected to last less than one year. In this case, the emissions were allocated over the projected total time frame (6 months) rather than a full year. Note that several emission sources will operate over the duration of a full year, but will operate less than 8,760 hours over a 12-month period.
2. "Short term" refers to short-term emission rates, such as 1-hour, 3-hour, or 8-hour average time periods. For several emission sources, the short-term emission rate may be higher than the long-term emission rate.

CO = carbon monoxide
g/s = grams per second
NO_x = nitrogen oxides
$PM_{2.5}$ = particulate matter with an aerodynamic diameter less than 2.5 micrometers
SO_2 = sulfur dioxide
tpy = tons per year

Estimated impacts from CALPUFF-Lite consider emissions occurring during certain hours of the day and seasons of the year, in accordance with projected daily construction and production hours and the projected construction schedule. Because of the spatial length (approximately 14.5 miles) and relatively longer period of time (approximately 6 months) required to construct the rail spur; the CALPUFF-Lite model assumes that railroad construction begins at the south end (near Interstate 70) during winter months, and continues through the following spring season. Seven of the thirteen "volumes" for the railroad volume source are "turned on" in CALPUFF-Lite during three winter-season months, and the remaining six of thirteen "volumes" are turned on during the three spring-season months. The winter and spring months were included in this analysis because initial modeling indicated the largest visibility impacts will occur during winter months.

4.5 CALPUFF-Lite Results and AQRV Analysis

CALPUFF-Lite modeling results for the proposed Red Cliff Mine are presented in Tables 4-5, 4-6, and 4-7. Maximum predicted values are reported for all modeled criteria pollutants, along with maximum nitrogen (N) and sulfur (S) deposition values, and a visibility assessment, for each Class I or sensitive Class II area within the modeling domain. Maximum modeled criteria pollutant concentrations are compared to the Class I increment SILs, and deposition rates are compared to a deposition analysis threshold (DAT) of 0.005 kilogram per hectare per year (kg/ha/yr). The visibility assessment is expressed in terms of the number of days, for each modeled year, that the deciview change exceeds 1.0 (a change of one deciview is approximately equal to a 10 percent change in atmospheric light extinction). A deciview is a measure of visibility; higher deciview levels represent poorer visibility. A one deciview change translates to a "just noticeable" change in visibility for most individuals.

None of the maximum modeled NO_x or SO_2 concentrations for any of the three project phases are above their respective SILs. None of the maximum modeled PM_{10} concentrations during the production phase (Phase 3) are above their respective SILs. However, maximum modeled concentrations of PM_{10} during the Phase 1 and Phase 2 construction phases are above the 24-hour SIL for each year, at each Class I or sensitive Class II area modeled. SILs are not thresholds for asserting unacceptable environmental impacts; rather, they are used in PSD permitting to provide a basic screening of potential impacts and justify the need for further analysis. These results do not necessarily indicate that large PM_{10} impacts will occur during the construction phases of the project. Instead, the results indicate that further analysis may be necessary to predict whether significant impacts will occur.

Visibility changes greater than one deciview are observed for several days across most of the modeled Class I and sensitive Class II areas during the Phase 1 and Phase 2 construction periods. Most of these days occur at the Flat Tops Wilderness, Colorado National Monument, and Black Canyon of the Gunnison Wilderness. The highest number of days with visibility changes occurs at the Colorado National Monument, located less than 25 kilometers from the proposed site. No visibility impacts greater than one deciview are observed for any sites after production (Phase 3) begins.

Five maximum predicted nitrogen deposition rates during Phase 1 construction and two maximum predicted nitrogen deposition rates during Phase 2 construction are greater than the DAT of 0.005 kg/ha/yr. These predicted rates occur at the Colorado National Monument. No other Class I or sensitive Class II areas are predicted to have nitrogen deposition exceeding the DAT during the construction phases, and none of the modeled areas are predicted to have sulfur deposition exceeding the DAT during construction. None of the predicted nitrogen or sulfur deposition rates exceed the DAT during Phase 3 production.

In summary, predicted air quality concentrations at Class I or sensitive Class II areas during Phase 3 (production) are less than the SILs. Therefore, ongoing air quality degradation would be relatively small. During Phase 1 and Phase 2 construction periods, some potentially noticeable air quality degradation may occur with regard to PM_{10}, visibility, and nitrogen deposition. All potential PM_{10}, visibility, and nitrogen deposition impacts are temporary in nature, because they occur during the two construction phases, which are projected to last a total of 1.5 years for both phases.

As mentioned earlier, these CALPUFF-Lite modeling results provide conservatively high air quality impacts due to the model's design and intended use as a screening tool.

Table 4-5
MAXIMUM CALPUFF-LITE PREDICTED IMPACTS FROM PHASE 1 (RAILROAD CONSTRUCTION)

Class I & Class II Areas↓	Pollutant→	NO_x	SO_x			PM_{10}		Visibility[1]	Deposition N[2]	Deposition S[3]
	Modeling Period→	Annual µg/m³	3-hour µg/m³	24-hour µg/m³	Annual µg/m³	24-hour µg/m³	Annual µg/m³	Deciview Change	kg/ha/yr	kg/ha/yr
	↓Year/SIL→	0.1	1	0.2	0.08	0.32	0.16	Days >=1.0	0.005	0.005
Canyonlands National Park	86	0.00156	0.00146	0.00021	0.00000	0.77100	0.01840	0	0.00082	0.00000
	87	0.00136	0.00117	0.00016	0.00001	0.80900	0.01590	1	0.00119	0.00000
	88	0.00126	0.00085	0.00011	0.00000	0.57300	0.01310	0	0.00069	0.00000
	89	0.00185	0.00070	0.00013	0.00000	0.42300	0.01640	0	0.00083	0.00000
	90	0.00209	0.00088	0.00012	0.00001	0.55500	0.01760	0	0.00094	0.00000
Arches National Park	86	0.00253	0.00055	0.00008	0.00000	0.51100	0.01630	0	0.00063	0.00000
	87	0.00232	0.00034	0.00006	0.00000	0.33100	0.01300	0	0.00070	0.00000
	88	0.00239	0.00027	0.00007	0.00000	0.39100	0.01620	0	0.00066	0.00000
	89	0.00252	0.00030	0.00006	0.00000	0.37900	0.01470	0	0.00064	0.00000
	90	0.00278	0.00047	0.00008	0.00000	0.42500	0.01550	0	0.00073	0.00000
Maroon – Bells Snowmass Wilderness	86	0.00147	0.00178	0.00028	0.00001	0.70900	0.02020	0	0.00110	0.00000
	87	0.00143	0.00200	0.00035	0.00001	0.85200	0.02140	0	0.00187	0.00001
	88	0.00131	0.00112	0.00015	0.00000	0.74900	0.01550	0	0.00096	0.00000
	89	0.00170	0.00149	0.00026	0.00001	0.65400	0.01860	0	0.00122	0.00000
	90	0.00206	0.00176	0.00027	0.00001	0.65000	0.02130	0	0.00134	0.00000
Dinosaur National Monument	86	0.00235	0.00164	0.00025	0.00001	0.95600	0.02190	1	0.00130	0.00000
	87	0.00244	0.00203	0.00031	0.00001	0.79700	0.02510	0	0.00209	0.00001
	88	0.00204	0.00169	0.00022	0.00001	0.48800	0.02020	0	0.00128	0.00000
	89	0.00271	0.00162	0.00027	0.00001	0.64600	0.02270	0	0.00145	0.00000
	90	0.00270	0.00153	0.00026	0.00001	0.69200	0.02720	1	0.00166	0.00000
Flat Tops Wilderness	86	0.00235	0.00208	0.00030	0.00001	0.92700	0.02230	2	0.00114	0.00000
	87	0.00232	0.00191	0.00029	0.00001	0.76000	0.02450	0	0.00191	0.00001
	88	0.00189	0.00156	0.00020	0.00001	0.46700	0.01920	0	0.00109	0.00000
	89	0.00259	0.00163	0.00025	0.00001	0.59500	0.02240	0	0.00137	0.00000
	90	0.00261	0.00149	0.00026	0.00001	0.63600	0.02590	1	0.00140	0.00000

Table 4-5
MAXIMUM CALPUFF-LITE PREDICTED IMPACTS FROM PHASE 1 (RAILROAD CONSTRUCTION)

Class I & Class II Areas↓	Pollutant→	NO_x	SO_x			PM_{10}		Visibility[1]	Deposition N[2]	Deposition S[3]
	Modeling Period→	Annual µg/m³	3-hour µg/m³	24-hour µg/m³	Annual µg/m³	24-hour µg/m³	Annual µg/m³	Deciview Change	kg/ha/yr	kg/ha/yr
	↓Year/SIL→	0.1	1	0.2	0.08	0.32	0.16	Days >=1.0	0.005	0.005
Colorado National Monument	86	0.03430	0.00332	0.00062	0.00003	1.97000	0.09490	3	0.00628	0.00001
	87	0.03980	0.00390	0.00069	0.00004	2.39000	0.10500	7	0.00694	0.00001
	88	0.05260	0.00359	0.00069	0.00005	2.39000	0.14600	20	0.00866	0.00001
	89	0.05030	0.00347	0.00080	0.00005	2.64000	0.14600	16	0.00876	0.00001
	90	0.03640	0.00339	0.00070	0.00004	1.53000	0.10700	6	0.00670	0.00001
Black Canyon of the Gunnison Wilderness	86	0.00223	0.00153	0.00025	0.00001	1.00000	0.02130	1	0.00000	0.00000
	87	0.00246	0.00217	0.00037	0.00001	0.91200	0.02560	0	0.00000	0.00000
	88	0.00209	0.00166	0.00022	0.00001	0.75800	0.02110	0	0.00000	0.00000
	89	0.00281	0.00181	0.00028	0.00001	0.67500	0.02340	0	0.00000	0.00000
	90	0.00283	0.00171	0.00025	0.00001	0.74300	0.02810	1	0.00000	0.00000

[1] Number of days with deciview change >1.0.
[2] Nitrogen deposition (N)
[3] Sulfur deposition (S)

µg/m = micrograms per meter
kg/ha/yr = kilogram per hectare per year
NO_x = nitrogen oxides
PM_{10} = particulate matter with an aerodynamic diameter less than 10 micrometers
SIL = significant impact levels
SO_x = sulfur oxides

Table 4-6
MAXIMUM CALPUFF-LITE PREDICTED IMPACTS FROM PHASE 2 (MINE AREA, TRANSMISSION LINE, AND ROAD CONSTRUCTION)

Class I & Class II Areas↓	Pollutant→	NO_x	SO_x			PM_{10}		Visibility[1]	Deposition N[2]	Deposition S[3]
	Modeling Period→	Annual µg/m³	3-hour µg/m³	24-hour µg/m³	Annual µg/m³	24-hour µg/m³	Annual µg/m³	Deciview Change	kg/ha/yr	kg/ha/yr
	↓Year/SIL→	0.1	1	0.2	0.08	0.32	0.16	Days >=1.0	0.005	0.005
Canyonlands National Park	86	0.00039	0.00031	0.00005	0.00000	0.36657	0.01498	0	0.00034	0.00000
	87	0.00035	0.00031	0.00006	0.00000	0.33262	0.01545	0	0.00043	0.00000
	88	0.00033	0.00047	0.00007	0.00000	0.40435	0.01517	0	0.00039	0.00000
	89	0.00040	0.00025	0.00004	0.00000	0.52048	0.01475	0	0.00032	0.00000
	90	0.00054	0.00027	0.00005	0.00000	0.55103	0.01954	0	0.00040	0.00000
Arches National Park	86	0.00072	0.00055	0.00008	0.00000	0.35640	0.01502	0	0.00045	0.00000
	87	0.00061	0.00034	0.00005	0.00000	0.28351	0.01575	0	0.00055	0.00000
	88	0.00064	0.00031	0.00006	0.00000	0.39629	0.01811	0	0.00040	0.00000
	89	0.00066	0.00065	0.00012	0.00000	0.80472	0.01584	0	0.00045	0.00000
	90	0.00098	0.00030	0.00007	0.00000	0.75804	0.02247	0	0.00040	0.00000
Maroon – Bells Snowmass Wilderness	86	0.00100	0.00201	0.00031	0.00001	1.10210	0.03164	1	0.00118	0.00001
	87	0.00089	0.00187	0.00030	0.00001	1.08590	0.03155	1	0.00155	0.00001
	88	0.00086	0.00225	0.00031	0.00001	0.98654	0.02846	1	0.00137	0.00001
	89	0.00117	0.00167	0.00023	0.00001	0.76340	0.03164	0	0.00134	0.00001
	90	0.00096	0.00181	0.00026	0.00001	0.91212	0.03471	2	0.00130	0.00001
Dinosaur National Monument	86	0.00119	0.00170	0.00028	0.00001	1.06900	0.03211	3	0.00132	0.00001
	87	0.00123	0.00193	0.00027	0.00001	0.90548	0.03711	1	0.00186	0.00001
	88	0.00126	0.00230	0.00030	0.00001	1.02960	0.0345	2	0.00159	0.00001
	89	0.00149	0.00178	0.00024	0.00001	0.77674	0.03479	0	0.00142	0.00001
	90	0.00135	0.00170	0.00024	0.00001	0.79433	0.03766	2	0.00137	0.00001
Flat Tops Wilderness	86	0.00122	0.00183	0.0003	0.00001	1.17490	0.03354	2	0.00117	0.00001
	87	0.00123	0.00199	0.00028	0.00001	1.00660	0.03866	2	0.00175	0.00001
	88	0.00125	0.00255	0.00033	0.00001	1.18150	0.03522	2	0.00151	0.00001
	89	0.00148	0.00196	0.00025	0.00001	0.84322	0.03580	3	0.00137	0.00001
	90	0.00137	0.00177	0.00023	0.00001	0.82726	0.03817	2	0.00127	0.00001

Table 4-6
MAXIMUM CALPUFF-LITE PREDICTED IMPACTS FROM PHASE 2 (MINE AREA, TRANSMISSION LINE, AND ROAD CONSTRUCTION)

Class I & Class II Areas↓	Pollutant→	NO_x	SO_x			PM_{10}		Visibility[1]	Deposition N[2]	Deposition S[3]
	Modeling Period→	Annual µg/m³	3-hour µg/m³	24-hour µg/m³	Annual µg/m³	24-hour µg/m³	Annual µg/m³	Deciview Change	kg/ha/yr	kg/ha/yr
	↓Year/SIL→	0.1	1	0.2	0.08	0.32	0.16	Days >=1.0	0.005	0.005
Colorado National Monument	86	0.01149	0.01062	0.00133	0.00003	3.00000	0.08551	4	0.00562	0.00002
	87	0.01160	0.00542	0.00068	0.00002	1.76320	0.08955	1	0.00459	0.00002
	88	0.01090	0.00760	0.00095	0.00003	1.63920	0.09963	2	0.00499	0.00002
	89	0.01281	0.00801	0.00100	0.00003	2.41570	0.09787	3	0.00440	0.00001
	90	0.01008	0.00794	0.00102	0.00003	2.33550	0.09230	4	0.00524	0.00002
Black Canyon of the Gunnison Wilderness	86	0.00125	0.00198	0.00030	0.00001	1.12130	0.03423	4	0.00130	0.00001
	87	0.00129	0.00181	0.00029	0.00001	1.08850	0.04014	2	0.00184	0.00001
	88	0.00137	0.00229	0.00030	0.00001	1.04900	0.03797	2	0.00163	0.00001
	89	0.00165	0.00173	0.00025	0.00001	0.82995	0.03864	1	0.00150	0.00001
	90	0.00148	0.00177	0.00026	0.00001	0.89975	0.04111	3	0.00138	0.00001

[1] Number of days with deciview change >1.0.
[2] Nitrogen deposition (N)
[3] Sulfur deposition (S)

µg/m = micrograms per meter
kg/ha/yr = kilogram per hectare per year
NO_x = nitrogen oxides
PM_{10} = particulate matter with an aerodynamic diameter less than 10 micrometers
SIL = significant impact levels
SO_x = sulfur oxides

Table 4-7
MAXIMUM CALPUFF-LITE PREDICTED IMPACTS FROM PHASE 3 (PRODUCTION)

Class I & Class II Areas↓	Pollutant→	NO_x	SO_x			PM_{10}		Visibility[1]	Deposition N[2]	Deposition S[3]
	Modeling Period→	Annual μg/m³	3-hour μg/m³	24-hour μg/m³	Annual μg/m³	24-hour μg/m³	Annual μg/m³	Deciview Change	kg/ha/yr	kg/ha/yr
	↓Year/SIL→	0.1	1	0.2	0.08	0.32	0.16	Days >=1.0	0.005	0.005
Canyonlands National Park	86	0.00128	0.00004	0.00001	0.00000	0.01457	0.00153	0	0.00057	0.00000
	87	0.00136	0.00004	0.00001	0.00000	0.00960	0.00157	0	0.00066	0.00000
	88	0.00126	0.00004	0.00001	0.00000	0.01452	0.00152	0	0.00061	0.00000
	89	0.00145	0.00009	0.00002	0.00000	0.05401	0.00169	0	0.00056	0.00000
	90	0.00173	0.00004	0.00001	0.00000	0.03470	0.00190	0	0.00067	0.00000
Arches National Park	86	0.00410	0.00011	0.00002	0.00000	0.02026	0.00303	0	0.00123	0.00000
	87	0.00423	0.00007	0.00002	0.00000	0.01457	0.00308	0	0.00139	0.00000
	88	0.00411	0.00006	0.00002	0.00000	0.02009	0.00297	0	0.00128	0.00000
	89	0.00419	0.00013	0.00003	0.00000	0.06061	0.00320	0	0.00120	0.00000
	90	0.00471	0.00006	0.00002	0.00000	0.05266	0.00344	0	0.00133	0.00000
Maroon – Bells Snowmass Wilderness	86	0.00272	0.00033	0.00006	0.00000	0.04951	0.00437	0	0.00186	0.00000
	87	0.00269	0.00046	0.00007	0.00001	0.06006	0.00474	0	0.00231	0.00000
	88	0.00262	0.00041	0.00006	0.00000	0.05746	0.00436	0	0.00205	0.00000
	89	0.00334	0.00036	0.00006	0.00001	0.04932	0.00487	0	0.00218	0.00000
	90	0.00321	0.00038	0.00006	0.00001	0.04857	0.00466	0	0.00198	0.00000
Dinosaur National Monument	86	0.00441	0.00047	0.00008	0.00001	0.06406	0.00581	0	0.00246	0.00000
	87	0.00447	0.00042	0.00006	0.00001	0.05619	0.00626	0	0.00304	0.00000
	88	0.00448	0.00067	0.00009	0.00001	0.07507	0.00600	0	0.00288	0.00000
	89	0.00478	0.00042	0.00007	0.00001	0.05984	0.00601	0	0.00252	0.00000
	90	0.00451	0.00052	0.00007	0.00001	0.05996	0.00555	0	0.00228	0.00000
Flat Tops Wilderness	86	0.00424	0.00046	0.00007	0.00001	0.06253	0.00562	0	0.00221	0.00000
	87	0.00419	0.00045	0.00006	0.00001	0.05940	0.00606	0	0.00281	0.00000
	88	0.00419	0.00059	0.00008	0.00001	0.06742	0.00583	0	0.00265	0.00000
	89	0.00465	0.00042	0.00006	0.00001	0.05727	0.00594	0	0.00236	0.00000
	90	0.00438	0.00048	0.00006	0.00001	0.05524	0.00547	0	0.00219	0.00000

Table 4-7
MAXIMUM CALPUFF-LITE PREDICTED IMPACTS FROM PHASE 3 (PRODUCTION)

Class I & Class II Areas↓	Pollutant→	NO_x	SO_x			PM_{10}		Visibility[1]	Deposition N[2]	Deposition S[3]
	Modeling Period→	Annual µg/m³	3-hour µg/m³	24-hour µg/m³	Annual µg/m³	24-hour µg/m³	Annual µg/m³	Deciview Change	kg/ha/yr	kg/ha/yr
	↓Year/SIL→	0.1	1	0.2	0.08	0.32	0.16	Days >=1.0	0.005	0.005
Colorado National Monument	86	0.06837	0.00129	0.00023	0.00004	0.16324	0.02776	0	0.01416	0.00001
	87	0.07231	0.00115	0.00024	0.00004	0.17413	0.02933	0	0.01507	0.00001
	88	0.06916	0.00115	0.00031	0.00004	0.21695	0.02777	0	0.01414	0.00001
	89	0.06345	0.00100	0.00028	0.00004	0.20546	0.02721	0	0.01360	0.00001
	90	0.06544	0.00116	0.00026	0.00004	0.19258	0.02717	0	0.01361	0.00001
Black Canyon of the Gunnison Wilderness	86	0.00471	0.00041	0.00007	0.00001	0.06379	0.00594	0	0.00241	0.00000
	87	0.00479	0.00042	0.00006	0.00001	0.05737	0.00648	0	0.00306	0.00000
	88	0.00481	0.00070	0.00009	0.00001	0.07874	0.00619	0	0.00286	0.00000
	89	0.00512	0.00041	0.00007	0.00001	0.06002	0.00622	0	0.00253	0.00000
	90	0.00483	0.00054	0.00007	0.00001	0.05988	0.00574	0	0.00225	0.00000

[1] Number of days with deciview change >1.0.
[2] Nitrogen deposition (N)
[3] Sulfur deposition (S)

µg/m = micrograms per meter
kg/ha/yr = kilogram per hectare per year
NO_x = nitrogen oxides
PM_{10} = particulate matter with an aerodynamic diameter less than 10 micrometers
SIL = significant impact levels
SO_x = sulfur oxides

5.0 References

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Attachment A

Estimated Duration for Project Phases

CAM-Colorado LLC
Tasks for Red Cliff Mine Construction
Mesa & Garfield Counties, Colorado

		Year 1				Year 2			
		1	2	3	4	1	2	3	4
Construction									
	Spur Track & Pipeline	X	X	X					
	Pump System		X						
	Sediment Ponds & Collection Ditches				X	X			
	Loadout Loop & Batch Weigh System			X	X	X			
	Access & Haul Roads				X	X			
	Portal Face-up					X			
	Crushing & Screening Facility					X			
	Conveyor Belts				X	X	X		
	Office/Shop/Warehouse & Misc Facilities					X	X		
	Sewage Treatment Facility						X		
	Transmission Line Construction				X	X			
	Electrical Substation(s) & Distribution					X	X		
	Preparation Plant Construction					X	X		
	Water Tank						X		
	Refuse Pile Preparation						X		
Mine Coal								X	

Source: email sent from Jim Stover to URS Corporation, 12/17/2007.

Attachment B

Emission Calculations

PROJECT TITLE:	BY:
RedCliff Contruction - Portals, Benches, and Facilities	URS
PROJECT NO.	
22238745	
SUBJECT:	DATE:
Combustion Emissions	June 2, 2008

ON-SITE MACHINERY TAILPIPE EMISSIONS

Fuel Type	Heat Content	Fuel Consumption	Energy Consumption	
	Btu/gal	*gal/yr*	*MMBtu/yr*	*hp-hr/yr*
Diesel	137,000	100,799	13,810	5,424,000
Gasoline	130,000	122	16	3,660

Emission Factors

Diesel			*Reference*
NO_x	9.1E-03	*lb/hp-hr*	*Nonroad Engine Emissions Modeling - EPA*
CO	3.0E-03	*lb/hp-hr*	*Nonroad Engine Emissions Modeling - EPA*
PM_{10}	4.4E-04	*lb/hp-hr*	*Nonroad Engine Emissions Modeling - EPA*
VOC*	4.1E-04	*lb/hp-hr*	*Nonroad Engine Emissions Modeling - EPA*
SO_2	0.0015	% S	*Fuel Quality*
CO_2	1.15	*lb/hp-hr*	*AP-42, Table 3.3-1*
CH_4 **	0.13	*g/L fuel*	*Compendium of GHG Emission Methodologies for the Oil and Gas Industry, Table 4-9****
N_2O **	0.08	*g/L fuel*	*Compendium of GHG Emission Methodologies for the Oil and Gas Industry, Table 4-9****

** HC factor x 1.053 (EPA Conversion Factor)*
*** Published by the American Petroleum Institute (2004). Assumes moderate control of heavy-duty diesel vehicles.*

Gasoline			*Reference*
NO_x	0.651	*gram / mile*	*AP-42, MOBILES5, Light Duty Gasoline Trucks 1*
CO	9.659	*gram / mile*	*AP-42, MOBILES5, Light Duty Gasoline Trucks 1*
PM_{10}	0.054	*gram / mile*	*Particulate Emission Factors for Mobile Sources - EPA - Heavy Duty Gas*
VOC**	0.524	*gram / mile*	*AP-42, MOBILES5, Light Duty Gasoline Trucks 1*
SO_2	0.084	*lb/MMBtu*	*AP-42, Table 3.3-1*
CO_2	154	*lb/MMBtu*	*AP-42, Table 3.3-1*
CH_4 ****	0.44	*g/L fuel*	*Compendium of GHG Emission Methodologies for the Oil and Gas Industry, Table 4-9****
N_2O ****	0.2	*g/L fuel*	*Compendium of GHG Emission Methodologies for the Oil and Gas Industry, Table 4-9****

*** HC factor x 0.933 (EPA Conversion Factor)*
***** Assumes oxidation catalyst for gasoline vehicles.*

BLASTING EMISSIONS

Blasts per year	3.0	
Tons ANFO per blast	5.0	*tons*
NOx per ton ANFO	17.0	*lb/t*
NOx emissions	0.1	*tons*

Emissions

Pollutant	Blasting	Diesel Combustion	Gasoline Combustion	Total	Total
	ton/yr	*ton/yr*	*ton/yr*	*ton/yr*	*g/sec*
NO_x	0.1	14.593	0.002	14.7	3.09
CO		4.777	0.026	4.8	1.01
PM_{10}		0.706	0.000	0.7	0.15
VOC		0.662	0.001	0.7	0.14
SO_2		0.011	0.001	0.0	0.00
CO_2		1840.092	1.216	1,841.3	386.67
CH_4		0.055	0.000	0.1	0.01
N_2O		0.034	0.000	0.0	0.01

Miscellaneous Information

Load Factor (Hi)	59%		Conversion Factors	2,546	*Btu/hp-hr*
Diesel Density	7.05	*lb/gal*		453.6	*g/lb*
				2,000	*lb/ton*
				1,200	*hr/yr*
				3.79	*l/gal*
				3,600	*sec/hr*

PROJECT TITLE:	BY:
RedCliff Contruction - Transmission Line	URS
PROJECT NO.	
22238745	
SUBJECT:	DATE:
Emission Summary	June 2, 2008

ENGINEERING CALCULATIONS

EMISSION SUMMARY

Criteria Pollutants: Annual (Long-Term) Emissions (ton/yr)

Pollutant	Fugitive PM10	Combustion Sources	Total
NO_x		6.34	6.34
CO		2.20	2.20
PM_{10}	22.06	0.31	22.37
$PM_{2.5}$	6.62	0.31	6.92
VOC		0.29	0.29
SO_2		0.01	0.01
CO_2		803.92	803.92
CH_4		0.02	0.02
$CH_4(CO_2e)$[1]		0.52	0.52
N_2O		0.02	0.02
$N_2O(CO_2e)$[1]		4.68	4.68

Criteria Pollutants: Short-term Emissions (grams/sec)

Pollutant	Fugitive PM10	Combustion Sources	Total
NO_x		1.33	1.33
CO		0.46	0.46
PM_{10}	1.54	0.06	1.61
$PM_{2.5}$	0.46	0.06	0.53
VOC		0.06	0.06
SO_2		0.00	0.00
CO_2		168.82	168.82
CH_4		0.01	0.01
N_2O		0.00	0.00

[1] (CO_2e) = Carbon Dioxide Equivalent. *Non-CO2 Greehouse Gas Emissions from Developed Countries: 1990 - 2010*, Environmental Protection Agency, December 2001.
Global Warming Potential of CH_4 = 21. CH_4(tons) X 21(GWP) = $CH_4(CO_2e)$ Global Warming Potential of N_2O = 310. N_2O(tons) X 310(GWP) = $N_2O(CO_2e)$

PROJECT TITLE:	BY:
RedCliff Contruction - Railroad	URS
PROJECT NO.	
22238745	
SUBJECT:	DATE:
Emission Summary	June 2, 2008

ENGINEERING CALCULATIONS

EMISSION SUMMARY

Criteria Pollutants: Annual (Long-Term) Emissions (ton/yr)

Pollutant	Fugitive PM10	Combustion Sources	Total
NO_x		73.16	73.16
CO		23.97	23.97
PM_{10}	80.56	3.54	84.10
$PM_{2.5}$	24.17	3.54	27.71
VOC		3.32	3.32
SO_2		0.05	0.05
CO_2		9,226.15	9,226.15
CH_4		0.27	0.27
$CH_4(CO_2e)$[1]		5.76	5.76
N_2O		0.17	0.17
$N_2O(CO_2e)$[1]		52.33	52.33

Criteria Pollutants: Short-term Emissions (grams/sec)

Pollutant	Fugitive PM10	Combustion Sources	Total
NO_x		5.12	5.12
CO		1.68	1.68
PM_{10}	5.64	0.25	5.89
$PM_{2.5}$	1.69	0.25	1.94
VOC		0.23	0.23
SO_2		0.00	0.00
CO_2		645.83	645.83
CH_4		0.02	0.02
N_2O		0.01	0.01

[1] (CO_2e) = Carbon Dioxide Equivalent. *Non-CO2 Greehouse Gas Emissions from Developed Countries: 1990 - 2010*, Environmental Protection Agency, December 2001.
Global Warming Potential of CH_4 = 21. CH_4(tons) X 21(GWP) = $CH_4(CO_2e)$
Global Warming Potential of N_2O = 310. N_2O(tons) X 310(GWP) = $N_2O(CO_2e)$

PROJECT TITLE:	BY:
RedCliff Contruction - Production	URS
PROJECT NO.	
22238745	
SUBJECT:	DATE:
Emission Summary - Year 1	June 2, 2008

ENGINEERING CALCULATIONS

EMISSION SUMMARY

Criteria Pollutants: Annual (Long-Term) Emissions (ton/yr)

Pollutant	Mining Fugitive	Coal Transport to and from	Mining Combustion Sources	Mining Point Sources	Total
NO_x			80.54		80.54
CO			10.04		10.04
PM_{10}	15.79	2.68	3.33	2.00	23.80
$PM_{2.5}$	4.74	0.80	1.00	0.60	7.14
VOC			3.91		3.91
SO_2			0.04		0.04
CO_2			10462.98		10,462.98
CH_4	85,111		0.09		85,110.77
$CH_4(CO_2e)$[1]	1,787,324		1.90		1,787,326.22
N_2O			0.61		0.61
$N_2O(CO_2e)$[1]			189.27		189.27

Criteria Pollutants: Short-term Emissions (grams/sec)

Pollutant	Mining Fugitive	Coal Transport to and from	Mining Combustion Sources	Mining Point Sources	Total
NO_x			2.32		2.32
CO			0.29		0.29
PM_{10}	0.45	0.08	0.10	0.06	0.68
$PM_{2.5}$	0.14	0.02	0.03	0.02	0.21
VOC			0.11		0.11
SO_2			0.00		0.00
CO_2			300.99		300.99
CH_4	2,448.39		0.00		2,448.39
N_2O			0.02		0.02

[1] (CO_2e) = Carbon Dioxide Equivalent. *Non-CO2 Greehouse Gas Emissions from Developed Countries: 1990 - 2010*, Environmental Protection Agency, December 2001. Global Warming Potential of CH_4 = 21. CH_4(tons) X 21(GWP) = $CH_4(CO_2e)$ Global Warming Potential of N_2O = 310. N_2O(tons) X 310(GWP) = $N_2O(CO_2e)$

PROJECT TITLE:	BY:
RedCliff Contruction - Mitchell Road	URS
PROJECT NO.	
22238745	
SUBJECT:	DATE:
Emission Summary	June 2, 2008

ENGINEERING CALCULATIONS

EMISSION SUMMARY

Criteria Pollutants: Annual (Long-Term) Emissions (ton/yr)

Pollutant	Fugitive PM10	Combustion Sources	Total
NO_x		2.95	2.95
CO		0.97	0.97
PM_{10}	14.89	0.14	15.03
$PM_{2.5}$	4.47	0.14	4.61
VOC		0.13	0.13
SO_2		0.00	0.00
CO_2		372.10	372.10
CH_4		0.01	0.01
$CH_4(CO_2e)$[1]		0.23	0.23
N_2O		0.01	0.01
$N_2O(CO_2e)$[1]		2.11	2.11

Criteria Pollutants: Short-term Emissions (grams/sec)

Pollutant	Fugitive PM10	Combustion Sources	Total
NO_x		1.86	1.86
CO		0.61	0.61
PM_{10}	9.38	0.09	9.47
$PM_{2.5}$	2.81	0.09	2.90
VOC		0.08	0.08
SO_2		0.00	0.00
CO_2		234.42	234.42
CH_4		0.01	0.01
N_2O		0.00	0.00

[1] (CO_2e) = Carbon Dioxide Equivalent. *Non-CO2 Greehouse Gas Emissions from Developed Countries: 1990 - 2010*, Environmental Protection Agency, December 2001.
Global Warming Potential of CH_4 = 21. CH_4(tons) X 21(GWP) = $CH_4(CO_2e)$
Global Warming Potential of N_2O = 310. N_2O(tons) X 310(GWP) = $N_2O(CO_2e)$

PROJECT TITLE:	BY:
RedCliff Contruction - Haul Road	URS
PROJECT NO.	
22238745	
SUBJECT:	DATE:
Emission Summary	June 2, 2008

ENGINEERING CALCULATIONS

EMISSION SUMMARY

Criteria Pollutants: Annual (Long-Term) Emissions (ton/yr)

Pollutant	Fugitive PM10	Combustion Sources	Total
NO_x		1.15	1.15
CO		0.39	0.39
PM_{10}	0.71	0.06	0.77
$PM_{2.5}$	0.21	0.06	0.27
VOC		0.05	0.05
SO_2		0.00	0.00
CO_2		145.76	145.76
CH_4		0.36	0.36
$CH_4(CO_2e)$[1]		7.52	7.52
N_2O		0.22	0.22
$N_2O(CO_2e)$[1]		68.34	68.34

Criteria Pollutants: Short-term Emissions (grams/sec)

Pollutant	Fugitive PM10	Combustion Sources	Total
NO_x		0.73	0.73
CO		0.24	0.24
PM_{10}	0.45	0.04	0.48
$PM_{2.5}$	0.13	0.04	0.17
VOC		0.03	0.03
SO_2		0.00	0.00
CO_2		91.83	91.83
CH_4		0.23	0.23
N_2O		0.14	0.14

[1] (CO_2e) = Carbon Dioxide Equivalent. *Non-CO2 Greehouse Gas Emissions from Developed Countries: 1990 - 2010*, Environmental Protection Agency, December 2001.
Global Warming Potential of CH_4 = 21. CH_4(tons) X 21(GWP) = $CH_4(CO_2e)$
Global Warming Potential of N_2O = 310. N_2O(tons) X 310(GWP) = $N_2O(CO_2e)$