APPENDIX A2
DOE Analysis of Feasibility of Carbon Capture and Sequestration for the Mesaba Energy Project

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DOE ANALYSIS OF FEASIBILITY OF CARBON CAPTURE AND SEQUESTRATION FOR THE MESABA ENERGY PROJECT

This section discusses carbon capture and sequestration (CCS) and examines why it is not commercially feasible for the proposed action. The discussion includes consideration of the technical and economic feasibility of CCS given current and expected state-of-the-art technologies, foreseeable developments, market forces, and the regulatory framework in relation to the expected in-service date of the project.

The Mesaba Energy Project was selected in 2004 under the Clean Coal Power Initiative (CCPI) Round 2 Funding Opportunity Announcement. CCS was not a requirement of the Round 2 announcement, was not proposed in Excelsior's application submitted in response to the announcement, nor is it included within the project as negotiated and awarded in the DOE Cooperative Agreement. CCS will be the focus of the future CCPI Round 3 Funding Opportunity Announcement.

DOE has parallel research programs aimed at reducing the cost of electricity associated with power production and proving the technical viability of CCS technology. Advancements in gasification, turbine, and CCS technology must converge to make CCS technically and economically feasible. Projects like Mesaba will advance the state-of-the-art in gasification technology thereby making CCS more likely to be deployed in the future.

DOE expects that the combined efforts of these programs will enable large-scale plants to come on-line by 2020 that offer 90% carbon capture with 99% storage permanence at less than a 10% increase in the cost of energy services[1]. The planned in-service date for the Mesaba Energy Project is well in advance of the timeline for achieving the DOE goal.

Technical Feasibility of Carbon Capture

As discussed in Section 2.2.1.3, Section 5.1.2, and Appendix A1, Excelsior has presented a multiple-option carbon management plan to the Minnesota Public Utilities Commission (PUC). At its baseline, the Mesaba Energy Project would be designed with sufficient space available in its footprint for future installation of carbon capture equipment. Adjacent systems would also be designed to facilitate modification for interfacing the carbon capture equipment.

The plan includes the option of using commercially available amine scrubbers to remove carbon dioxide from the syngas stream prior to combustion in the gas turbines that would, assuming 100% subbituminous coal input, result in a nominal 30% reduction in overall carbon dioxide emissions from the plant. Incorporation of this base case carbon capture scenario would result in an adverse impact to plant efficiency and the price of electricity. Other commercially available capture technologies, such as Selexol® and Rectisol® would have a greater adverse impact on plant efficiency and the price of electricity[2].

Excelsior's carbon management plan for the Mesaba Energy Project includes an additional option to convert the carbon monoxide present in the syngas to carbon dioxide for greater removal, if future conditions justified this option. This could conceivably result in about a 90% reduction in overall carbon dioxide emissions from the plant. However, the technologies required for this rely on a gas turbine that is capable of running on hydrogen-rich gas. For example, this process relies on converting water and carbon monoxide to carbon dioxide and hydrogen, as shown in the reaction below, using a water-gas shift reactor.

$$CO + H_2O \rightarrow CO_2 + H_2$$

This results in a carbon monoxide-depleted, hydrogen-rich syngas. Conventional, commercially available combustion gas turbines envisioned for this project cannot operate on carbon monoxide-depleted syngas where the hydrogen concentration approaches 100%. Currently commercially-available combustion gas turbines at sizes much smaller than those envisioned for this project operate on hydrogen-rich fuels. These machines are typically operating on a blend of hydrogen (typically less than 60% hydrogen) and some other energy containing fuel, such as carbon monoxide or methane. However, the size, combustion technology and vintage of these smaller and older machines results in poor performance in terms of low efficiency and high emissions. This current experience, on smaller machines fueled with a hydrogen blend, does not translate to technology for larger machines fueled with nearly 100% hydrogen that would be needed for the Mesaba project, where high efficiency and low emissions are a requirement.

Currently, advanced turbines are in development that address these issues but are not expected to be commercially available at the Mesaba project's in-service date. Even when these advanced turbines are commercially available, the option of precombustion decarbonization to produce a hydrogen fuel would result in substantial capital cost, reduce overall plant efficiency and adversely impact the price of electricity from the Mesaba project. Testimony sponsored by Excelsior in the PUC docket estimated that under the 90% removal scenario, capital equipment cost could increase by up to 40%; corresponding increases in the net plant heat rate would approach 21%[3]. Other independent estimates are that the addition of 90% capture technologies to a gasification plant would increase the cost of energy by about 17%[4] and decrease the net power plant efficiency by about 6-9%[5].

Technical Feasibility of Carbon Dioxide Transport

There are no sufficiently characterized geologic reservoirs capable of sequestering carbon dioxide within the state of Minnesota. The nearest geologic formation of potential interest would be the Lower Cretaceous saline formation approximately 265 miles from the proposed West Range Site. The nearest formation with the potential for revenues would be associated with enhanced oil recovery (EOR) in the Williston Basin of North Dakota. Both scenarios would require a pressurized pipeline; such a pipeline would need

to extend at least 400 miles to reach the Williston Basin. Much experience has been gained in the design, construction and operation of pipelines for transport of carbon dioxide for EOR. There are about 3,000 miles of existing carbon dioxide pipeline in the United States, including examples of pipelines up to 500 miles in length. It is therefore technically feasible to build a pipeline to oil fields or other sequestration sites within about 500 miles from the Mesaba Energy Project location. However, assuming rights-of-way, permits and off-take agreements could be obtained, the cost associated with the transport would significantly increase the cost of electricity.

Technical Feasibility of Carbon Sequestration

Sequestration options include suitable EOR and injection into compatible geologic formations. Beneficial reuse, such as carbonation for soda pop, does not constitute sequestration because it ultimately results in release to the atmosphere. Sequestration is the subject of a great deal of research relative to the efficacy of long-term storage (i.e., permanence) and characterizing suitable "carbon sinks" to ensure that any potential adverse environmental impacts are understood and minimized. DOE has created a network of seven Regional Carbon Sequestration Partnerships to develop the technology, infrastructure, and regulatory framework necessary to implement carbon sequestration in different regions of the Nation. Planning for large-scale sequestration tests is scheduled to begin in fiscal year (FY) 2008 and the tests would run through FY 2017. The purpose of the tests is to demonstrate that large quantities (e.g. one million tons of carbon dioxide per year) can be transported, injected, and stored safely, permanently, and economically.[1]

Large-scale and long-term commercial application of carbon dioxide injection for EOR has occurred in the Texas Permian Basin and in the Weyburn field of the Williston Basin. However, these are economically-driven operations to increase oil production not necessarily scientifically-driven to prove the technical feasibility of permanently sequestering carbon.

Therefore, the technical feasibility of carbon sequestration for the Mesaba Energy Project cannot be validated in the near-term until extensive field tests are conducted to fully characterize potential storage sites and the long-term storage of sequestered carbon has been demonstrated and verified. Further, an MIT study[4] concluded that the major uncertainties surrounding geologic sequestration should be resolved within 10-15 years, which is consistent with the DOE Carbon Sequestration Program goal.

Economic Feasibility of Carbon Capture and Sequestration

The effect of CCS on the cost of electricity from the Mesaba Energy Project has not been quantified. However, there have been a number of studies of the costs of CCS for IGCC plants that show the costs of CCS could increase the cost of electricity by as much as 40%,[6] depending on assumptions regarding the value of the carbon dioxide produced. No statutory or regulatory requirement exists for CCS. Nor does a viable market currently exist for carbon credits. Environmental and construction permitting associated with transport and sequestration would significantly delay the project, further increasing the

cost of electricity. Even if the carbon dioxide could be sold for EOR operations, the revenues from carbon dioxide (estimated at about $20 per ton) would be grossly insufficient to recover such costs. Hence, imposition of CCS on the project will effectively make the cost of electricity non-competitive.

Summary Conclusion

Carbon capture and sequestration is not considered feasible for the Mesaba Energy Project at this time. However, the carbon management plan for the Mesaba Energy Project is a logical starting point from which the PUC can derive findings and thereby establish the appropriate timing and price at which carbon capture and sequestration becomes in the Minnesota ratepayers' interest. Without an order from the PUC that incorporates the costs associated with CCS within the power purchase agreement, the Mesaba Energy Project would not be economically viable.

References

1. Carbon Sequestration Technology Roadmap and Program Plan, 2007, NETL.
2. Comparative IGCC Performance and Costs for Domestic Coals, Conoco-Phillips, Gasification Technology Council, May 2005.
3. Prepared Rebuttal Testimony of Douglas H. Cortez on behalf of Excelsior Energy Inc. and MEP-I LLC, October 10, 2006, page 9.
4. The Future of Coal in a Greenhouse Gas Constrained World, MIT, http://sequestration.mit.edu/pdf/GHGT8_Herzog_Katzer.pdf
5. DOE/NETL 401/053106
6. Cost and Performance Baseline for Fossil Energy Plants, DOE/NETL-2007/1281, May 2007.

APPENDIX B
Air Quality Analysis Data

(Note: Color versions of figures in this Appendix are included in the file posted at the DOE NEPA website: http://www.gc.energy.gov/NEPA/final_evironmental_impact_statements.htm)

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B. AIR QUALITY IMPACT ASSESSMENT

B.1 PREDICTIVE (NEAR-FIELD) MODELING

B.1.1 Modeling Approach

The latest available version of AERMOD (07026), the EPA regulatory default model in the nearfield, was utilized to assess impacts from the Mesaba IGCC Power Plant. Model inputs and control parameter options were selected in accordance with the protocol established in *Guideline on Air Quality Models, Revised* (GAQM) and *User's Guide for the AMS/EPA Regulatory Model - AERMOD*, both EPA documents, as well as Minnesota Pollution Control Agency (MPCA) guidance document *MPCA Air Dispersion Modeling Guidance for Title V Modeling Requirements and Federal Prevention of Significant Deterioration (PSD) Requirements (Version 2.2)* (MPCA, October 2004).

For the modeling analysis for Mesaba IGCC Power Plant, AERMOD was set in regulatory default mode and ambient concentrations; no urban location was identified for the source and thus, AERMOD assumed a rural location. Dry or wet plume depletion was not utilized for any pollutant. A receptor grid was generated per MPCA guidance. See B.1.3 for details.

For meteorological data, pre-processed AERMET (06341) data files downloaded from MPCA were utilized, as required by their guidance. Based on the location of West and East Range sites, MPCA required Hibbing meteorological surface data and International Falls upper air data. MPCA generated data files for these two stations for 1972 to 1976 for every 0.5 degree latitude and longitude across Minnesota. Per MPCA guidance, the files with the closest latitude and longitude to the site should be used for the analysis. For the West Range site, the meteorological data files utilized were HI475935.*, while for the East Range site, the meteorological data files employed were HI475920.*.

The initial air quality modeling addressed the individual point sources of the Mesaba Energy Project, Phase I and Phase II, including four combustion turbine generator (CTG) stacks, two tank vent boiler (TVB) stacks, two auxiliary boilers, and two flare stacks, as well as all fugitive PM_{10} sources (Excelsior, 2006). The modeling was conducted to determine which pollutants will have significant ambient air impacts, and to identify the significant impact area (SIA) for each pollutant. Modeling was conducted for the criteria air pollutants, SO_2, carbon monoxide (CO), NO_X, and particulate matter less than 10 microns (PM_{10}), each applicable averaging time, the operating scenarios (i.e., normal operations and an alternative worst-case flaring scenario). Ozone (O_3) emissions could not be modeled or analyzed because O_3 is not emitted directly from a combustion source. Compliance with O_3 standards is normally analyzed as part of a state or regional implementation plan. Emissions of lead (Pb) were not modeled because the potential Pb emissions from the proposed project will be less than the PSD significant threshold.

Table B.1-1. Annual Criteria Air Pollutant Emission (Phase I Only and Phase I & II Combined)

Pollutant	PSD Significance Threshold (TPY)	Phase I Potential to Emit (1) (TPY)	Phase I & II Potential to Emit (1) (TPY)
CO	100	1,270	2,539
NO_X	40	1,436	2,872
SO_2	40	695	1390
PM	25	271(2)/360(3)	542(2)/719(3)
PM_{10}	15	266(2)/355(3)	532(2)/709(3)
O_3 as VOC	40	99	197

Table B.1-1. Annual Criteria Air Pollutant Emission (Phase I Only and Phase I & II Combined)

Pollutant	PSD Significance Threshold (TPY)	Phase I Potential to Emit [1] (TPY)	Phase I & II Potential to Emit [1] (TPY)
Pb	0.6	0.015	0.03
Sulfuric Acid (H_2SO_4) (mist)	7	65	130
Hydrogen Sulfide (H_2S)	10	9	17

[1] The potential to emit is the maximum capacity of a stationary source to emit any air pollutant under its physical and operational design (i.e., the worst-case scenario) and does not include any regulatory limitations. For the Mesaba Generating Station sources, the worst-case scenario assumes full load at 8760 hrs per year.

[2] West Range Site

[3] East Range Site: Higher emissions because water quality at the East Range Site results in higher PM_{10} emissions from the cooling tower.

Source: Excelsior, 2006a

The SIA was determined for those pollutants that are shown to have a significant impact in ambient air at any point. The SIA was defined for each pollutant as a circle, centered on the plant site, with a radius equal to the greatest distance to a significant impact for any applicable averaging time or emission scenario. No further modeling was conducted if any pollutant did not have a significant impact. However, for pollutants with significant impact, additional modeling was carried out to evaluate compliance with PSD increments and national ambient air quality standards (NAAQS) or Minnesota ambient air quality standards (MAAQS). Applicable significant impact levels (SILs), PSD increments, and the stricter of NAAQS and MAAQS are provided in Table B.1-2.

Table B.1-2. Applicable Air Quality Standards, Increments and SILs

Pollutant	Averaging Time	NAAQS / MAAQS ($\mu g/m^3$)	PSD Class II Increment ($\mu g/m^3$)	Significant Impact Level ($\mu g/m^3$)
SO_2	1-Hour	1,300	512	25
	3-Hour	915	512	25
	24-Hour	365	91	5
	Annual	60	20	1
NO_2	Annual	100	25	1
PM_{10}	24-Hour	150	30	5
	Annual	50	17	1
CO	1-Hour	40,000	NA	2,000
	8-Hour	10,000	NA	500

Source: Excelsior, 2006a

Source input for increment modeling included all point sources associated with Phase I and Phase II and all regional increment-consuming sources included in the emissions inventory, which included data provided by MPCA and accumulated from recent permit applications. In addition to those sources included in the increment analysis, additional nearby sources (provided by MPCA and accumulated from recent permit applications) were added to the source inventory for the NAAQS analysis. Regional source impacts were included (for worst-case modeled impact times and receptors), by modeling the First-Approximation Run Data (FARDATA) emission inventory appropriate to the West Range Site and East

Range Site, as provided by MPCA modeling staff. For comparison to the NAAQS, a background concentration representing natural background was added to all model-predicted concentrations.

In addition to the modeling analyses described above, model results were applied to address other PSD requirements: the potential need for pre-construction monitoring and additional impact analyses relating to growth, soils and vegetation, visibility impairment, and deposition.

B.1.2 Modeled Emissions Rates

The maximum expected point source criteria pollutant emission rates from each phase of the Mesaba Energy Project for different averaging times and operating scenarios, as presented in Tables B.1-3 and B.1-4, were used as model input for the air modeling analyses. The stack parameters in Table B.1-5 were also used as input data. The data presented in Table B.1-3 represent emissions during normal operation of Phases I and II, which were modeled as the "base case" to define the expected air quality impacts of the Mesaba IGCC Power Plant. In response to comments from the Federal Land Managers, Excelsior has identified the worst-case emission scenarios that are possible in various operating scenarios including flaring. To address emission rates and stack gas conditions for these worst-case short-term scenarios, air modeling was also carried out for applicable averaging times (24 hours and less) using the emission rates given in Tables B.1-4. The emission rates represent worst-case maximum emissions for each scenario.

Other sources at the Mesaba IGCC Power Plant will consist of two emergency fire pumps and two emergency diesel generators per phase. Because these sources will operate for only short time periods, when the primary emission sources will not be in operation, they were not included in the air modeling analyses. Hours of operation for these other sources will likely be limited by permit conditions. The emissions from periodic testing of these emergency resources are negligible in comparison to the sources shown in Tables B.1-3 and B.1-4. Fugitive emissions of PM_{10} will result from the storage and handling of coal and other materials and have been modeled under normal operations as described in Appendix D of Excelsior's Air Permit Application.

Table B.1-3. Emission Rates (in g/s) for Normal Operation Scenario – Mesaba I & II

Averaging Time	CTs (each of 4)	TVB (each of 2)	Flare (each of 2)	Aux Boiler (each of 2)	Cooling Twr[1] (each of 34)
One-Hour					
SO_2	22.3	1.06	0.001	0.05	0
CO	12.0	0.74	0.14	1.21	0
Three-Hour					
SO_2	18.5	0.94	0.001	0.05	0
Eight-Hour					
CO	12.0	0.74	0.14	1.21	0
24-Hour					
SO_2	14.0	0.81	0.001	0.05	0
PM_{10}	3.15	0.088	0.002	0.08	*
Annual					
SO_2	9.32	0.45	0.35	0.01	0
PM_{10}	3.15	0.03	0.05	0.02	*
NO_x	19.91	0.76	0.39	0.15	0

[1] Cooling Tower PM10 emission rates vary by tower and plant site. Emission rates per cell are:

West Range Site:	12 cell towers	0.0410 g/s
	5 cell towers	0.0390 g/s
East Range Site:	12 cell towers	0.2181 g/s
	5 cell towers	0.2130 g/s

Table B.1-4. Emission Rates (in g/s) for Alternate Flaring Scenarios – Mesaba I & II[1]

Averaging Time	First CT (each of 2)	Second CT (each of 2)	TVB (each of 2)	Flare (each of 2)
One-Hour				
SO_2	22.30	0.74	1.06	65.52
CO	345.23	345.23	0.74	357.8
Three-Hour				
SO_2	18.5	0.74	0.94	46.3
Eight-Hour				
CO	68.21	68.21	0.74	336.73
24-Hour				
SO_2	7.7	7.7	0.81	9.5
PM_{10}	2.9	2.9	0.09	0.44
Annual				
Not Applicable	---	---	---	---

[1] Emissions from Auxiliary Boilers and Cooling Towers are the same as for Normal Operation Scenario.

Table B.1-5. Mesaba I & II Stack Parameters

Source	Height (m)	Diameter (m)	Temp (deg K)	Velocity (m/s)
Combustion Turbines (each of four)				
All scenarios	45.72	6.1	394.3	20.1
Tank Vent Boilers (each of two)				
One-to-24 Hour	64.01	1.83	579.8	8.46
Annual	64.01	1.83	579.8	1.95
Auxiliary Boiler (each of two)				
All scenarios	12.19	1.52	422.1	9.70
Cooling Towers (each of 34 cells)				
All Scenarios	14.63	10.06	313.0	8.14
Flare (each of two)				
Normal Operation	56.39	0.25	1273.0	20.0
Flaring Scenario				
One-Hour	56.39	7.57	1273.0	20.0
Three-Hour	56.39	7.35	1273.0	20.0
Eight-Hour	56.39	7.35	1273.0	20.0
24-Hour	56.39	6.87	1273.0	20.0

As part of the NAAQS analysis, a Good Engineering Practice (GEP) stack height analysis was conducted. The evaluation demonstrated that all the stacks are less than GEP; therefore they were modeled at their actual heights.

B.1.3 Receptor Grid

For both the West and East Range site locations, discrete receptors in NAD83 UTM zone 15 coordinates were generated based on MPCA modeling guidance, using the Title V modeling policy. The receptor grids are based on a Cartesian coordinate system. Receptor grids for each site are independent of each other, but were generated based on the same methodology using a series of nested grids centered on site location. The placement for these nested grids and associated receptor spacing are summarized in Table B.1-6.

Table B.1-6. Mesaba IGCC Power Plant Receptor Grids

Distance from Property Boundary (km)	Receptor Spacing (m)	Grid Type
At Fence Line	10	Cartesian
0.025 to 0.25	25	Cartesian
0.30 to 0.50	50	Cartesian
0.60 to 1.0	100	Cartesian

1.2 to 2.0	200	Cartesian
2.5 to 4.5	500	Cartesian
5.0 to 10.0	1,000	Cartesian
20.0 to 50.0	10,000	Polar-Based with Cartesian Coordinates

Source: Excelsior

Property boundary (fence line) receptors were set at a spacing of 10 meters. Starting from the fence line and out to about 250 meters, discrete receptors were set at a spacing of 25 meters. From 300 to 500 meters from the property boundary, discrete receptors were spaced at 50 meters, and so on as shown in the table. Using this placement scheme, 8,528 receptors were generated for the West site and 7,295 receptors were generated for the East site. Figure B.1-1 displays the full receptor grid for the West Range site and Figure B.1-2 depicts the full receptor grid for the East Range site.

Figure B.1-1 Full Receptor Grid for Mesaba Energy West Range Site

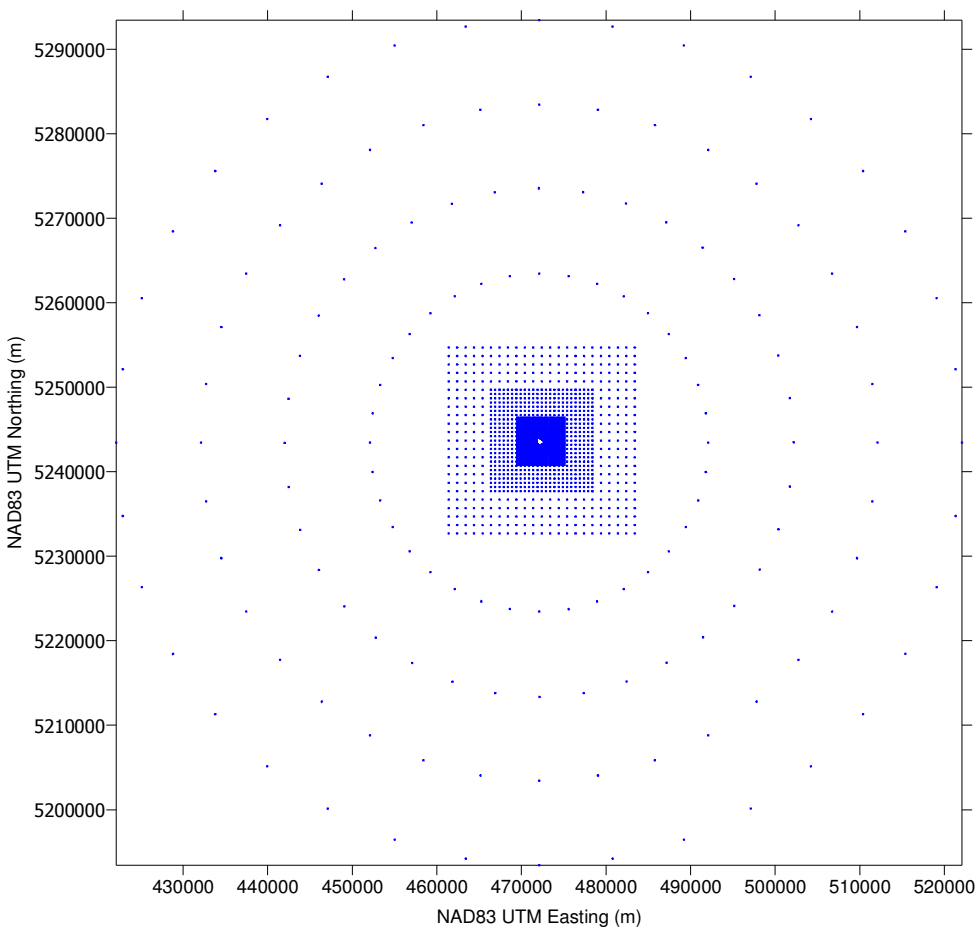
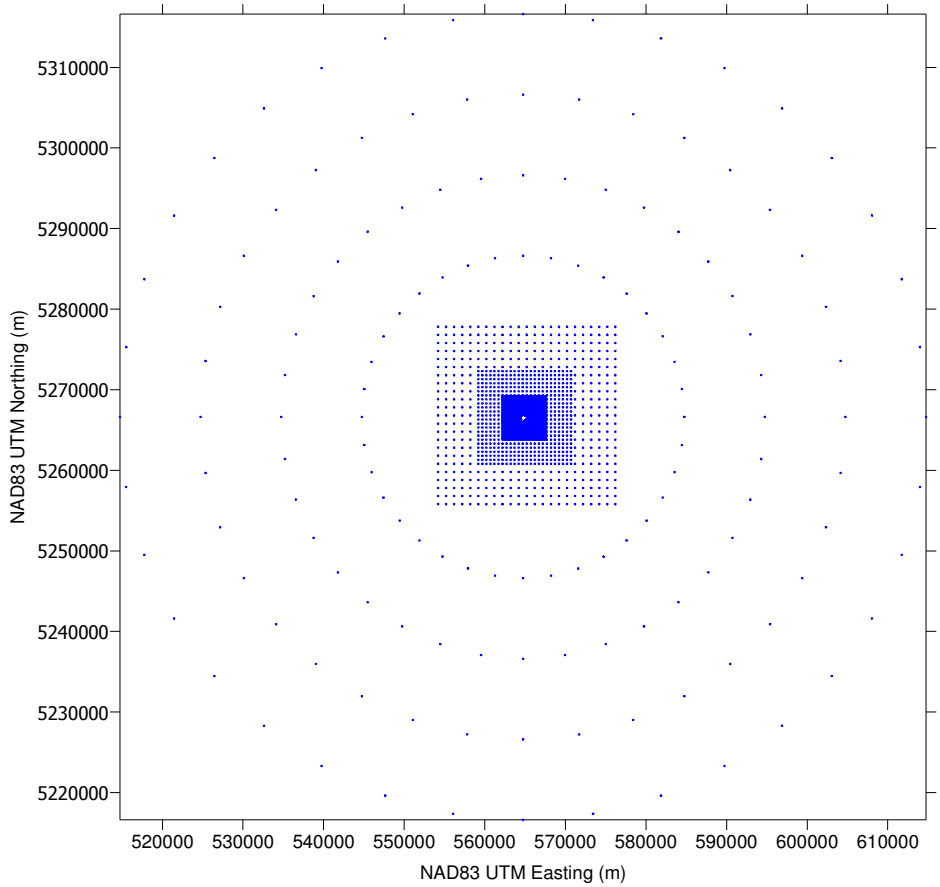


Figure B.1-2 Full Receptor Grid for Mesaba Energy East Range Site



For each site, receptors generated above were processed through AERMAP (version 06341). (Note that AERMAP version 09040 was released after significant impact analysis modeling for the project was completed, and as no significant differences in results between the two pre-processors are expected based on the release notes and comparisons with other projects, the receptor grid was not re-processed through AERMAP 09040). For the West Range Site, 132 7.5-minute 30-meter DEM maps were used, and for the East Range site 137 DEM maps were employed, with all DEM maps in North American Datum 1927 (NAD27). The receptors and domain area were set in AERMAP in NAD83, i.e., option '4' in the program control file. No shift was incorporated into the ANCHORXY control parameter, i.e., AERMAP was told that all receptors imported were in NAD83 UTM coordinates and no local coordinate system was used. Given this setup for the project, AERMAP converted the DEM map data from NAD27 to NAD83. AERMAP generated an output receptor file consisting of UTM Easting (m), UTM Northing (m), MSL elevation (m), and hill profile (m) parameters for each receptor. Figures B.1-3 and B.1-4 show resultant terrain in meters, as calculated by AERMAP, for the receptor grid within approximately 5 kilometers of the West Range and East Range sites, respectively. A waste rock storage pile located in close proximity to the East Range site is not included in the AERMAP terrain output. However, prior model analyses for that site incorporated the elevations of the waste rock deposit, and showed no effect on highest model-predicted concentrations.

Figure B.1-3 Close-In Receptor Grid and Terrain (m) from AERMAP for the West Range Site

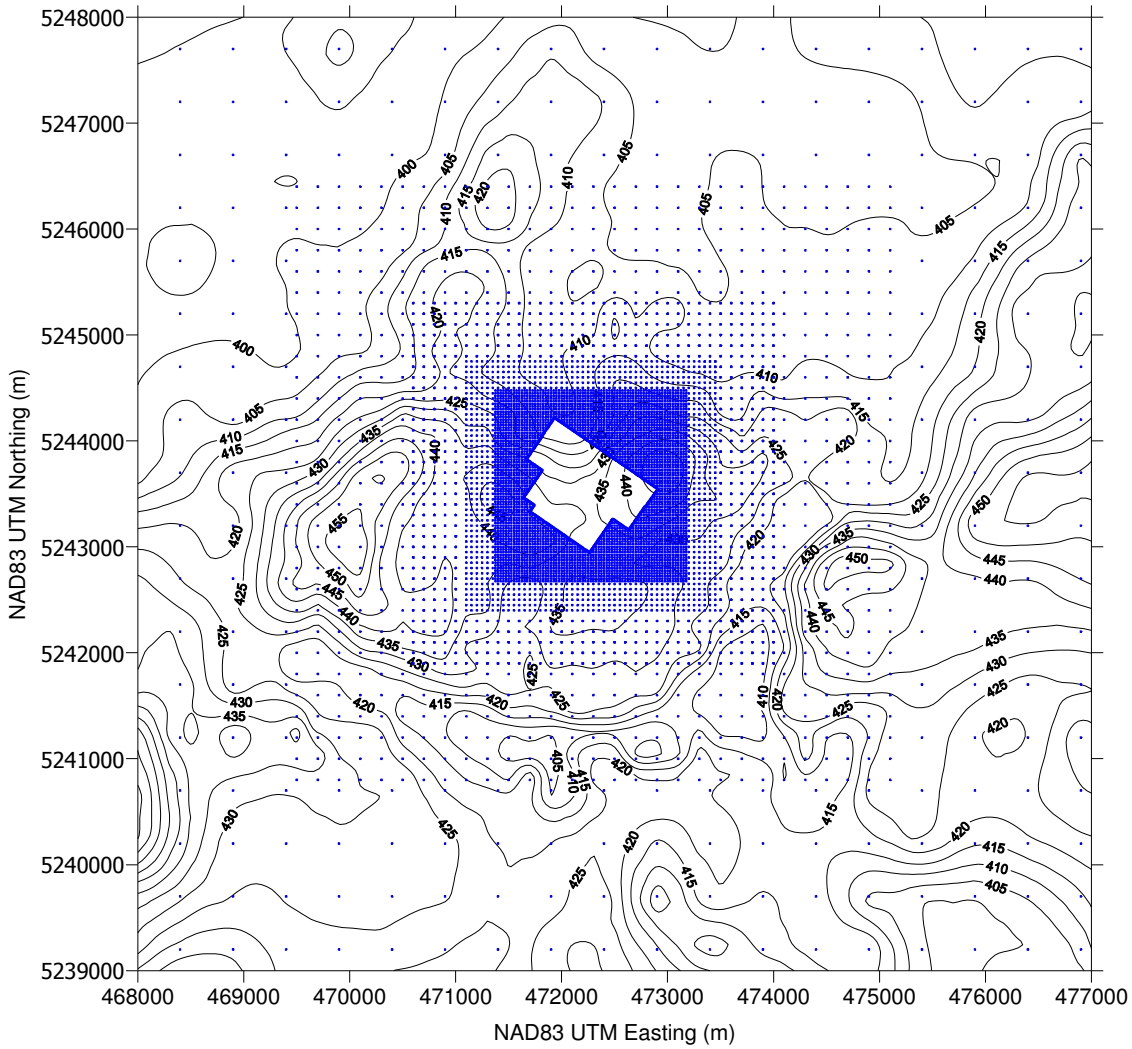
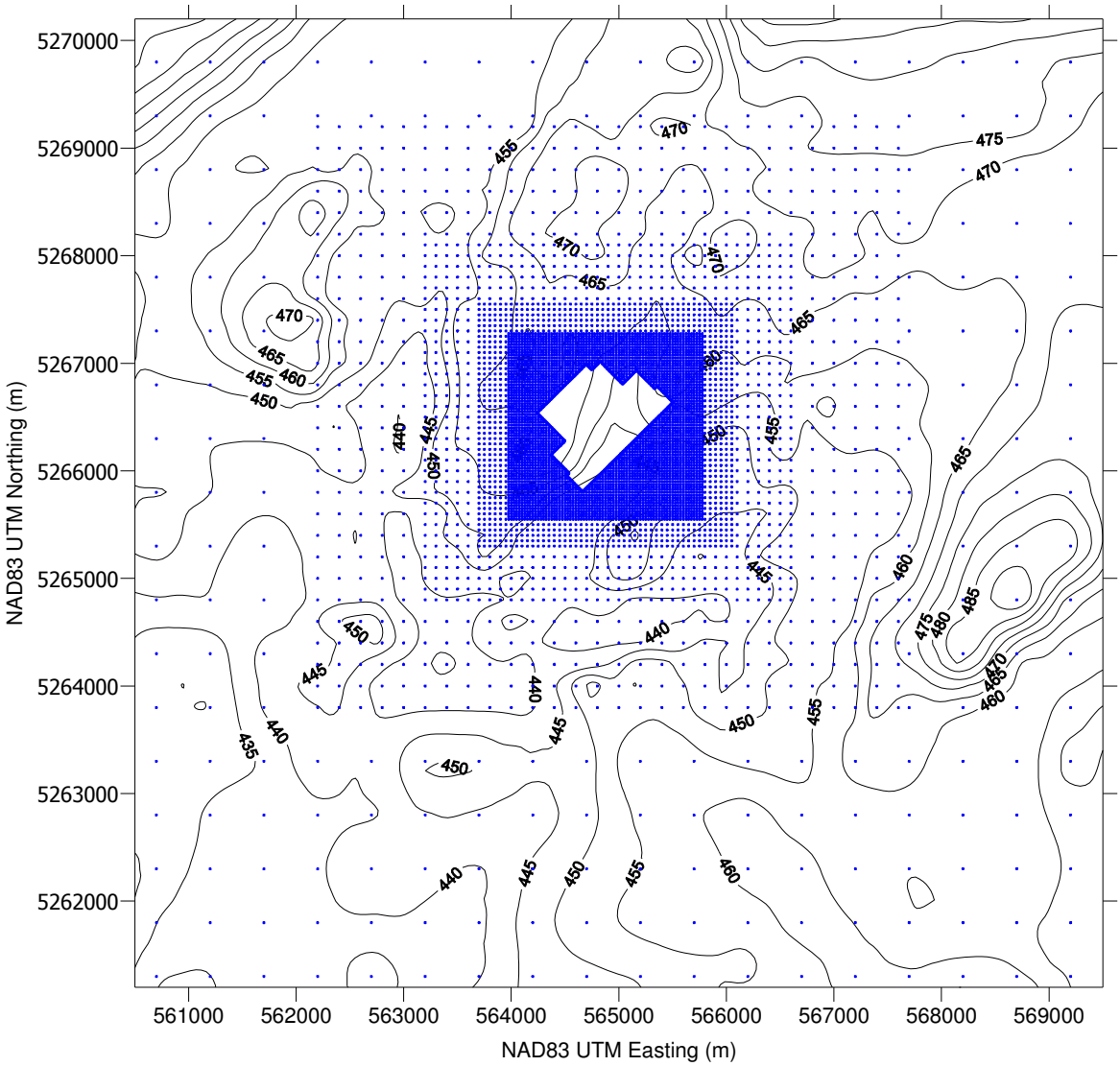


Figure B.1-4 Close-In Receptor Grid and Terrain (m) from AERMAP for the East Range Site



In addition, for the East site, a small portion of the Class I Area BWCA is located within 50 kilometers of the site, and thus falls inside the near-field range required to be modeled with AERMOD. To account for this, receptor locations for BWCA were downloaded from the National Park Service (NPS) web site (http://www.nature.nps.gov/air/maps/Receptors/index.cfm). The receptor data from NPS includes latitude and longitude in NAD83, as well as MSL elevation. The latitude and longitude values were converted to NAD83 UTM coordinate system using a shareware software package. Based on the location of the northeast corner of the fence line, all receptors within a distance of 50.1 kilometers were extracted. Figure 3-5 displays the 52 NPS BWCA receptors that fell within 50.1 kilometers (orange), as well as a portion of the southwestern receptors for BWCA (red). The 52 receptors falling inside 50.1 km radius were entered into AERMAP with the same 137 DEM maps from above, and MSL elevation and hill profile data were generated. While MSL elevations are included with the NPS receptors from the NPS web site, these data were not used. AERMAP calculates elevation and hill profile values based on the DEM map data, and these parameters are interrelated. In addition, this method also maintains

consistency with the Class II modeling analysis by relying on the same pre-processor to develop receptor elevations.

B.1.4 Regional Source Input and Background Concentrations

To account for impacts of distant and regional sources, the FARDATA approach developed by MPCA was applied. With this approach, a distant/regional modeling inventory FARDATA was included in AERMOD EVENT model runs for the highest impact cases. The FARDATA modeling provided an approximation of the date-/time-specific impacts of all regional sources, which were added to the impacts from the Mesaba Energy Project and nearby sources. Regional source inventories applicable to modeling for the Mesaba IGCC Power Plant prospective project sites were included in all PSD increment and NAAQS modeling analyses. Data on increment-consuming (or expanding) sources were accumulated from MPCA and recent permit applications.

For NAAQS modeling, total allowable emissions from significant nearby sources were included in the input file, and total modeled emissions of regional sources are listed in Table B.1-7. Emissions from sources that were not specifically modeled are still reflected in the results due to the use of FARDATA. The same inventory was used for both the West and East Range Sites.

For increment modeling, increment consuming emissions were included in the input file as positive numbers and increment-expanding emissions (decreases since the baseline date) were included as negative numbers. Total modeled emissions of regional increment sources are listed in Table B.1-8. The Class II increment inventory consists of sources within 100km of each site. Most sources shown in the table were modeled for both sites; in cases where a source was within 100km of one site and not the other, the site for which the source was modeled is indicated next to the source name in the table. The increment inventory varies from the NAAQS inventory because the former is based on changes in emissions since the PSD baseline date. Also, the NAAQS inventory did not directly model some smaller and more distant sources in order to reduce computing time, and because those sources were represented with the FARDATA approach.

Table B.1-7. Regional Sources Modeled Emissions for Mesaba Energy Project – NAAQS Modeling

Source	SO_2		PM_{10}		NO_x	
	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s
Arcelor Mittal Minorca Mine (Ispat)	1,079	136	-	-	-	-
Blandin Paper Company	649	81.8	72.2	9.10	416	52.4
Hibbing Public Utilities (Laurentian)	1,071	135	80.2	10.1	384	48.4
Hibbing Taconite	714	89.9	652	82.2	2,571	324
Mesabi Nugget	225	28.4	113	14.2	253	31.9
Minnesota Steel	144	18.1	921	116	400	50.4
MN Pwr – Boswell	25,548	3,219	2,706	341	6,564	827
MN Pwr – Laskin	2,698	340	798	100.6	660	83.2
US Steel - Keetac	258	32.5	678	85.4	1,889	238
US Steel - Minntac	1,635	206	1,230	155	3,040	383
United Taconite - Fairlane	929	117	-	-	3,651	460
Virginia Public Util. (Laurentian)	2,500	315	-	-	-	-

Source: Excelsior

Table B.1-8. Regional Sources Modeled Emissions for Mesaba Energy Project - Class II PSD Increment Modeling

Source	SO_2		PM_{10}		NO_x	
	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s
Altrista Consumer Prod	0.8	0.1	6.4	0.8	6.4	0.8
Arcelor Mittal Minorca Mine (Ispat)	3.2	0.4	18.3	2.3	201	25.3
Blandin Paper [WR only]	596	75.1	53.7	6.8	417	52.5
Duluth Steam Coop [ER only]	-	-	4.3	0.5	65.1	8.2
Hibbing Public Utilities (Laurentian)	-	-	12.8	1.6	374	47.1
Mesabi Nugget	96.5	12.2	127	16.0	272	34.3
MN Pwr – Boswell [WR only]	-2,841	-358.0	-71.0	-8.9	-1,153	-145.3
	4,300	541.8	204	25.7	1,769	222.9
MN Pwr – Tac Harbor [ER only]	-399	-50.3	-153	-19.3	-249	-31.4
	329	41.5	92.3	11.6	77.8	9.8
MN Pwr – Hibbard [ER only]	-724	-91.2	-18.6	-2.3	-	-
	350	44.1	5.5	0.7	175	22.1
Minnesota Steel	116	14.6	309	38.9	436	54.9
Sappi – Cloquet	-917	-115.5	-19.8	-2.5	-104	-13.1
	883	111.3	111	14.0	303	38.2
USG Interiors – Cloquet	-	-	-11.2	-1.4	-	-
	-	-	74.0	9.3	-	-
Virginia Public Util.	-125	-15.7	9.7	1.2	281	35.4
Hibbing Taconite	772	97.3	560	70.6	2,547	320.9
Northshore - Silver Bay [ER only]	-48.6	-6.1	-106	-13.4	-89.7	-11.3
	27.8	3.5	35.1	4.4	657	82.8
US Steel - Keetac	-189	-23.8	-109	-13.7	-1,812	-228.4
	263	33.1	54.9	6.9	2,728	343.7
US Steel - Minntac	-	-	-467	-58.9	-1.370	-172.6
	157	19.8	65.9	8.3	890	112.1
Great Lakes Comp # 5	-	-	-3.6	-0.5	71.5	9.0
Hanna (Bulter)	-	-	-171	-21.5	-	-
LTV Cliffs Erie	-195	-24.6	-2,311	-291	-46.8	-5.9
Cutler Magner (Graymont) [ER only]	559	70.4	42.9	5.4	225	28.3
Murphy Oil [ER only]	300	37.8	18.8	2.4	33.3	4.2

Source: Excelsior

For the NAAQS analyses, a "natural background" concentration was added to total model-predicted concentrations (Excelsior, 2006a). The natural background concentrations utilized are shown in Table B.1-9, and were recommended by MPCA.

Table B.1-9. Natural Background Concentration Modeled

Pollutant	Average Time	Concentration ($\mu g/m^3$)
SO_2	Short-term	10
	Annual	2
NO_2	Annual	5
PM_{10}	24-Hour	20
	Annual	10

Source: Excelsior 2006

B.1.5 Near-Field Modeling Results

State and Federal air quality rules prohibit emissions from a new facility that cause or contribute to ambient concentrations that exceed the MAAQS or NAAQS. In addition, emissions cannot cause concentrations that exceed established PSD increments. To demonstrate compliance with these requirements, an air dispersion modeling analysis for the Mesaba Generating Station at the West Range Site was conducted. The results are discussed below.

Significant Impact Analysis

Table B.1-10 shows modeled impacts at normal operation and at the alternative short-term/flaring scenarios described in Section B.1.1.1.

Table B.1-10. Highest Project Impacts and PSD SILs

Pollutant	Averaging Time	West Range Site		East Range Site		SIL $\mu g/m^3$
		Normal Operation $\mu g/m^3$	Alternative Flaring $\mu g/m^3$	Normal Operation $\mu g/m^3$	Alternative Flaring $\mu g/m^3$	
SO_2	1-hour	124.1	93.1	304.1	140.5	25
	3-hour	74.7	53.5	208.7	82.3	25
	24-hour	31.1	21.7	62.5	35.4	5
	Annual	4.01	N/A	3.70	N/A	1
PM_{10}	24-hour	28.2	28.2	32.6	28.2	5
	Annual	1.75	N/A	4.15	N/A	1
CO	1-hour	158.7	2,034	178.2	4,716	2000
	8-hour	60.1	260.4	116.9	634.7	500
NO_X	Annual	7.16	N/A	7.93	N/A	1

Source: Excelsior

Results of AERMOD modeling of operations at the Mesaba Generating Station produce the following conclusions:

- Impacts are above the applicable SIL for all pollutants, and all averaging times, except for eight hours for CO at the West Range Site.
- Impacts are greatest under normal operating conditions, except for CO; highest CO impacts would occur during the alternative scenario.

Wherever modeled pollutant concentration increases exceed the SILs, further modeling is required under PSD rules to ensure that the Class II PSD increment for the area is not violated. Because the highest predicted impacts were significant, increment and NAAQS compliance modeling was necessary for SO_2, PM_{10}, and NO_X. This further evaluation included all sources within 50 kilometers (31 miles) of the project's area of impact. There are no applicable PSD increments for CO. The normal operation scenario was addressed in PSD increment and NAAQS analyses for SO_2, PM_{10}, and NO_X since they represent the highest concentrations. The alternative flaring scenario was addressed only for the CO NAAQS demonstration.

The farthest distance from the site where the SILs are exceeded determines the SIA. Based on the modeling results, the maximum radius of the SIA for each pollutant is 50 kilometers (31 miles) for SO_2, 2 kilometers (1.2 miles) for PM_{10}, 3.0 kilometers (1.9 miles) for NO_X, and 0.8 kilometers (0.5 miles) for CO. The highest predicted concentrations for any pollutant were found to occur within approximately 1 kilometer (0.6 miles) of either site. Thus, impacts of Mesaba Generating Station would be limited to a small area in close proximity to the site.

PSD Increment Analysis

Increment analyses were completed for SO_2, PM_{10}, and NO_X. The modeling included all Mesaba One and Two sources at maximum emission rates in normal operation plus all nearby increment consuming (and expanding) emissions sources. The results of the increment analyses are shown in Table B.1-11 and B.1-12, along with a comparison to the allowable Class II PSD increments. This demonstrates that the Mesaba Energy Project, in combination with all other nearby and regional PSD sources, would comply with all state and Federal Class II increment limits.

Table B.1-11. Results of Class II PSD Increment Analysis at West Range Site

Pollutant	Averaging Time	Highest* Concentration ($\mu g/m^3$)	PSD Increment Limits ($\mu g/m^3$)
SO_2	1-hour	118.2	512
	3-hour	71.2	512
	24-hour	21.0	91
	Annual	4.2	20
PM_{10}	24-hour	24.8	30
	Annual	1.7	17
NO_2	Annual	7.6	25

*For short-term periods, the highest second-high concentration from five years of meteorological data is shown. For annual average, the highest concentration for any of the five years is listed.

Table B.1-12. Results of Class II PSD Increment Analysis at East Range Site

Pollutant	Averaging Time	Highest* Concentration ($\mu g/m^3$)	PSD Increment Limits ($\mu g/m^3$)
SO_2	1-hour	294.3	512
	3-hour	200.4	512
	24-hour	52.5	91
	Annual	2.9	20
PM_{10}	24-hour	26.3	30
	Annual	0.7	17
NO_2	Annual	8.1	25

*For short-term periods, the highest second-high concentration from five years of meteorological data is shown. For annual average, the highest concentration for any of the five years is listed.

Class II NAAQS Evaluation

The NAAQS modeling calculated the maximum impact of the Mesaba Generating Station and all other regional sources and compared the highest total impacts, plus background concentrations, to the applicable MAAQS and NAAQS. Maximum emission rates in normal operation were modeled for all Mesaba Generating Station sources and pollutants, except in the case of CO for which the flaring scenario had the maximum impacts. Excelsior did not quantify or model the $PM_{2.5}$ emissions from the proposed power plant. Compliance with PM_{10} standards was used to serve as a surrogate demonstration of $PM_{2.5}$ compliance.

Table B.1-13 summarizes results of the NAAQS model analysis and the $PM_{2.5}$ estimation. For SO_2, PM_{10}, and NO_X the table shows maximum impacts of the Mesaba Energy Project, plus local sources that were explicitly included in the five-year model runs, plus all regional sources from FAR modeling of the highest impact days, plus the background values supplied by MPCA. For CO, no inventory of regional emissions is available. Therefore, the data in Table B.1-13 show CO concentrations from the Mesaba Energy Project alone (using the worst case flaring scenario) and conservative total concentration estimates obtained by adding an urban background concentration to the predicted Mesaba Generating Station impacts. All predicted concentrations are far below allowable levels, and the results demonstrate compliance with all MAAQS and NAAQS. Data for $PM_{2.5}$ were estimated using PM_{10} concentrations as a basis for modeled sources and IMPROVE ambient monitoring for background. The majority of PM_{10} impacts are a result of fugitive emissions. A multiplier in the range of 0.06 to 0.11 has been shown to be a reasonable estimate of $PM_{2.5}$ impacts from fugitive PM_{10} impacts. When using a multiplier of 0.11 for relative $PM_{2.5}$ to PM_{10}, the resulting concentrations of 24-hour and annual $PM_{2.5}$ would not exceed their respective NAAQS. Additionally, there are very low impacts of regional sources within the Phase I and II Mesaba Generating Station's SIA.

Table B.1-13a. Results of Class II NAAQS Modeling

Pollutant	Averaging Time	Background ($\mu g/m^3$)	Total [1] West Range ($\mu g/m^3$)	Total [1] East Range ($\mu g/m^3$)	N/MAAQS ($\mu g/m^3$)
SO_2	1-hour	10	521.9	565.1	1300
	3-hour	10	237.6	360.4	915
	24-hour	10	73.3	166.5	365
	Annual	2	8.6	30.8	60
PM_{10} [2]	24-hour	20	126.1	112.2	150
	Annual	10	37.9	32.9	50
NO_X	Annual	5	17.0	32.5	100
CO	1-hour	7,000[3]	8,959	11,565	40,000

[1] Listed Highest Concentrations include Mesaba, all regional sources, and background. They are highest second-high for one to 24-hour averaging times except for PM_{10}, which is the highest 6th high from five years. Annual average values are the highest for any year.
[2] Although the EPA revoked the annual PM10 standard in December 2006, the standard is still in the Minnesota regulations.
[3] Background CO concentrations are very conservative estimates from urban monitors in Minneapolis/St. Paul. No background data exist for the Mesaba Generating Station area.
Source: Excelsior

Table B.1-13b. Estimated $PM_{2.5}$ Concentration[1]

Pollutant	Averaging Time	Ambient ($\mu g/m^3$)	West Range ($\mu g/m^3$)	East Range ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
$PM_{2.5}$	24-hour	20	11.7	10.1	35
	Annual	5	3.1	2.5	15

[1] $PM_{2.5}$ concentrations are estimated based on the 0.11 ratio of $PM_{2.5}$ to PM_{10}. Ambient concentrations were calculated from IMPROVE ambient monitoring data from nearby Class I areas (BWCAW and VNP), using available data from 2000-2003. This is very conservative, because recent ambient data already includes many sources that were also modeled, and therefore the results reflect substantial double-counting.
Source: Excelsior

Minnesota and PSD Regulations Monitoring Requirements

Minnesota and Federal PSD regulations specify *de minimis* monitoring concentrations. Pre-construction monitoring may be required to accurately characterize existing air quality. Under PSD regulations, preconstruction monitoring may be required if projected emissions from the Mesaba Energy Project exceed the *de minimis* threshold and background concentrations related to existing sources in the vicinity of the proposed Mesaba Generating Station are exceeding the *de minimis* levels. The PSD *de minimis* monitoring concentrations are shown in Table B.1-14, in addition to the maximum projected Mesaba Energy Project SO_2, PM_{10}, NO_2, and CO concentrations (see also Tables B.1-11 and B.1-12). The Pb and O_3 emissions were not modeled because O_3 is not emitted directly from a combustion source and potential Pb emissions from the proposed project are negligible.

Table B.1-14 PSD Significant Monitoring Concentrations and Maximum Impacts

Pollutant	Averaging Time	Highest West Range Impact ($\mu g/m^3$)	Highest East Range Impact ($\mu g/m^3$)	*De Minimis* Monitoring Level ($\mu g/m^3$)
SO_2	24-hour	31.1	62.4	13
PM_{10}	24-hour	28.2	32.6	10
NO_2	Annual	7.2	7.9	14
CO	8-hour	260	635	575

Source: Excelsior

Table B.1-14 indicates that the Phase I and Phase II impacts for NO_2 are below the *de minimis* monitoring concentrations and SO_2, and PM_{10} (and CO at the East Range Site), model-predicted impacts from the Mesaba Energy Project exceed the threshold monitoring concentrations. However, based on background PM_{10} monitoring data available in northeast Minnesota from Virginia, Duluth, and from IMPROVE monitoring in the northern Class I areas, background PM_{10} concentrations are below *de minimis* levels. Additionally, limited SO_2 data from Ely, MN and Voyageurs National Park also indicate that background SO_2 concentrations are low in northern Minnesota, and are generally below the *de minimis* monitoring levels. No CO monitoring data was available near the proposed sites, but only the flaring scenario at the East Range Site exceeded monitoring thresholds. An application requesting a waiver of the preconstruction monitoring requirements was submitted to MPCA with the application for a Part 70/New Source Review Construction Authorization Permit. Section 3.3.3 provides existing local and regional air quality data.

The results of the NAAQS compliance analysis (see Table B.1-13) indicate that the Mesaba Energy Project, Phase I and II, would not violate any air quality standards and total ambient pollutant concentrations levels would remain well below applicable limits. The combination of existing representative regional monitoring data and low predicted ambient pollutant concentration levels, which do not violate any NAAQS, indicate that preconstruction monitoring is not necessary and would not contribute to a significant improvement in impact assessment.

B.2 CLASS I AREA-RELATED (FAR-FIELD) MODELING

B.2.1 Modeling Approach

Air quality modeling analyses were conducted to estimate the impacts of the Phase I and Phase II Mesaba IGCC Power Plant on air quality in Class I areas. Separate sets of Class I modeling analyses addressed the PSD Class I increments for SO_2, PM_{10}, and NO_X, and the air quality related values (AQRVs) of sulfur (S) and nitrogen (N) deposition, and visibility impairment (regional haze). The dispersion modeling analysis used recommended EPA long-range transport modeling methodologies, and followed guidance as presented in EPA's Guideline on Air Quality Models, the IWAQM Phase 2 report, the FLAG Phase I report, and the proposed FLAG Phase I Report – Revised (FLAG, 2008). The analyses also incorporated suggestions and guidance received in meetings, conference calls, and written correspondence with the U.S. Forest Service, the National Park Service, and the US Fish and Wildlife Service[2]. The Class I analyses addressed impacts to the Boundary Waters Canoe Area Wilderness (BWCAW), Voyageurs National Park (VNP), the Rainbow Lakes Wilderness (RLW), and Isle Royale National Park (IRNP). The distance from the West Range Site to the closest point in each of these Class I areas is approximately 61 miles (98 kilometers) for the BWCAW, 75 miles (121 kilometers) for VNP, 117 miles (188 kilometers) for RLW, and 195 miles (313 kilometers) for IRNP. This is slightly beyond the 300-km distance where long-range transport modeling has been shown to provide realistic impact predictions, and therefore IRNP is not modeled for the West Range Site. The distance from the East Range Site to the closest point in each of these Class I areas is approximately 24 miles (39 kilometers) for the BWCAW, 54 miles (87 kilometers) for VNP, 87 miles (140 kilometers) for RLW, and 136 miles (218 kilometers) for Isle Royale National Park.

[2] The modeling protocol approved by the FLMs consists of the following correspondence:

- TRC, et al., "Mesaba Energy Project, Mesaba One and Mesaba Two, Class I Area Modeling Protocol," October 2008.
- December 1, 2008 letter from James Sanders and Jeanne Higgins (representing the U.S. Forest Service's Superior and Chequamegon-Nicolet National Forests, respectively) providing comments on the October 2008 Class I Area Modeling Protocol.
- December 8, 2008 email response from Excelsior Energy Inc. to December 1, 2008 comments from Mr. Sanders and Ms. Higgins.
- TRC, et al., "Mesaba Energy Project, Mesaba One and Mesaba Two, Class I Area Modeling Supplemental Protocol," January 2009 (transmitted via email and letter of January 15, 2009 to Carolina Espejel-Schutt of the MPCA). This document addressed issues discussed in telephone conference calls on December 11th and 12th between Excelsior Energy Inc., its consultants, and regulatory personnel from MPCA, EPA, and the FLMs, such discussions described in Section 2.1 of the Supplemental Protocol.
- March 5, 2009 letter from John Bunyak, U.S. Department of Interior, National Park Service ("NPS") to Carolina Espejel-Schutt providing the basis on which modeling acceptable to the FLMs should be undertaken and providing the option to submit supplemental information.
- March 6, 2009 email message from Trent Wickman, U.S. Forest Service to Bob Evans confirming that the U.S. Forest Service would accept Excelsior's modeling protocol provided the NPS approved it.
- March 9, 2009 email message from Andrea Stacy, National Park Service ("NPS") stating that March 5, 2009 letter to Carolina Espejel-Schutt confirmed NPS's conditional acceptance of Excelsior's modeling protocol.

The CALPUFF air quality model was used for all Class I area analyses where the receptors were more than 50 km from the Mesaba IGCC Power Plant. For the few receptors in the BWCAW within 50 km of the East Range Site, Class I increment analyses were conducted using both CALPUFF and separately using AERMOD (based on the meteorology and methodology described in Section B-1). CALPUFF is the approved EPA long-range transport model referenced in the Guideline on Air Quality Models and consists of the following three components:

The CALMET model for processing of meteorological data;
The CALPUFF model for the transport and dispersion calculations; and
The CALPOST model for analysis and post-processing of model results.

In the process of responding to comments on the Draft EIS, Excelsior prepared an updated Class I air modeling protocol (Excelsior, 2008). Changes included updates to use more recent meteorology than had been available previously, corrections of inaccurate land use data, integration of data from buoys in Lake Superior, and a finer CALPUFF grid resolution of 1km. The FLMs provided technical comments in December of 2008 and Excelsior and the FLMs subsequently engaged in a number of conference calls in which many technical matters regarding the protocol were resolved. In a March 2009 letter, the FLMs identified the model settings that they would accept for the Mesaba Energy Project. The letter also noted that Excelsior could submit supplemental model runs. Table B.2-1 presents the model settings and parameters used for the CALMET and CALPUFF modeling conducted in accordance with the FLMs recommendations. Parameters/settings not specified are assumed to be at default settings. The letter specifies that the air quality impact analysis should be performed with two years of 36 km MM5data and a CALMET grid resolution of 4km in addition to another one or two years of 12 km MM5 data and a CALMET grid resolution of 1km. Because 2002 was the only year for which 12km MM5 data was available in the public domain, the higher-resolution modeling was performed for that year. For 2003 and 2004, only 36km MM5 data was available, so the 4km CALMET grid resolution was used for those two years. The letter also stated that Excelsior can provide additional modeling results as supplemental information, so additional modeling was conducted for 2002 at 4km resolution and for 2003 and 2004 at 1km resolution. Finally, due to the much larger domain required for multi-source modeling and the increased computational time that would be incurred, the 4km grid resolution was used for multi-source modeling for all three years.

Table B.2-1. CALMET/CALPUFF Input Parameters

Input Group	Parameter	Mesaba Selection	Explanation
CALMET - 1km grid resolution			
5	RMAX 1	10	No default values
	RMAX 2	15	No default values
	RMAX 3	75	No default values
	TERRAD	10	No default values
	R1	5	No default values
	R2	7.5	No default values
N/A	Use of buoy data	Hourly data only	Exclude monthly average data when buoy not present
CALMET - 4km grid resolution			
5	RMAX 1	30	No default values
	RMAX 2	50	No default values
	RMAX 3	75	No default values
	TERRAD	10	No default values

Table B.2-1. CALMET/CALPUFF Input Parameters

Input Group	Parameter	Mesaba Selection	Explanation
	R1	10	No default values
	R2	20	No default values
N/A	Use of buoy data	Hourly data only	Exclude monthly average data when buoy not present
CALPUFF			
3	Species Modeled	SO_2, SO_4, NO_X, EC, SOA, $PM_{2.5}$, HNO_3, NO_3	Modeled all species emitted by Mesaba sources, and others (HNO_3, NO_3) involved in plume chemistry
4	LSAMP	F	No gridded receptors (sampling grid) used
8	Part. Size	Mean = 0.48	All particulate species assumed $PM_{2.5}$
		Std. Dev. = 2	
11	$BCKNH_3$	1.0 ppb	Conservative background ammonia concentration (0.5 ppb recommended for forested lands)
12	NSPLIT	3	Puff-splitting used (default)

Source: Excelsior, 2008

The CALPUFF modeling analyses used meteorological data for the years 2002-2004. Additional surface, upper air, and precipitation data were used in CALMET to refine the meteorological fields. For the smaller grid resolution (shown below), Figure B.2-1 shows the locations of meteorological stations used for the single-source CALMET processing. For multisource modeling additional observation data were used due to the larger domain.

B.2.1.1 Class I Areas Modeling Domain

For modeling using a 1-km CALMET grid resolution, the CALMET/CALPUFF modeling domain was a 485- by 355-kilometer area approximately centered on the Class I areas in the vicinity of the two sites being considered for the Mesaba IGCC Power Plant. The coordinate system was Lambert Conformal WGS-84. Receptor locations within each of the Class I areas were obtained from the National Park Service. Hourly surface data from 35 stations (with two additional buoy stations) were used along with precipitation data from 26 stations and upper air data from one station. Figure B.2-1 shows the proposed site location, the Class I areas of interest, and the modeling domain used for 1-km grid resolution modeling of the Mesaba Project.

For modeling using a 4-km CALMET grid resolution, which was also used for the multi-source runs, a much larger domain was necessary due to the broader geographical area over which these sources were spread. The domain consisted of a 1,072- by 504-kilometer area approximately centered on the VNP and BWCA Class I areas. Hourly surface data from 142 stations (with four additional buoy stations) were used along with precipitation data from 158 stations and upper air data from four stations. Figure B.2-2 shows the proposed site locations, the Class I areas of interest, the regions within 300km of those site locations and Class I areas, and the modeling domain used for the 4-km grid resolution modeling.

Figure B.2-1: Single-Source Modeling Domain for the Excelsior Mesaba IGCC Project

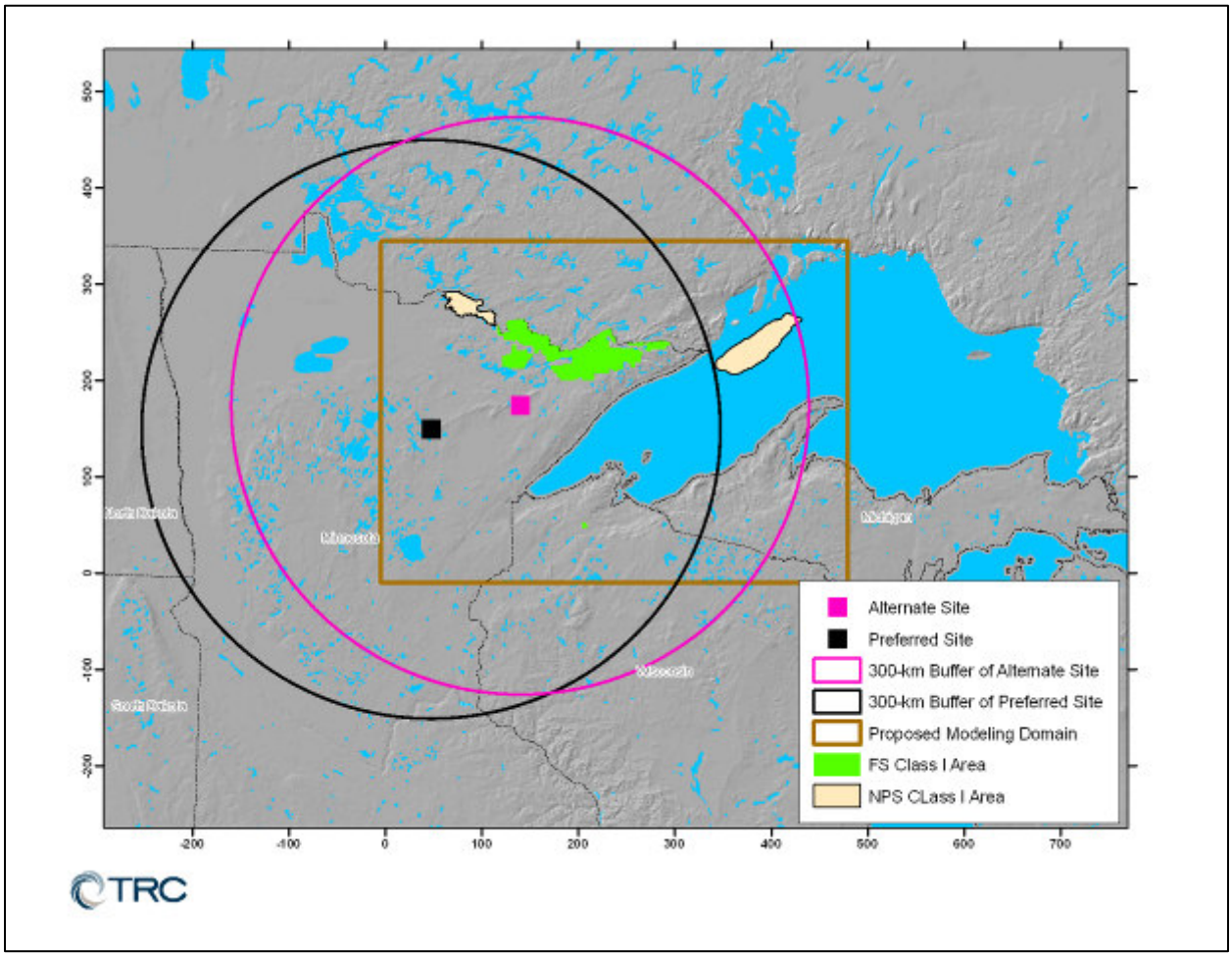
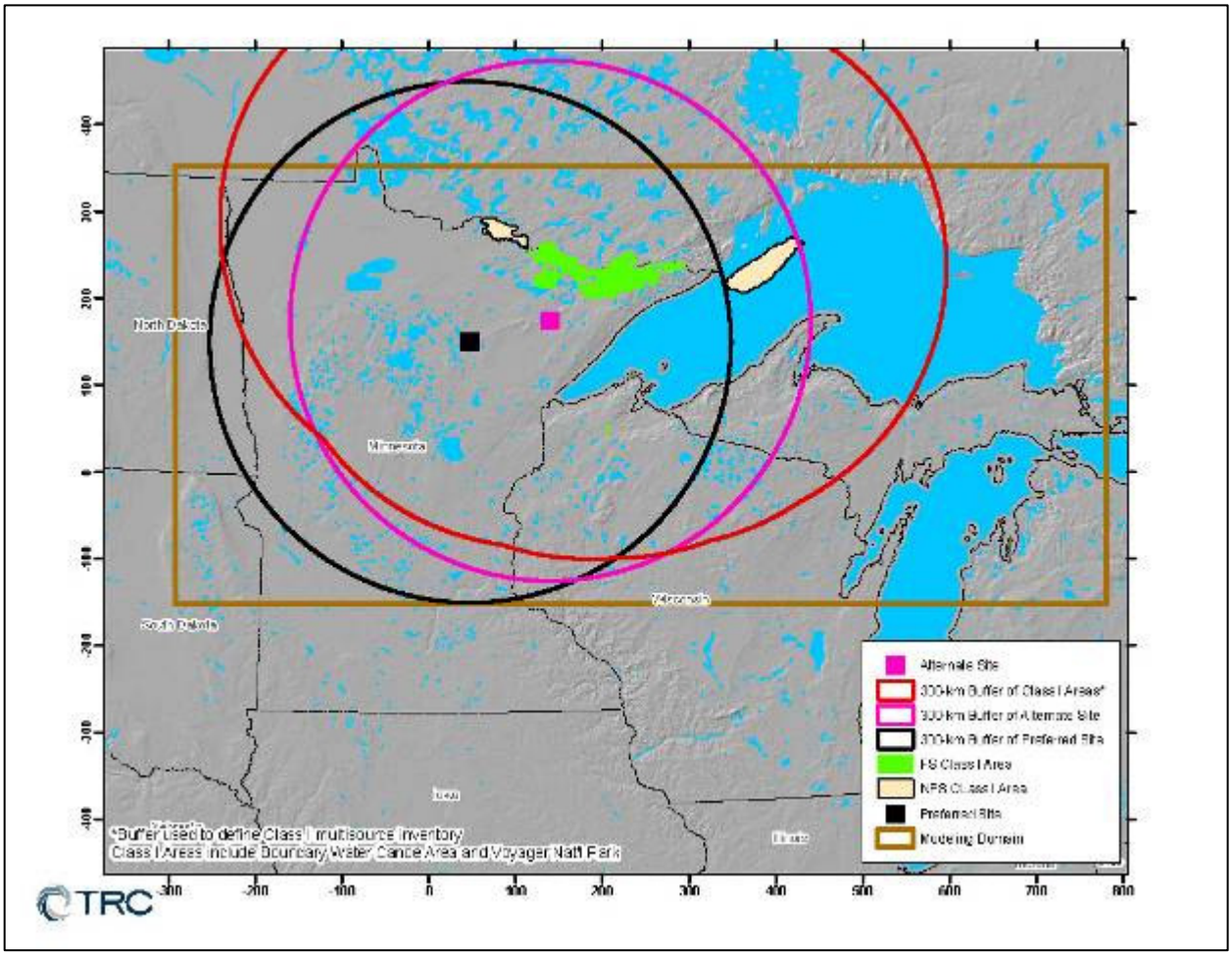


Figure B.2-2: Multi-Source Modeling Domain for the Excelsior Mesaba IGCC Project



B.2.1.2 Modeled Emission Rates

In response to comments on the Draft EIS, Excelsior has modeled a range of emission rates and scenarios for Mesaba One and Two, as presented to the FLMs in the protocol and its supplement. The scenarios include the proposed level of emission controls, an enhanced level of emission controls, as well as reasonably worst-case sensitivity scenarios for short-term startup and shutdown conditions. Pollutant emission rates are shown in Tables B.2-2 to B.2-4 and represent the maximum expected emissions and the appropriate averaging times from the Mesaba IGCC Power Plant per phase and are used for all CALPUFF modeling. For the AQRV modeling analyses, particulate matter speciation was calculated using FLM guidance for gas-fired combustion turbines. In some cases, modeled scenarios include Mesaba One at one level of emission controls with Mesaba Two at a different level of emission controls.

Table B.2-2: Modeling Parameters for Mesaba CALPUFF Modeling: for All Scenarios Analyzing Proposed Emission Rates (Per Phase)

Parameter	Combustion Turbines (each of two)		Tank Vent Boilers (each)	
	AQRV	Increment	AQRV	Increment
stack height (m)	45.72	45.72	64.01	64.01
stack diameter (m)	6.1	6.1	1.83	1.83
temp (K)	394.3	394.3	579.8	579.8
Velocity (m/s)				
short-term	20.1	20.1	8.46	8.46
Annual	20.1	20.1	1.95	1.95
SO_2 - 3-hr (g/s)	17.2	18.5	0.87	0.94
24-hr	13.0	14.0	0.75	0.81
Annual	8.67	9.32	0.42	0.45
NO_x – 3-hr (g/s)	19.66	19.66	2.46	2.46
24-hr	19.66	19.66	2.46	2.46
Annual	19.91	19.91	0.76	0.76
Elemental Carbon (g/s) all time periods	0.79	0	0	0
Sulfate (g/s) all time periods	0.97	0	0	0
Organic aerosol (g/s) all time periods	1.368	0	0	0
$PM_{2.5}$ (g/s) all time periods	0	0	0.088	0
PM_{10} (g/s) all time periods	0	3.15	0	0.088

Table B.2-3: Modeling Parameters for Mesaba CALPUFF Modeling: for All Scenarios Analyzing Enhanced Controls Emission Rates (Per Phase)

Parameter	Combustion Turbines (each of two)		Tank Vent Boilers (each)	
	AQRV	Increment	AQRV	Increment
stack height (m)	45.72	45.72	64.01	64.01
stack diameter (m)	6.1	6.1	1.83	1.83
temp (K)	394.3	394.3	579.8	579.8
velocity (m/s)				
short-term	20.1	20.1	8.46	8.46
Annual	20.1	20.1	1.95	1.95
SO_2 – 3-hr (g/s)	6.88	7.40	0.57	0.61
24-hr	5.21	5.60	0.51	0.55
Annual	3.47	3.73	0.38	0.41
NO_x – 3-hr (g/s)	6.55	6.55	2.46	2.46
24-hr	6.55	6.55	2.46	2.46
Annual	6.64	6.64	0.76	0.76
Elemental Carbon (g/s) all time periods	0.787	0	0	0
Sulfate (g/s) all time periods	0.398	0	0	0
Organic aerosol (g/s) all time periods	1.96	0	0	0
$PM_{2.5}$ (g/s) all time periods	0	0	0.088	0
PM_{10} (g/s) all time periods	0	3.15	0	0.088

Table B.2-4: Modeling Parameters for Mesaba CALPUFF Modeling: for Sensitivity Scenarios Analyzing High Flaring Emission Rates (Per Phase)

Parameter	Combustion Turbines (each of two)		Flare (each)		Tank Vent Boilers (each)	
	AQRV	Increment	AQRV	Increment	AQRV	Increment
stack height (m)	45.72	45.72	56.39	56.39	64.01	64.01
stack diameter (m) 3-hr 24-hr	 6.1 6.1	 6.1 6.1	 7.35 6.87	 7.35 6.87	 1.83 1.83	 1.83 1.83
temp (K)	394.3	394.3	1273.0	1273.0	579.8	579.8
velocity (m/s)	20.1	20.1	20.0	20.0	8.46	8.46
SO_2 – 3-hr (g/s)* 24-hr	17.2, 0.69 7.2	18.5, 0.74 7.7	43.1 9.6	46.3 9.6	0.87 0.75	0.94 0.81
NO_x – 24-hr (g/s)	19.7	19.7	2.9	2.9	2.5	2.5
Elemental Carbon (g/s) 24-hr	0.72	0	0	0	0	0
Sulfate (g/s) 24-hr	0.37	0	0	0	0	0
Organic aerosol (g/s) 24-hr	1.8	0	0	0	0	0
$PM_{2.5}$ (g/s) 24-hr	0	0	0.44	0	0.088	0
PM_{10} (g/s) 24-hr	0	2.9	0	0.44	0	0.088

* For the 3-hr case, the SO_2 emissions from the two combustion turbines differ significantly, so both values are shown.

Cumulative modeling was also conducted for the purpose of determining the amounts of Class I increment consumption for the pollutants, averaging periods and Class I areas for which the Mesaba One and Two impacts were predicted to exceed the applicable SIL. Excelsior developed emission inventories of increment consuming and expanding sources within 300 km of the applicable Class I areas based on data supplied by the MPCA, the Wisconsin Department of Natural Resources, the Michigan Department of Environmental Quality, accumulated data from recent air permit applications for other facilities in the region, and data from actual air permits. The emission inventories are presented in Table B.2-5. The rates shown do not reflect total emissions, but rather the emission rate that consumes or expands (shown as a separate negative rate) increment relative to the PSD baseline. They are calculated based on actual emission rates when that data is available, and permitted emission rates when it is not.

Table B.2-5. Regional Sources Modeled Emissions for Mesaba Energy Project - Class I PSD Increment Modeling

Source	SO_2		PM_{10}	
	lb/hr	g/s	lb/hr	g/s
Alltrista Consumer Products	0.8	0.1	6.4	0.8
American Crystal Sugar – Crookston	-	-	43.6	5.49
American Crystal Sugar – E Grand Forks	-	-	194	24.4
Blandin Paper Company	596	75.1	53.7	6.76
Boise White Paper LLC	176	22.2	26.7	3.36
Duluth Steam Cooperative Association	-	-	4.3	0.54
Georgia-Pacific – Duluth Hardboard	-	-	64.2	8.09
Great Lakes Comp # 5	-	-	-3.6	-0.46
Hanna (Butler Mining)	-	-	-171	-21.5
Hibbing Public Utilities Commission (Laurentian)	-	-	12.8	1.61
Hibbing Taconite Company	772	97.3	560	70.6
Ispat Inland Mining Co (Arcelor Mittal)	3.2	0.4	18.3	2.3
Lamb Weston RDO Frozen	271	34.1	31.9	4.02
LTV Cliffs Erie	-195	-24.6	-2,311	-291.2
Marvin Windows and Doors	-	-	12.9	1.63
Mesabi Nugget LLC	96.5	12.2	127	16.0
Minnesota Power – Clay Boswell*	-2,841	-358	-71.0	-8.94
	4,300 / 2,703	542 / 341	204	25.7
Minnesota Power – Hibbard*	-724	-91.2	-18.6	-2.34
	350 / 254	44.1 / 32.0	5.5	0.69
Minnesota Power – Taconite Harbor*	-399	-50.3	-153	-19.3
	329 / 269	41.4 / 33.9	92.3	11.6
Minnesota Steel Industries	116	14.6	309	38.9
Norbord Industries Inc	11.5	1.4	55.1	6.94
Northshore Mining – Silver Bay	-48.6	-6.1	-106	-13.4
	27.8	3.5	35.1	4.42
Royal Oak Enterprises Inc	-	-	-97.8	-12.3
SAPPI – Cloquet	-917	-116	-19.8	-2.49
	883	111	111	14.0
U.S. Steel – Keetac	-189	-23.8	-109	-13.7
	263	33.1	54.9	6.92
U.S. Steel – Minntac	-	-	-467	-58.9
	157	19.8	65.9	8.30

Table B.2-5. Regional Sources Modeled Emissions for Mesaba Energy Project - Class I PSD Increment Modeling

Source	SO_2		PM_{10}	
	lb/hr	g/s	lb/hr	g/s
United Taconite – Fairlane Plant	-	-	136	17.1
USG Interiors Inc, Cloquet	-	-	-11.2	-1.41
	-	-	74.0	9.32
Verso (formerly IP) Paper – Sartell	433	54.5	41.9	5.28
Virginia Dept of Public Utilities (Laurentian)	-125	-15.7	9.7	1.22
Flambeau River Papers	534	67.3	48.6	6.12
Graymont (CLM Corporation)	559	70.4	42.9	5.40
Great Lakes Gas #6 – Iron River	-	-	6.8	0.86
Louisiana – Pacific Hayward	-	-	89.6	11.3
Murphy Oil USA, Inc.	300	37.8	18.8	2.37
Packaging Corp of America	1,320	166	33.0	4.16
Empire Iron Mining Partnership	1,196	151	45.6	5.74
Grede Foundries Inc	13.8	1.7	26.6	3.35
L'Anse Warden Power Plant	-303	-38.2	-10.5	-1.32
Marquette Board of Light & Power	230	29.0	15.5	1.95
Mathy Construction Company	65.7	8.3	15.1	1.90
Northern Michigan University	51.3	6.5	6.1	0.77
Smurfit-Stone Container	454	57.2	30.8	3.88
Tilden Mining Company L.C.	1,709	215	239	30.1
Verso (IP) Paper – Quinnesec	726	91.5	116	14.6
White Pine Electric Power LLC	79.2	10.0	4.8	0.60
Wisconsin Electric Power Co.*	-19.7	-2.5	-1.1	-0.14
	2,947 / 2,848	371 / 359	216	27.2

* Based on actual emissions. SO_2 emissions shown for two averaging periods (3-hour / 24-hour)

B.2.1.3 Class I Area Modeling Results

Air quality modeling analyses were conducted to estimate the impact of the Phase I and Phase II Mesaba Energy Project on air quality in Class I areas. The analyses addressed impacts to the BWCAW, VNP, RLW, and IRNP. The Class I Increment analyses addressed the PSD Class I increments for SO_2, PM_{10}, and NO_X, and the AQRV analyses addressed S and N deposition and visibility. The results are discussed below.

Class I Impacts and Increment Consumption

The CALPUFF model was used to calculate pollutant impacts from the Mesaba Energy Project for Class I areas. Supplemental modeling using AERMOD and methodology described in the near-field

discussion above was conducted for a small number of receptors in the BWCAW that fell within 50 km of the East Range Site. The two-phase Mesaba Generating Station was modeled at the worst-case emission rates for the West and East Range Sites and the results are compared with Class I PSD increments and SILs (see Tables B.2-6 and B.2-7). For both sites, sensitivity analyses were conducted for Mesaba One which compared impacts of worst-case flaring emissions versus worst-case normal operation emissions, and the results showed that normal operations resulted in higher impacts in all cases except for 3-hour SO_2. Therefore, the results shown in all non-flaring cases below are based on both phases of the West Range Site operating at the proposed emission rates shown in Table B.2-2. The results for the East Range Site assume the first phase operating at those emission rates, but the second phase operating at the enhanced emission rates shown in Table B.2-3, due to the closer proximity of the East Range Site to the Class I areas. Flaring scenario emission rates are shown in Table B.2-4. While modeling runs were conducted for the other scenarios with lower emissions, the modeled impacts were lower, and increment compliance is assured for those scenarios if it can be demonstrated for the worst-case scenarios as shown below.

Table B.2-6. Class I PSD Increment Modeling Results for West Range Site (Phase I & II at 'Proposed' Emission Levels)

Pollutant	Averaging Period	Year Evaluated			Class I Inc ($\mu g/m^3$)	Class I SIL ($\mu g/m^3$)	Max ($\mu g/m^3$)
		2002 (1)	2003 (2)	2004 (2)			
Boundary Waters Canoe Area Wilderness							
SO_2	3-Hour (N*)	1.74	1.42	1.93	25	1	**1.93**
	3-Hour (2F*)	2.97	2.80	3.12	25	1	**3.12**
	3-Hour (1F*)	1.48	1.43	1.55	25	1	**1.55**
	24-Hour	0.39	0.35	0.56	5	0.2	**0.56**
	Annual	0.018	0.018	0.018	2	0.1	0.018
NO_X	Annual	0.017	0.015	0.017	2.5	0.1	0.017
PM_{10}	24-Hour	0.25	0.37	0.25	8	0.3	**0.37**
	Annual	0.012	0.013	0.012	4	0.2	0.013
Voyageurs National Park							
SO_2	3-Hour (N*)	1.28	2.05	1.77	25	1	**2.05**
	3-Hour (2F*)	2.21	3.64	3.32	25	1	**3.64**
	3-Hour (1F*)	1.11	1.81	1.64	25	1	**1.81**
	24-Hour	0.33	0.40	0.64	5	0.2	**0.64**
	Annual	0.018	0.024	0.022	2	0.1	0.024
NO_X	Annual	0.016	0.023	0.020	2.5	0.1	0.023
PM_{10}	24-Hour	0.29	0.26	0.56	8	0.3	**0.56**
	Annual	0.012	0.015	0.015	4	0.2	0.015
Rainbow Lakes Wilderness							
SO_2	3-Hour (N*)	0.49	0.43	0.41	25	1	0.49
	3-Hour (2F*)	0.67	0.76	0.60	25	1	0.76
	3-Hour (1F*)	0.33	0.38	0.31	25	1	0.38
	24-Hour	0.11	0.09	0.09	5	0.2	0.11

Table B.2-6. Class I PSD Increment Modeling Results for West Range Site (Phase I & II at 'Proposed' Emission Levels)

Pollutant	Averaging Period	Year Evaluated			Class I Inc ($\mu g/m^3$)	Class I SIL ($\mu g/m^3$)	Max ($\mu g/m^3$)
		2002 (1)	2003 (2)	2004 (2)			
	Annual	0.010	0.009	0.007	2	0.1	0.010
NO_X	Annual	0.009	0.015	0.006	2.5	0.1	0.015
PM_{10}	24-Hour	0.13	0.11	0.09	8	0.3	0.13
	Annual	0.008	0.008	0.006	4	0.2	0.008

Source: Excelsior
* Normal operation ('N'), two-phase flaring ('2F'), and single-phase flaring ('1F') scenarios were analyzed.
(1) 12km MM5 data, 1km CALMET grid resolution
(2) 36km MM5 data, 4km CALMET grid resolution

Table B.2-7. Class I PSD Increment Modeling Results for East Range Site (Phase I at 'Proposed' Emission Levels; Phase II at 'Enhanced' Emission Levels)

Pollutant	Averaging Period	Year Evaluated			Class I Inc ($\mu g/m^3$)	Class I SIL ($\mu g/m^3$)	Max ($\mu g/m^3$)
		2002 (1)	2003 (2)	2004 (2)			
Boundary Waters Canoe Area Wilderness							
SO_2	3-Hour (N*)	3.77	3.46	3.49	25	1	**3.77**
	3-Hour (2F*)	7.90	7.75	7.49	25	1	**7.90**
	3-Hour (1F*)	3.96	3.82	3.65	25	1	**3.96**
	24-Hour	0.72	0.73	1.02	5	0.2	**1.02**
	Annual	0.041	0.053	0.044	2	0.1	0.053
NO_X	Annual	0.050	0.067	0.057	2.5	0.1	0.067
PM_{10}	24-Hour	0.77	0.53	0.40	8	0.3	**0.77**
	Annual	0.023	0.026	0.022	4	0.2	0.026
Voyageurs National Park							
SO_2	3-Hour (N*)	1.28	0.89	0.96	25	1	**1.28**
	3-Hour (2F*)	3.20	2.18	2.14	25	1	**3.20**
	3-Hour (1F*)	1.60	1.09	1.07	25	1	**1.60**
	24-Hour	0.26	0.23	0.25	5	0.2	**0.26**
	Annual	0.010	0.011	0.012	2	0.1	0.012
NO_X	Annual	0.010	0.010	0.012	2.5	0.1	0.012
PM_{10}	24-Hour	0.19	0.25	0.20	8	0.3	0.25
	Annual	0.008	0.009	0.009	4	0.2	0.009
Rainbow Lakes Wilderness							
SO_2	3-Hour (N*)	0.72	0.70	0.69	25	1	0.72
	3-Hour (2F*)	1.64	1.80	1.50	25	1	**1.80**
	3-Hour (1F*)	0.79	0.86	0.78	25	1	0.86

Table B.2-7. Class I PSD Increment Modeling Results for East Range Site (Phase I at 'Proposed' Emission Levels; Phase II at 'Enhanced' Emission Levels)

Pollutant	Averaging Period	Year Evaluated			Class I Inc ($\mu g/m^3$)	Class I SIL ($\mu g/m^3$)	Max ($\mu g/m^3$)
		2002 (1)	2003 (2)	2004 (2)			
	24-Hour	0.17	0.12	0.19	5	0.2	0.19
	Annual	0.008	0.009	0.010	2	0.1	0.010
NO_X	Annual	0.007	0.009	0.010	2.5	0.1	0.010
PM_{10}	24-Hour	0.16	0.11	0.21	8	0.3	0.21
	Annual	0.008	0.008	0.009	4	0.2	0.009
Isle Royale National Park							
SO_2	3-Hour (N*)	0.24	0.27	0.36	25	1	0.36
	3-Hour (2F*)	0.57	0.69	1.01	25	1	**1.01**
	3-Hour (1F*)	0.28	0.34	0.52	25	1	0.52
	24-Hour	0.07	0.05	0.08	5	0.2	0.08
	Annual	0.004	0.004	0.004	2	0.1	0.004
NO_X	Annual	0.005	0.003	0.004	2.5	0.1	0.005
PM_{10}	24-Hour	0.15	0.08	0.07	8	0.3	0.15
	Annual	0.008	0.007	0.006	4	0.2	0.008

Source: Excelsior
* Normal operation ('N'), two-phase flaring ('2F'), and single-phase flaring ('1F') scenarios were analyzed.
(1) 12km MM5 data, 1km CALMET grid resolution
(2) 36km MM5 data, 4km CALMET grid resolution

The data indicate that maximum Mesaba Energy Project impacts are below allowable increments for all pollutants in the Class I areas. Impacts are also below the SILs in most cases, indicating that impacts would be insignificant, with no further analysis necessary. However, for short-term SO_2 and PM_{10} concentrations, impacts are indicated to exceed some SILs in the BWCAW and VNP (see bolded values in the tables above). These results were consistent with those from the AERMOD modeling for BWCAW receptors within 50km of the East Range Site – i.e., the same SILs were triggered. Because of the 3-hour and 24-hour SO_2 and 24-hour PM_{10} projected impacts, it was necessary to conduct a cumulative impact analysis, including other regional SO_2 and PM_{10} increment sources as well as reasonably foreseeable sources (see Table B.2-3), to quantify the total PSD increment consumption.

While the flaring scenario for the East Range Site also indicated potential impacts above some SILs for RLW and IRNP, a cumulative analysis was not conducted for those Class I areas for a number of reasons. The first flaring scenario is very conservative; it assumed no enhanced controls for either Mesaba One or Two and was based on concurrent startup and upset events, which would occur very rarely (i.e., fewer than 20 times per year). Additional refinement may show that those SILs would not be triggered. Second, cumulative analyses based on rare startup/shutdown/malfunction occurrences are not appropriate as the underlying assumption is that these conditions would prevail continuously every hour of each year, which is not possible given the limited number of potential hours of flaring events and also, because they are unlikely to coincide with the maximum impacts shown by other sources.[3] Finally, as

[3] *See* discussion under '3. Actual Emissions Rates Used to Model Short-Term Increment Compliance' of USEPA. "Prevention of Significant Deterioration New Source Review: Refinement of Increment Modeling Procedures;

shown for the second flaring scenario, where flaring only occurs for one Phase at a time, none of the predicted impacts for RLW or IRNP exceed the SILs, so no cumulative analyses were warranted for those two Class I areas.

The results of the cumulative analyses are shown in Table B.2-8 and B.2-9. In accordance with PSD regulations, the highest second-high values are shown for each year.

Table B.2-8. Class I PSD Increment Cumulative Modeling Results – West Range Site [1]

Pollutant	Averaging Period	Year Evaluated [2]			Class I Inc ($\mu g/m^3$)	Max ($\mu g/m^3$)
		2002	2003	2004		
Boundary Waters Canoe Area Wilderness						
SO_2	3-Hour	7.04	7.54	8.63	25	8.63
	24-Hour	1.95	1.93	2.68	5	2.68
PM_{10}	24-Hour	1.21	0.94	1.17	8	1.21
Voyageurs National Park						
SO_2	3-Hour	8.13	7.87	7.53	25	8.13
	24-Hour	1.90	1.74	1.65	5	1.90
PM_{10}	24-Hour	0.74	0.98	1.03	8	1.03

[1] Emissions: Mesaba One and Two at 'Proposed' emissions levels
[2] 36km MM5 data, 4km CALMET grid resolution for all three years

Table B.2-9. Class I PSD Increment Cumulative Modeling Results – East Range Site [1]

Pollutant	Averaging Period	Year Evaluated [2]			Class I Inc ($\mu g/m^3$)	Max ($\mu g/m^3$)
		2002	2003	2004		
Boundary Waters Canoe Area Wilderness						
SO_2	3-Hour	6.50	6.75	8.06	25	8.06
	24-Hour	1.68	1.74	2.45	5	2.45
PM_{10}	24-Hour	1.18	0.86	1.11	8	1.18
Voyageurs National Park						
SO_2	3-Hour	7.33	6.70	6.54	25	7.33
	24-Hour	1.82	1.48	1.46	5	1.82

[1] Emissions: Mesaba One at 'Proposed' emissions levels; Mesaba Two at 'Enhanced' emission levels
[2] 36km MM5 data, 4km CALMET grid resolution for all three years

Proposed Rule." Federal Register Vol. 72, No. 108, p.31389-90, June 6, 2007. Available: http://edocket.access.gpo.gov/2007/pdf/E7-10459.pdf.
See also "Unless the startup/ shutdown/malfunctions conditions are requested for an extended period or have unusually high emission rates, predicted significant impacts during these scenarios will not require a multisource modeling analysis." Section 7.9 on p. 7-6 of New Jersey Department of Environmental Protection. "Technical Manual 1002: Guidance on Preparing an Air Quality Modeling Protocol." August, 1997. Available: www.nj.gov/dep/aqpp/downloads/techman/**1002**.PDF.

As indicated in Tables B.2-8 and B.2-9, the cumulative modeling analyses show compliance with the PSD increments. The maximum consumption is shown in the right-most column, and the allowable consumption (the increment) is shown in the second column from the right. In fact, in all cases, even with the conservative nature of the modeled inventory, no more than 54 percent of the increment is predicted to be consumed.

Cumulative modeling conducted using AERMOD for the receptors in BWCAW within 50km of the East Range Site showed even lower impacts. Table B.2-10 shows that the AERMOD modeling results are well below the allowable increment and consistently lower than the CALPUFF results in Table B.2-9, confirming the conclusion of compliance for all PSD increments.

Table B.2-10. Class I PSD Increment Cumulative Modeling Results – East Range Site (AERMOD Analysis of Receptors within 50 km)

Pollutant	Averaging Period	Year Evaluated					Class I Inc ($\mu g/m^3$)	Max ($\mu g/m^3$)
		1972	1973	1974	1975	1976		
Boundary Waters Canoe Area Wilderness								
SO_2	3-Hour	5.35	5.02	5.50	5.59	5.31	25	5.59
	24-Hour	1.10	0.90	1.19	1.27	1.29	5	1.29
PM_{10}	24-Hour	0.63	0.49	0.56	0.52	0.55	8	0.63

Class I Visibility/Regional Haze Analyses

Visibility/regional haze impact analyses were carried out for BWCAW and VNP for both sites, as well as for IRNP for the East Range Site. The West Range Site is more than 300 km from IRNP, and visibility is not a designated AQRV for RLW. The recommended methodology for assessing visibility impacts according to the Federal Land Managers' Air Quality Related Values Work Group (FLAG) guidance involves the use of CALPOST to process the data on concentrations of pollutants from the CALPUFF modeling of 24-hour emissions. In CALPOST, a daily value of light extinction is defined by the concentrations of each pollutant that can affect visibility, taking into account the efficiency of each particulate type in scattering light, and the relative humidity which influences the size of sulfates and nitrates. The FLM has established threshold changes in light extinction (Δb_{ext}) as a percentage of natural background that are believed to represent potential thresholds of concern that may lead to adverse impacts on visibility. These thresholds are 5 percent (a potentially detectable change) and 10 percent (a level that may represent an unacceptable degradation).

Current FLM guidance specifies the use of "Method 2" of CALPOST for calculation of visibility impacts. The FLAG Method 2 represents a conservative approach, which is expected to yield high extinction values and over-predict potential visibility degradation. In Method 2, relative humidity data from the nearest surface weather station is used to calculate both source and background light extinction. Since the issuance of FLAG 2000, the science of visibility modeling has progressed and the need to address the inherent conservative assumptions and resulting over-predictions under Method 2 has become apparent. FLMs have developed a revised draft FLAG document that was released for comment in June 2008 proposing a new methodology for calculating visibility impacts. Although the revised FLAG document has not yet been finalized, in the March 2009 letter, the FLMs indicated that supplemental visibility calculations can be submitted using "Method 8" of CALPOST, which is the suggested new method in the draft FLAG guidance. Therefore, both Method 2 and Method 8 results will be presented. The FLAG 2000 Method 2 approach relies on the maximum extinction values for comparison to the threshold levels of concern, and focuses on the number of days modeled per year above the 5% and 10% light extinction thresholds, while FLAG 2008 focuses on the light extinction modeled for the 8th worst

day of each year (i.e., the 98th percentile). Therefore, the results of the two methods are presented on those bases.

As discussed previously, a range of emission scenarios were modeled and the results for visibility are presented in Tables B.2-11 and B.2-12 below. 'Proposed' refers to the controlled emission rates listed in Table B.2-2, 'Enhanced' refers to the controlled emission rates listed in Table B.2-3, and 'None' indicates that the scenario is a Phase I only analysis. As with the PSD increment analyses, while flaring scenarios were modeled, the results were lower than (or essentially the same as) their correlative normal operation scenarios, and therefore they do not represent the worst-case operating scenario and need not be considered further. The set of scenarios modeled for the East Range Site considered and included more controls due to its closer proximity to Class I areas.

Table B.2-11. Class I Visibility Modeling Results – West Range Site

Emission Rate		Method 2						Method 8		
Phase I	Phase II	2002 (1)		2003 (2)		2004 (2)		2002 (1)	2003 (2)	2004 (2)
		Days ≥ 5%	Days ≥ 10%	Days ≥ 5%	Days ≥ 10%	Days ≥ 5%	Days ≥ 10%	8th high ΔB_{ext} (%)	8th high ΔB_{ext} (%)	8th high ΔB_{ext} (%)
Boundary Waters Canoe Area Wilderness										
Proposed	None	1	0	3	0	1	0	1.80	2.47	2.51
Proposed	Proposed	19	1	21	6	14	6	5.13	4.82	5.04
Proposed	Enhanced	9	0	15	3	11	0	3.86	3.62	4.04
Voyageurs National Park										
Proposed	None	1	0	2	0	6	1	1.98	2.99	2.71
Proposed	Proposed	13	3	16	2	22	7	4.80	5.95	5.46
Proposed	Enhanced	6	0	7	2	15	4	3.73	4.63	4.23

(1) 12km MM5 data, 1km CALMET grid resolution
(2) 36km MM5 data, 4km CALMET grid resolution

The visibility modeling analysis results for the West Range site shown in Table B.2-11 indicate that, considering the most conservative Method 2 results, impacts greater than five or 10 percent could occur at some point within BWCAW and VNP. Using that Method, and depending on the operating scenario, the number of days per year with greater than 5 percent extinction ranges from 1 to 22 at the West Range site. The Method 8 results, which are based on less conservative assumptions and consider to some extent the influence of natural visibility impairment, provide potentially more realistic predicted impacts. Those results indicate that only for the scenario with the highest potential emissions, i.e., the proposed (BACT) emission rates for both Phase 1 and Phase 2, would any 8th highest values be above the 5 percent extinction threshold, and then for only two of the three years in each Class I area. The operating scenario with only Phase I at the proposed emission rates, and the operating scenario with Phase I at the proposed emission rates and Phase II at the enhanced controlled emission rates, are both predicted to result in 8th highest values well below the 5 percent threshold.

Table B.2-12. Class I Visibility Modeling Results – East Range Site

Emission Rate		Method 2						Method 8		
Phase I	Phase II	2002 (1)		2003 (2)		2004 (2)		2002 (1)	2003 (2)	2004 (2)
		Days ≥ 5%	Days ≥ 10%	Days ≥ 5%	Days ≥ 10%	Days ≥ 5%	Days ≥ 10%	8th high ΔB_{ext} (%)	8th high ΔB_{ext} (%)	8th high ΔB_{ext} (%)
Boundary Waters Canoe Area Wilderness										
Proposed	None	46	7	15	0	10	0	6.23	6.16	5.30
Proposed	Enhanced	86	29	60	9	47	5	9.89	10.28	8.63
Enhanced	Enhanced	50	8	34	1	19	0	7.42	7.42	6.29
Voyageurs National Park										
Proposed	None	1	0	2	0	3	1	1.94	2.45	2.50
Proposed	Enhanced	3	1	4	0	7	2	2.98	3.81	3.72
Enhanced	Enhanced	1	0	1	0	2	0	2.07	2.54	2.43
Isle Royale National Park										
Proposed	None	1	0	0	0	0	0	1.50	1.24	1.25
Proposed	Enhanced	2	1	0	0	0	0	2.26	1.82	1.86
Enhanced	Enhanced	1	0	0	0	0	0	1.51	1.16	1.24

(1) 12km MM5 data, 1km CALMET grid resolution
(2) 36km MM5 data, 4km CALMET grid resolution

The visibility modeling analysis results for the East Range site shown in Table B.2-12 reflect the influence of the site's closer proximity to BWCAW and the commensurate higher predicted number of days with a change in light extinction above 5 and 10 percent for the same operating scenarios. Both the Method 2 and Method 8 results indicate that emissions associated with any of the operating scenarios and Project Phases have the potential to produce impacts above 5 percent light extinction. Since even the lowest emission rate case based on Phase I and Phase II enhanced emission controls would result in potentially adverse impacts, mitigation of the predicted impacts would likely require either a further refinement of the modeling approach and methodology, or a means of offsetting the predicted impacts through the identification and acquisition of sufficient emissions reductions from non-Project sources.

Since the East Range site is within 50 km of BWCAW, some of the predicted visibility impact events discussed above occurred at receptors within 50 km and, per guidance from the FLMs, those receptors were preliminarily subject to analysis using the CALPUFF modeling system. For such receptors, the visibility analyses could be performed using the PLUVUE model to determine the potential plume blight impacts, instead of using the CALPUFF modeling system. Excelsior proposes that should the East Range site be selected for construction of the Project, a more refined plume blight impact analysis be performed for these receptors.

Additionally, the predicted visibility impacts can be mitigated by offsetting an equivalent number of visibility events in the Class I area by reducing emissions such as SO_2 from sources not associated with the Project. Excelsior has investigated this potential mitigation option and has identified sources of emissions in the vicinity of the East Range site that may be considered for the mitigation effort. A major source of SO_2 emissions located less than 3 km from the East Range site currently has permitted and actual emissions that could be reduced to adequately mitigate the predicted impacts from the Project for

most or all of the operating scenarios considered. Excelsior proposes to pursue this mitigation option should the East Range site be selected for the Project.

Thus, use of some combination of appropriate operating scenarios, refined modeling analyses and the acquisition of any necessary emission offsets from nearby sources will be considered to mitigate any predicted adverse visibility impacts from the Mesaba Project.

The predicted visibility impacts on the other Class I areas evaluated for the East Range site, VNP and IRNP, are expected to be very small with only a few days per year predicted to be above the 5 percent threshold based on the conservative Method 2 analyses. The Method 8 results show that all 8th high values at both Class I areas are well below the 5 percent light extinction threshold and are not expected to be of concern.

As discussed above, supplementary modeling was also conducted for various combinations of MM5 and CALMET grid resolutions in order to ascertain whether these model settings impacted the results, and because Excelsior felt that higher resolution modeling is more technically accurate. Table B.2-13 compares the results for these modeling variations for 2002 (the only year in which higher-resolution MM5 data is available), using the 'Proposed' emission rates for Mesaba One and 'Enhanced' emission rates for Mesaba Two as a test case.

Table B.2-13a. Class I Visibility Modeling – Comparison of Meteorological Data Resolutions for 2002 – West Range Site [(1)]

Resolution		Method 2		Method 8
MM5	CALMET	Days ≥ 5%	Days ≥ 10%	8th high ΔB_{ext} (%)
Boundary Waters Canoe Area Wilderness				
12 km	1 km	9	0	3.86
36 km	1 km	9	1	3.82
36 km	4 km	9	1	3.91
Voyageurs National Park				
12 km	1 km	6	0	3.73
36 km	1 km	13	0	3.50
36 km	4 km	16	0	4.48

[(1)] Emissions: Mesaba One at 'Proposed' emissions levels, Mesaba Two at 'Enhanced' emissions levels

Table B.2-13b. Class I Visibility Modeling – Comparison of Meteorological Data Resolutions for 2002 – East Range Site [(1)]

Resolution		Method 2		Method 8
MM5	CALMET	Days ≥ 5%	Days ≥ 10%	8th high ΔB_{ext} (%)
Boundary Waters Canoe Area Wilderness				
12 km	1 km	86	29	9.89
36 km	1 km	90	33	10.29
36 km	4 km	83	24	9.58

Table B.2-13b. Class I Visibility Modeling – Comparison of Meteorological Data Resolutions for 2002 – East Range Site [1]

Resolution		Method 2		Method 8
MM5	CALMET	Days ≥ 5%	Days ≥ 10%	8th high ΔB_{ext} (%)
Voyageurs National Park				
12 km	1 km	3	1	2.98
36 km	1 km	7	1	3.39
36 km	4 km	8	2	3.77

[1] Emissions: Mesaba One at 'Proposed' emissions levels, Mesaba Two at 'Enhanced' emissions levels

For BWCAW, the predicted visibility impact results in Table B.2-13 show little change and no trend as a function of the resolution of the meteorological data. In contrast, for VNP, as the resolution of the meteorological data and grid increases, the visibility impact results show a significant reduction in both the frequency of predicted light extinction events above 5 percent and in the magnitude of the maximum predicted event. For the impacts of the East Range site on BWCAW, both the maximum frequency of light extinction events above 5 percent and the maximum event occurred using the 36 km MM5 data together with a CALMET grid resolution of 1 km. For the impacts of both the West Range and East Range sites on VNP, both the maximum frequency of light extinction events above 5 percent and the maximum event occurred using the 36 km MM5 data together with a CALMET grid resolution of 4 km.

Unfortunately, 12km MM5 data is not available for 2003 and 2004. However, Excelsior conducted some additional modeling as supplementary information using 1km CALMET grid resolution for those years. These results are shown in Tables B.2-14 and B.2-15, including 2002 using 12km MM5 data.

Table B.2-14a. Class I Visibility Supplementary Modeling Results – West Range Site

Emission Rate		Method 2						Method 8		
Phase I	Phase II	2002 [1]		2003 [2]		2004 [2]		2002 [1]	2003 [2]	2004 [2]
		Days ≥ 5%	Days ≥ 10%	Days ≥ 5%	Days ≥ 10%	Days ≥ 5%	Days ≥ 10%	8th high ΔB_{ext} (%)	8th high ΔB_{ext} (%)	8th high ΔB_{ext} (%)
Boundary Waters Canoe Area Wilderness										
Proposed	None	1	0	3	0	1	0	1.80	2.17	2.36
Proposed	Enhanced	9	0	7	1	5	0	3.86	3.34	3.79
Voyageurs National Park										
Proposed	None	1	0	2	0	3	0	1.98	2.46	2.19
Proposed	Enhanced	6	0	5	1	7	2	3.73	3.87	3.35

[1] 12km MM5 data, 1km CALMET grid resolution
[2] 36km MM5 data, 1km CALMET grid resolution

Table B.2-14b. Class I Visibility Supplementary Modeling Results – West Range Site [1]

Emission Rate		Method 2						Method 8		
Phase I	Phase II	2002		2003		2004		2002	2003	2004
		Days ≥ 5%	Days ≥ 10%	Days ≥ 5%	Days ≥ 10%	Days ≥ 5%	Days ≥ 10%	8th high ΔB_{ext} (%)	8th high ΔB_{ext} (%)	8th high ΔB_{ext} (%)
Boundary Waters Canoe Area Wilderness										
Proposed	None	1	0	3	0	1	0	2.52	2.17	2.36
Proposed	Enhanced	9	1	7	1	5	0	3.82	3.34	3.79
Voyageurs National Park										
Proposed	None	2	0	2	0	3	0	2.32	2.46	2.19
Proposed	Enhanced	13	0	5	1	7	2	3.50	3.87	3.35

[1] 36km MM5 data, 1km CALMET grid resolution

For the West Range site, the effects of the higher resolution MM5 data are relatively small and they are partially obscured by the year to year variability that apparently occurred in the meteorological data. Nonetheless, the results presented in Table B.2-14b show that the 2002 meteorological data tended to produce a higher frequency of predicted days with a light extinction above 5 percent, compared to the results for the 2003 and 2004 data, all of which had the same 36 km MM5 and 1 km CALMET grid resolution. In contrast, the results presented in Table B.2-14a for the more refined 12 km MM5 meteorological data used for 2002 are nearly indistinguishable from the results for the 2003 and 2004 data, which were based on the less refined 36 km MM5 data. Thus, in this instance, the use of the more refined 12 km MM5 data canceled the effect of the year to year variability in the meteorological data.

Table B.2-15a. Class I Visibility Supplementary Modeling Results – East Range Site

Emission Rate		Method 2						Method 8		
Phase I	Phase II	2002 [1]		2003 [2]		2004 [2]		2002 [1]	2003 [2]	2004 [2]
		Days ≥ 5%	Days ≥ 10%	Days ≥ 5%	Days ≥ 10%	Days ≥ 5%	Days ≥ 10%	8th high ΔB_{ext} (%)	8th high ΔB_{ext} (%)	8th high ΔB_{ext} (%)
Boundary Waters Canoe Area Wilderness										
Proposed	None	46	7	26	3	14	2	6.23	6.54	6.29
Proposed	Enhanced	86	29	65	13	49	7	9.89	10.76	9.70
Voyageurs National Park										
Proposed	None	1	0	3	0	3	0	1.94	2.12	2.05
Proposed	Enhanced	3	1	5	1	6	2	2.98	3.44	3.20

[1] 12km MM5 data, 1km CALMET grid resolution
[2] 36km MM5 data, 1km CALMET grid resolution

Table B.2-15b. Class I Visibility Supplementary Modeling Results – East Range Site [(1)]

Emission Rate		Method 2						Method 8		
Phase I	Phase II	2002		2003		2004		2002	2003	2004
		Days ≥ 5%	Days ≥ 10%	Days ≥ 5%	Days ≥ 10%	Days ≥ 5%	Days ≥ 10%	8th high ΔB_{ext} (%)	8th high ΔB_{ext} (%)	8th high ΔB_{ext} (%)
Boundary Waters Canoe Area Wilderness										
Proposed	None	48	7	26	3	14	2	6.44	6.54	6.29
Proposed	Enhanced	90	33	65	13	49	7	10.29	10.76	9.70
Voyageurs National Park										
Proposed	None	1	0	3	0	3	0	2.22	2.12	2.05
Proposed	Enhanced	7	1	5	1	6	2	3.39	3.44	3.20

[(1)] 36km MM5 data, 1km CALMET grid resolution

For the East Range site, the effects of the higher resolution MM5 data are even smaller and more obscured by the year to year variability that apparently occurred in the meteorological data. As was the case for the West Range site, the East Range site results presented in Table B.2-15b show that the 2002 meteorological data tended to produce a higher frequency of predicted days with a light extinction above 5 percent, compared to the results for the 2003 and 2004 data, all of which had the same 36 km MM5 and 1 km CALMET grid resolution. In contrast to the results for the West Range site, the East Range site results presented in Table B.2-15a also show that the more refined 12 km MM5 meteorological data used for 2002 tended to produce a higher frequency of predicted days with a light extinction above 5 percent, compared to the results for the 2003 and 2004 data, which were based on the less refined 36 km MM5 data. Thus, in this instance, the use of the more refined 12 km MM5 data did not cancel the effect of the year to year variability in the meteorological data.

More discussion regarding the determination and selection of the CALMET grid resolution is available in Excelsior's January 2009 Class I Area Modeling Protocol Supplement.

Finally, Excelsior conducted supplemental modeling analyses of the effectiveness of a sample offset scenario at reducing model-predicted visibility impacts. These analyses were conducted only as examples to provide information and illustrate the concept of mitigation. They do not represent a proposal, because the necessity of mitigation has not been established, and the practicability of the scenarios has not been confirmed. The scenario studied was the offset of SO_2 emissions via allowance purchases and/or emission reductions from Laskin Energy Center (LEC). This scenario was chosen due to the proximity of LEC to the East Range Site, where model-predicted visibility impacts were highest, and due to the existence of an established program for SO_2 allowance trading.

The analyses used actual SO_2 emissions from 2006 and 2007 (an average of 755 lb/hr) as a baseline case, and studied offset cases of allowance purchases and/or emission reductions equal to 35% and 50% of actual emissions. NO_X and PM emissions from LEC were not modeled, so the results do not reflect LEC's total modeled visibility impact. The air modeling methodology was the same as for the multi-source analyses described above. The predicted impacts are calculated using Method 2 and are compared to the Method 2 predicted impacts for the Mesaba Energy Project. It should be noted that the conservatism of Method 2 is likely to over-predict both the impacts of Mesaba and LEC.

Table B.2-16 shows the results of the offset scenario analyses. Results for LEC alone (SO_2 emissions only) are presented on the left part of the table. Results of the remaining impact of Mesaba after subtracting the number of days of modeled visibility impact eliminated by the LEC offset are presented

on the right part of the table (only the aggregate of the three years is shown). The results from Table B.2-16 show that emission offsets can be a viable approach to reducing the number of days for which modeled visibility impacts are predicted.

Table B.2-16. Class I Visibility Supplementary Modeling Results – Offset Scenarios [1]

Scenario	Emission Rate (lb/hr)	Laskin Energy Center [2]								Mesaba with LEC Offset [3]			
		2002		2003		2004		Total		East Range[4]		West Range[5]	
		Days ≥ 5%	Days ≥ 10%	Days ≥ 5%	Days ≥ 10%	Days ≥ 5%	Days ≥ 10%	Days ≥ 5%	Days ≥ 10%	Days ≥ 5%	Days ≥ 10%	Days ≥ 5%	Days ≥ 10%
Boundary Waters Canoe Area Wilderness													
Baseline	755	37	11	10	3	9	3	56	17	190	38	58	14
-35%	490	20	4	4	2	5	2	29	8	163	29	31	5
-50%	377	11	3	3	0	3	1	17	4	151	25	19	1
Voyageurs National Park													
Baseline	755	8	3	5	1	7	2	20	6	19	4	62	11
-35%	490	4	0	1	0	5	1	10	1	9	-1[6]	52	6
-50%	377	3	0	1	0	2	0	6	0	5	-2[6]	48	5

(1) 36km MM5 data, 4km CALMET grid resolution and Method 2 for all analyses.
(2) Results based on SO2 emissions only and therefore do not reflect actual visibility impacts; NOX and PM10 were not modeled.
(3) Results are for Mesaba alone for Baseline LEC scenario, and for Mesaba with offset benefit from LEC for reduction scenarios.
(4) Emissions: Mesaba One at 'Proposed' emissions levels, Mesaba Two and 'Enhanced' emissions levels.
(5) Emissions: Mesaba One and Two at 'Proposed' emissions levels.
(6) Negative number because LEC offsets reduce more days than Mesaba would have impacted.

In addition to the discussion noted above regarding the modeled results and potential mitigation of any adverse impact, it is also important to recognize and take into account the Draft FLAG Phase I Report, which includes an expanded discussion of the process for adverse impact determination that in the event that initial modeling predicts calculated visibility impacts greater than the defined thresholds (e.g., 5%). That report states that further analysis can be conducted and additional contextual factors considered before a project-specific determination is made. According to the draft, the defined threshold does not represent a bright line test for adverse impact determination, but rather a level at which additional analysis is triggered, similar to the Deposition Analysis Threshold for nitrogen and sulfur deposition, discussed below. The following are examples of other factors to consider:

- Current pollutant concentrations and AQRV impacts in the Class I area
- Air quality trends in the Class I area
- Emission changes that have occurred or would occur (i.e., enforceable) by the time the new source begins operation
- Whether there are approved SIPs that account for new source growth and demonstrate attainment of national ambient air quality standards and "reasonable progress" toward visibility goals
- The expected useful life of the source
- The stringency of the emission limits (e.g., Best Available Control Technology)
- Other considerations such as options put forth by the applicant that would produce ancillary environmental benefits to AQRVs (e.g., reductions in toxic air contaminants, pollution prevention investments)

- Comments received from the public or other agencies during the comment period prior to issuing the permit

Minnesota is developing a State Implementation Plan for implementing the Regional Haze Rule, and that plan would certainly be a contextual consideration.

Deposition of Nitrogen and Sulfur

Potential impacts to soils, waters, and vegetation in Class I areas were evaluated on the basis of the model-predicted pollutant concentrations and the magnitude of predicted annual deposition of S and N. Criteria for assessment of deposition impacts are different for USFS areas (BWCAW and RLW) and National Park Service (NPS) areas (i.e., VNP). The NPS has established a Deposition Analysis Threshold (DAT) of 0.01 kilograms per hectare per year for both S and N deposition for Class I areas in the eastern United States. A DAT is the additional amount of N or S deposition within a Class I area, below which estimated impacts from a proposed new or modified source are considered insignificant.

The CALPUFF results for each of the Class I areas were processed with CALPOST to calculate total annual deposition of N and S at each receptor as a result of Mesaba Generating Station emissions. Total sulfur deposition is calculated from the wet (rain, snow, fog) and dry (particle, gas) deposition of SO_2 and sulfate; total nitrogen is represented by the sum of nitrogen from wet and dry fluxes of nitric acid, nitrate, ammonium sulfate and ammonium nitrate, and the dry flux of NO_X. Results are shown in Tables B.2-17 and B.2-18.

Table B.2-17. Class I Deposition Modeling Results – West Range Site

Emission Rate		Nitrogen Deposition (kg/ha-yr)			Sulfur Deposition (kg/ha-yr)		
Phase I	**Phase II**	**2002 (1)**	**2003 (2)**	**2004 (2)**	**2002 (1)**	**2003 (2)**	**2004 (2)**
Boundary Waters Canoe Area Wilderness							
Proposed	None	0.0039	0.0041	0.0038	0.0058	0.0069	0.0057
Proposed	Proposed	0.0077	0.0082	0.0075	**0.0115**	**0.0138**	**0.0114**
Proposed	Enhanced	0.0053	0.0056	0.0052	0.0081	0.0097	0.0080
Voyageurs National Park							
Proposed	None	0.0042	0.0049	0.0046	0.0074	0.0079	0.0075
Proposed	Proposed	0.0084	0.0099	0.0092	**0.0146**	**0.0159**	**0.0150**
Proposed	Enhanced	0.0058	0.0068	0.0063	**0.0103**	**0.0112**	**0.0106**
Rainbow Lakes Wilderness							
Proposed	None	0.0020	0.0021	0.0020	0.0030	0.0033	0.0029
Proposed	Proposed	0.0040	0.0042	0.0040	0.0060	0.0065	0.0059
Proposed	Enhanced	0.0027	0.0029	0.0027	0.0042	0.0046	0.0041

(1) 12km MM5 data, 1km CALMET grid resolution
(2) 36km MM5 data, 4km CALMET grid resolution

Table B.2-18. Class I Deposition Modeling Results – East Range Site

Emission Rate		Nitrogen Deposition (kg/ha-yr)			Sulfur Deposition (kg/ha-yr)		
Phase I	**Phase II**	**2002 (1)**	**2003 (2)**	**2004 (2)**	**2002 (1)**	**2003 (2)**	**2004 (2)**
Boundary Waters Canoe Area Wilderness							
Proposed	None	**0.0156**	**0.0176**	**0.0166**	**0.0246**	**0.0255**	**0.0269**
Proposed	Enhanced	**0.0219**	**0.0247**	**0.0230**	**0.0346**	**0.0359**	**0.0376**
Enhanced	Enhanced	**0.0128**	**0.0144**	**0.0130**	**0.0202**	**0.0211**	**0.0219**
Voyageurs National Park							
Proposed	None	0.0044	0.0042	0.0054	0.0082	0.0075	0.0087
Proposed	Enhanced	0.0061	0.0059	0.0074	**0.0115**	**0.0105**	**0.0122**
Enhanced	Enhanced	0.0035	0.0034	0.0042	0.0067	0.0062	0.0071
Rainbow Lakes Wilderness							
Proposed	None	0.0020	0.0031	0.0034	0.0032	0.0044	0.0048
Proposed	Enhanced	0.0027	0.0043	0.0047	0.0044	0.0061	0.0067
Enhanced	Enhanced	0.0015	0.0024	0.0025	0.0026	0.0036	0.0039
Isle Royale National Park							
Proposed	None	0.0012	0.0011	0.0012	0.0032	0.0028	0.0034
Proposed	Enhanced	0.0017	0.0015	0.0017	0.0045	0.0040	0.0048
Enhanced	Enhanced	0.0009	0.0008	0.0009	0.0026	0.0023	0.0028

(1) 12km MM5 data, 1km CALMET grid resolution
(2) 36km MM5 data, 4km CALMET grid resolution

As shown in Table B.2-17, the CALPUFF model results for nitrogen deposition for the West Range Site are below the DAT. The sulfur deposition model results are below the DAT for Mesaba One only, are slightly above the DAT with Mesaba Two at enhanced controls in VNP only, and are above the DAT for Mesaba One and Two with proposed controls at VNP and BWCAW.

As shown in Table B.2-18, deposition results for the East Range are below the DAT for IRNP, RLW, and VNP, except for one case for sulfur deposition at VNP where the results are slightly above the DAT. Results are above the DAT for both nitrogen and sulfur deposition at BWCAW. The analysis is conservative since it uses worst-case emissions and 100% operation. The DAT represents a screening level to assess any possibility of adverse impact, and is not a regulatory limit. Additionally, based on the deposition assessment criteria that the USFS used, the S and N deposition rates from the Mesaba Energy Project are well below Green Line at BWCAW (see Appendix D-1).