APPENDIX G

Daneros Mine Dispersion Modeling Results, Natural Bridges National Monument

MEMORANDUM

TO: Andrea Reither, Energy Fuels Resources (USA) Inc.

FROM: Eric Farstad, Redhorse Corporation

SUBJECT: Daneros Mine Dispersion Modeling Results, Natural Bridges National Monument, Revision 1

DATE: January 18, 2016

Redhorse Corporation (Redhorse) completed a dispersion modeling analysis for Energy Fuels Resources (USA) Inc. (Energy Fuels) to evaluate potential impacts at Natural Bridges National Monument (NBNM) from maximum proposed operations at the Daneros Mine. The modeling was completed in support of the Environmental Assessment (EA) for the proposed expansion of mining activities and included potential impacts from vehicle travel over Radium King Road. This memorandum summarizes the modeling methodology, source input data, meteorological data, model receptors, regional background pollutant concentrations and the modeling results.

The Daneros Mine is an underground uranium mine located in the central portion of the Colorado Plateau in western San Juan County, Utah. The project site is located in Bullseye Canyon, approximately five miles southwest of Fry Canyon and approximately 8 miles west of NBNM. The location of the site is within an area that is currently classified as an attainment or unclassifiable area for criteria air pollutants. Energy Fuels is planning to expand operations at the mine by adding two new portal areas, increasing surface disturbance, and expanding ore production to a maximum of 72,000 tons per year. The average annual ore production for the mine will be 25,000 tons per year, but the modeling analysis was completed assuming the maximum annual production rate to provide a worst-case impact assessment. As a result, the modeling results presented herein likely overestimate actual impacts that will occur from the mine's emission sources.

This modeling analysis was completed following the guidance and protocols outlined in *Utah Division of Air Quality Emissions Impact Assessment Guidelines* and the U.S. Environmental Protection Agency's (EPA's) *Guideline on Air Quality Models* (Revised 2005). EPA's regulatory model AERMOD (Version 14134) was used to model emissions of 10 micron particulate matter (PM_{10}), 2.5 micron particulate matter ($PM_{2.5}$), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO) from the Daneros Mine's emission sources. The AERMOD analysis incorporated several types of emission source and environmental data into the analysis. These data inputs are described briefly below.

Source Emission Rates and Stack Parameters

Once fully developed, the mine will consist of three portal areas, including the Daneros, Bullseye, and South portal areas. Each portal area will have an ore storage pile, development rock areas, and mobile surface equipment such as front-end loaders, dozers, low profile mining vehicles, and pickup trucks. Emissions from underground mining equipment and blasting will exit the mine through vent shafts. Because the mine is located in a remote area, stationary diesel-powered generators will be used to provide power to the mine. The mine will have 4, 455-kW diesel-fired generators that will be used for primary power as well as a 140-kW auxiliary generator for mine ventilation and emergency operations. In addition, ore haul trucks and ancillary mobile vehicles will travel off-site along the unpaved Radium King Road (County Road B258) from the mine site to

the junction of Utah State Route 95. These vehicles will generate fugitive dust and tailpipe emissions from travel along Radium King Road. Mine related vehicle travel along Radium King Road was modeled to include a maximum of 15 haul trucks and 10 pickup trucks/vans traveling round-trip daily. Mitigation measures to control fugitive dust are planned on the lower, straighter, stretch of Radium King Road and were included in the modeling protocols. This section of Radium King Road includes a 5 mile segment stretching from Universal Transverse Mercator (UTM) location 574468/4165709 meters East/meters North (the intersection with Utah State Route 95) and 578473/4159121 meters East/meters North. The mitigation measures will include application of water and chemical dust suppressants as needed to reduce dust emissions from vehicle traffic. The remainder of the haul route over Radium King Road is winding and haul truck speeds will be significantly reduced.

All of the emission sources described above were included in the model to estimate potential pollutant impacts from mine operations. Modeled emissions sources included both point sources (generators and tanks), volume sources (unpaved roads, material handling), and area sources (storage pile wind erosion). Figure 1 shows the Modeled emission source locations for the Daneros Mine and Radium King Road. The section of Radium King Road that will be treated with water and chemical dust suppressants is shown in Figure 1 as the yellow section of the road.

Model Receptors and Topography

Model receptors were developed for areas within and along the border of NBNM. Following EPA and Utah Division of Air Quality (UDAQ) guidelines, receptor locations were identified with sufficient density and spatial coverage to isolate the area with the highest impacts. To accomplish this goal, the following receptors were developed:

- 100-meter (m) spaced receptors along the NBNM boundary
- 500-m spaced receptors inside the NBNM boundary

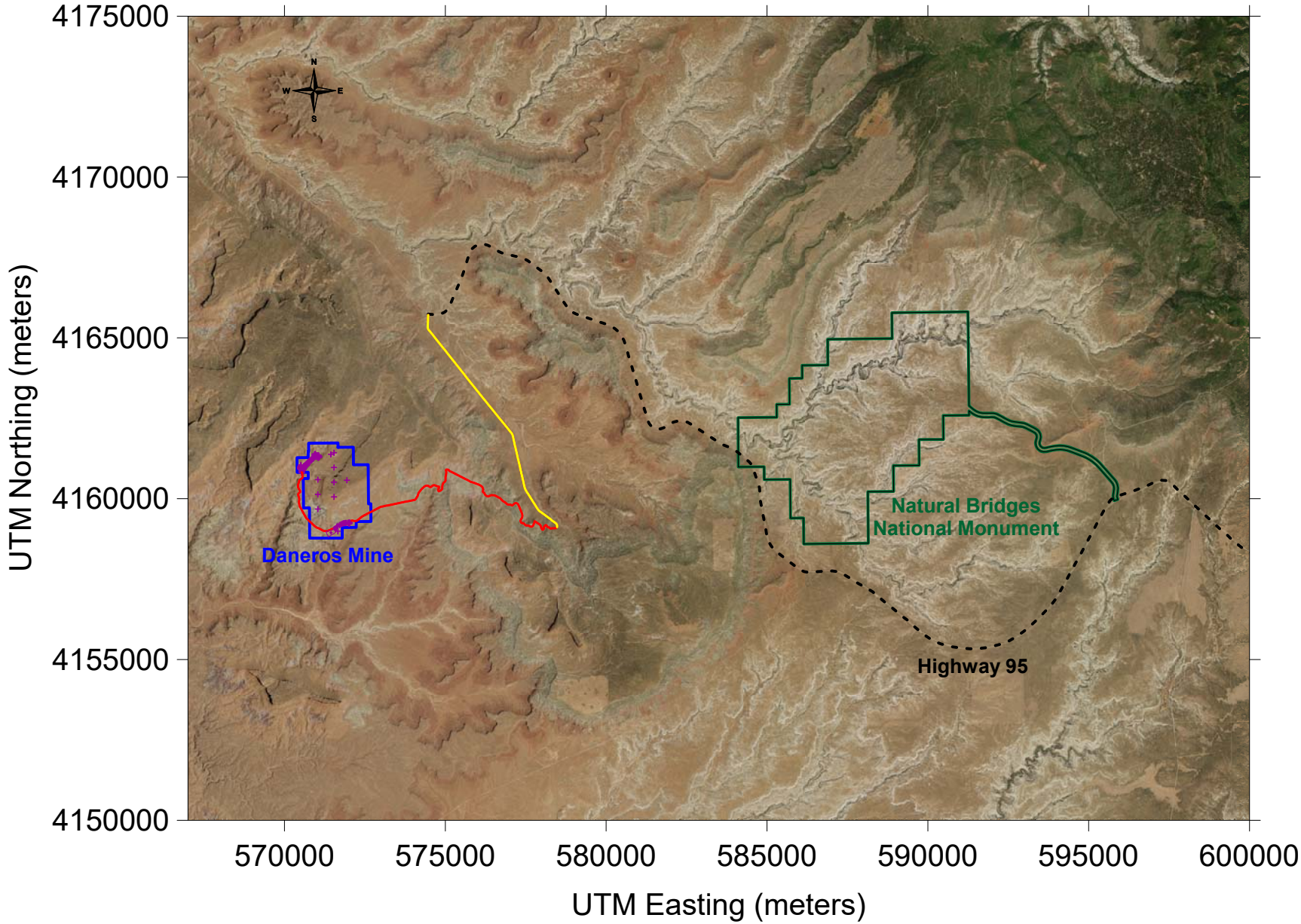
All model receptors were preprocessed using the AERMAP software (Version 11103) that is associated with AERMOD. The AERMAP software establishes a base elevation and terrain information for each receptor location. Digital terrain data from the U.S. Geological Survey (USGS) National Elevation Dataset (NED) were processed with AERMAP. Use of NED terrain data in AERMAP is recommended by EPA for characterizing the terrain throughout the model domain. Output from AERMAP was used as input to the AERMOD runstream file for each model run. Model receptors are presented in the UTM coordinate system, North American Datum of 1983 (NAD83).

Meteorological Data

The dispersion modeling completed in support of the Utah Notice of Intent (NOI) used surface meteorological data from the National Weather Service (NWS) station located in Page, Arizona for the period January 1, 2005 through December 31, 2009 and upper air meteorological data from the Flagstaff, AZ NWS station for the same period. Meteorological data were provided by UDAQ for use in this modeling. This same dataset was reprocessed using AERMET Version 14134 for NBNM modeling. The data were processed into model-ready format utilizing 1-minute wind data from the NWS Automated Surface Observing System (ASOS) network.

Ambient Pollutant Background Concentrations

Ambient background concentrations represent the contribution of pollutant sources that are not included in the modeling analysis, including naturally occurring sources. The background concentrations are usually determined using measured concentrations from nearby air monitors. The background concentrations are added to the modeled impacts and the sum compared with the applicable NAAQS.



LEGEND

- Daneros Maximum Exent of Surface Activity
- Natural Bridges National Monument Boundary
- Radium King Road, Section without Dust Treatment
- Radium King Road, Section with Dust Treatment
- Daneros Emission Points
- Highway 95

Figure 1
Energy Fuels Resources (USA) Inc.; Daneros Mine
Emission Source Points
Including Off-Site Vehicle Haul Route

Background concentrations were obtained from UDAQ for PM_{10} and NO_2 for the Daneros Mine modeling analysis (UDAQ 2012a and UDAQ 2012b). PM_{10} and NO_2 background concentration values were selected by UDAQ from Utah monitoring data to provide conservative estimates of background conditions. NO_2 background concentrations selected by UDAQ were measured in 2011 from a monitoring station located in Price, Utah.

Table 1 shows the background pollutant values used for this modeling analysis.

TABLE 1
POLLUTANT BACKGROUND CONCENTRATIONS

Pollutant	Averaging Period	Background Concentration ($\mu g/m^3$)[a]
Nitrogen Dioxide (NO_2)	Annual	11.20
	1-hour	41.58
PM_{10}	24-hour	45

a - micrograms per cubic meter

Summary of Model Results

The results of the modeling demonstrate that potential impacts from Daneros Mine operations will not have adverse impacts within the NBNM. Modeled impacts of CO, SO_2, and $PM_{2.5}$ at NBNM were all below EPA's Significant Impact Levels (SILs) which were established for these pollutants for New Source Review permitting purposes. An emission source whose modeled impacts are below the SILs for a given pollutant are considered to be low enough that further evaluation for compliance with the NAAQS and/or PSD increments is not needed. Modeled impacts of NO_2 and PM_{10} were both slightly above the SILs meaning that further evaluation may be warranted. The next level of evaluation is to add the modeled results to background concentrations and compare them with the NAAQS. As shown on Table 2, the "Total" concentrations for NO_2 and PM_{10} (the sum of the Regulatory Modeled Impact and Background) are significantly below the NAAQS as well as the Class I and II PSD increment values.

These results show that impacts from the mine's emission sources at locations within NBNM are not expected to cause adverse impacts at the National Monument. Table 2 summarizes the model results for the NBNM analysis.

TABLE 2
DANEROS MINE, DISPERSION MODELING RESULTS FOR NATURAL BRIDGES NATIONAL MONUMENT

Model Scenario	Pollutant	Averaging Period	Model Analysis Notes	Maximum Modeled Impact[a] ($\mu g/m^3$)	Class II SIL ($\mu g/m^3$)	Class I SIL ($\mu g/m^3$)	Regulatory Modeled Impact[b] ($\mu g/m^3$)	Class II PSD Increment ($\mu g/m^3$)	Class I PSD Increment ($\mu g/m^3$)	Background ($\mu g/m^3$)	Total ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
Page, AZ Meteorological Data (With Dust Treatment on Radium King Rd)	NO_2	1-Hour	Tier III OLM, hourly ozone, 0.10 NO2/NOx in-stack ratio	19.5	7.5	--	13.1	--	--	41.6	54.7	188[c]
		Annual		0.4	1	0.10	0.4	25[d]	2.5[d]	11.2	11.6	100[d]
	CO	1-Hour		40.9	2000	--	N/A	--	--	N/A	N/A	40000[e]
		8-Hour		11.3	500	--	N/A	--	--	N/A	N/A	10000[e]
	SO_2	1-Hour		0.4	7.8	--	N/A	--	--	N/A	N/A	196[f]
		3-Hour		0.2	25	1.00	N/A	512[e]	25[e]	N/A	N/A	1300[e]
		24-Hour		0.04	5	0.20	N/A	91[e]	5[e]	N/A	N/A	--
		Annual		0.01	1	0.08	N/A	20[d]	2[d]	N/A	N/A	--
	PM_{10}	24-hour		6.4	5	0.32	5.7	30[e]	8[e]	45.0	50.7	150[e]
		Annual		1.3	1	0.20	1.3	17[d]	4[d]	N/A	N/A	--
	$PM_{2.5}$	24-hour		0.7	1.2	0.07	0.5	9[e]	2[e]	N/A	N/A	35[g]
		Annual		0.2	0.3	0.06	0.1	4[d]	1[d]	N/A	N/A	12[h]

(a) The maximum modeled impact values represent the highest modeled value from the five-year meteorological dataset at any receptor in Natural Bridges National Monument. These modeled values are compared with the SILs.

(b) The regulatory modeled impact values are the modeled value representing the form of the NAAQS. The form of each NAAQS is both pollutant specific and averaging-period specific. The form of each NAAQS is listed in the following table notes.

(c) The standard is based on the 3-year average of the 98th percentile of the daily maximum 1-hour average

(d) Annual mean value not to be exceeded

(e) Not to be exceeded more than once per calendar year

(f) The standard is based on the 3-year average of the 99th percentile of the daily maximum 1-hour average

(g) The standard is based on the 3-year average of the 98th percentile of the 24-hour average

(h) The standard is based on the 3-year average of the weighted annual mean

References

Utah Division of Air Quality (UDAQ). 2012a. E-Mail Message Regarding Meteorological Data, Ozone Data, and Background Data for Use in Modeling the Daneros Mine. From David Prey, Meteorologist, to Eric Farstad, Air Quality Specialist, Redhorse Corporation. April 17.

UDAQ. 2012b. Record of Telephone Conversation Regarding Background Data for Use in Modeling the Daneros Mine. Between David Prey, Meteorologist, Eric Farstad, Air Quality Specialist, Redhorse Corporation, and Christy Woodward, Environmental Coordinator, Denison. May 3.