

APPENDIX D2

Health Risk

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6.4 Cumulative Impacts – Air Toxics Inhalation Risk

Cumulative impacts resulting from inhalation of air toxics emissions from the Mesaba Energy Project, nearby existing facilities, and other potential future emission sources listed in Section 3.2 are evaluated at both the East Range and West Range locations. In addition to the Mesaba One and Mesaba Two, future emissions from the proposed Minnesota Steel Industries (MSI) plant near the West Range location are included in this evaluation. Emission sources considered at the East Range location include the existing Laskin Energy Center (southwest of the IGCC Power Station footprint [hereafter, the “Footprint”]), the proposed Mesabi Nugget facility (northwest of the Footprint) and the proposed PolyMet Mining (PolyMet) project (north of the Footprint). It should be stressed that only the Laskin Energy Center (Laskin) is currently in operation, in fact permits have not been issued for the MSI or PolyMet facilities to date.

Two proposed wood-fired boilers at the Laurentian Wood-Fired Generation Plants located near Virginia, Minnesota and Hibbing, Minnesota are also listed in Section 3.2 as potential future emission sources. The Laurentian facility at Hibbing would be approximately 35 kilometers (km) from the proposed West Range Mesaba facility, and the Laurentian facility at Virginia would be approximately 40 km from the proposed East Range facility. Because of the relatively large distances from the Mesaba plant, the incremental risk which the Laurentian facilities would contribute due to inhalation of air toxics would not be significant and so are not evaluated further.

Approach

The method to determine potential cumulative impacts to receptors from inhaled (Mesaba One and Mesaba Two) emissions generated by Mesaba One and Mesaba Two and from other potential future emission sources uses a step-wise approach.

The first, more conservative step of the process determines the maximum cancer risk and non-cancer hazard index estimated for each facility. For the most part, this information is obtained from the most current Air Emission Risk Analysis (AERA) data submitted by each facility to the MPCA. For the Laskin facility, risk was estimated based on data obtained from the MPCA Annual Emission Inventory records. The maximum risks are evaluated for acute, sub-chronic, and chronic averaging periods (as available). As a worst-case scenario, it is assumed that the risks are additive and that receptors are exposed to inhaled pollutant concentrations that pose the maximum risks, without regard for the actual location of the risk determination.

The combined maximum cancer risks and maximum hazard indices from potential nearby facilities are compared to the thresholds of concern established by the Minnesota Department of Health (MDH). The threshold of concern for pollutants producing non-carcinogenic effects is 1 and the threshold of concern for pollutants producing carcinogenic effects is 1 in 100,000 or 1×10^{-5} .

If the combined cancer risks and hazard indices are below the MDH threshold values, then it is assumed that the cumulative worst-case risks are at acceptable levels and will not cause appreciable cumulative impacts.

If the combined risks or hazard indices are greater than the MDH threshold values, then the second, more refined, step in the process is conducted. Based on MPCA guidance, screening-level risk is assessed within a buffer zone of 3 km for facilities with stack heights less than 100 meter (m) and within a buffer zone of 10 km for facilities with stack heights greater than 100 m. In the second step, the calculated risks at receptor locations closest to the buffer zone portions common to each of the facilities (overlap areas) being assessed are added and compared to MDH threshold values. The facility buffer zones for the West Range can be seen on Figure 1 and for the East Range on Figure 2.

Because several of the facilities are not currently in operation, a third step of evaluation is conducted on the East Range to evaluate the cumulative effects of Mesaba One and Mesaba Two in combination with each of the Mesabi Nugget and PolyMet facilities separately. The purpose of this evaluation step is to evaluate the contribution of each facility in the event that either the Mesabi Nugget or PolyMet plants do not become operational.

Overview

Information regarding maximum inhalation cancer risks and hazard indices is obtained from the following sources:

- Mesaba Energy Project AERA, and related support files submitted to MPCA dated June 2006
- MSI Human Health Screening-Level Risk Assessment, dated May 2006
- PolyMet Mining, Inc. AERA, dated May 2005
- Mesabi Nugget, LLC, MPCA AERA Internal Form-03, dated April 7, 3005
- MPCA Annual Emissions Inventory record for year 2002, Laskin Energy Center

The MPCA AERA Internal Form-03 for Mesabi Nugget presented two sets of air toxics risk data. The “near field” data, representing the area at or between the Mesabi Nugget property boundary and the Cliffs Erie property boundary, is used for this evaluation. This data set contains the Mesabi Nugget maximum risk experienced by a receptor in the vicinity of Mesaba Energy and PolyMet.

In order to define the screening-level buffer zone areas in common to two or more facilities, SEH obtained stack height and location information for each facility. All facility stack heights, with the exception of MSI, are less than 100 m. At least one MSI stack height is listed at 100 m. Based on this information, or on files obtained from the facility or their consultant regarding buffer zone placement, SEH mapped the buffer zone boundaries. Mesaba One, Mesaba Two, Mesabi Nugget, Laskin, and PolyMet have buffer zones of 3 km. The MSI facility has a buffer zone of 10 km. Because the exact location of the PolyMet stacks are not known, the 3 km buffer zone for this facility is drawn from the approximate plant area boundary. The facility buffer zones for the West Range can be seen on Figure 1, Area A and for the East Range on Figure 2, Areas B and C.

As will be shown in subsequent sections, the maximum inhalation risks posed by two of the proposed facilities near the East Range Mesaba plant are at the MDH threshold values. Additional risk contributed by any other facility will cause the MDH threshold values to be exceeded. The contribution of the East Range Mesaba facility to inhalation risk is between 0.5 and 22 percent in all Step 2 and Step 3 evaluations.

It is also worthy to note that hazard indices and cancer risks are additive if a receptor experiences the emissions from all sources simultaneously. That is, emissions must coincide both spatially and temporally. It is highly unlikely that meteorological conditions would have maximum pollutant concentrations from two or more facilities located at the same time and at the same place. Meteorological conditions that would cause maximum concentrations from one facility at a specific receptor location would cause reduced concentrations at that same location from other facilities. In addition, as discussed below, while refined risk values are used for the Mesaba plant in Step 2 and Step 3 evaluations, maximum risk results must be used for both the Mesabi Nugget and PolyMet projects regardless of the geographical location of the overlap areas. Evaluation of cumulative impacts under these conditions results in greatly overestimated results.

West Range – Step 1 Results

The facilities on the West Range are Mesaba One, Mesaba Two, and MSI. The general area potentially impacted by both facilities can be seen on Figure 1, indicated by Area A. These results are summarized in Table 1.

**Table 1
West Range Cumulative Risk – Step 1**

Facility	Potential Inhalation Hazard Index/Averaging Period*			Potential Inhalation Cancer Risk*
	Acute (1-hour)	Sub-Chronic (1-month)	Chronic (annual)	
Mesaba	0.5	0.1	0.03	3×10^{-07}
MSI	0.7	Not conducted	0.2	6×10^{-07}
Potential Cumulative Impacts	1**	N/A	0.2	9×10^{-07}
MDH Threshold Values	1	1	1	1×10^{-05}
Cumulative Impact Decision	Minimal Impacts	N/A	No Impacts	No Impacts

*Hazard Index and Cancer Risks are reported to one significant figure only as stated in the U.S. EPA's Risk Assessment Guidance for Superfund (RAGS), Volume I – Human Health Evaluation Manual (Part A).

**The sum of the hazard indices is actually greater than one. However, because the hazard index is reported to one significant figure and that value is at the MDH threshold, the cumulative impacts decision is stated as minimal rather than exceeding the limit or having no impacts.

The combined acute hazard indices from both facilities result in a maximum acute cumulative hazard index of 1. A sub-chronic hazard index is not calculated for the MSI facility in the MSI Human Health Screening-Level Risk Assessment; therefore, a cumulative sub-chronic hazard index could not be evaluated. The maximum sub-chronic contribution from Mesaba One and Mesaba Two is 0.1, well below the threshold value of concern established by the MDH. The combined chronic hazard indices from both facilities result in a maximum cumulative hazard index of 0.2.

The combined cancer risks from both facilities results in a maximum cumulative cancer risk of 9×10^{-07} .

Based on the most current risk analyses performed for the Mesaba and MSI facilities, maximum acute and chronic hazard indices and cancer risk will not exceed MDH threshold values. A Step 2 evaluation is not required for these two facilities.

East Range – Step 1 Results

Four facilities are in relatively close proximity near the proposed East Range Mesaba site. Three of those facilities, Mesaba, Mesabi Nugget, and PolyMet are close enough geographically to result in the overlap of all three buffer zones. It is assumed that emissions from all three facilities could potentially impact a receptor in the overlap area. Likewise, the buffer zones for the Mesaba and Laskin facilities overlap. The Laskin buffer zone, however, does not overlap those of either Mesabi Nugget or PolyMet. The general area potentially impacted by Mesaba, Mesabi Nugget, and PolyMet can be seen on Figure 2, indicated by Area B. The general area potentially impacted by Mesaba and Laskin is indicated by Area C.

Mesaba One/Mesaba Two and Laskin Energy Center

Although the Laskin facility has been in operation for some time, an AERA is not available. SEH obtained the most recent air toxics data from the MPCA Annual Emissions Inventory database. The most recent data available was for 2002. Using the Laskin emission source information, SEH performed dispersion modeling of Laskin emissions at a 1 g/sec dispersion rate. Receptors having the maximum dispersion concentrations were identified. The 2002 annual pollutant emission rates and dispersion modeling factors were entered into the most recent version of the MPCA Risk Assessment Screening Spreadsheet (RASS) spreadsheet (dated August, 29, 2006). Inhalation cancer risk and non-cancer hazard indices were then generated by RASS. The Step 1 evaluation of the Mesaba and Laskin facilities is summarized in Table 2.

Table 2
East Range Mesaba/Laskin Cumulative Risk – Step 1

Facility	Potential Inhalation Hazard Index/Averaging Period*			Potential Inhalation Cancer Risk
	Acute (1-hour)	Sub-Chronic (1-month)	Chronic (annual)	
Mesaba	0.5	0.1	0.03	3×10^{-07}
Laskin Energy Center	0.2	0.01	0.04	2×10^{-06}
Potential Cumulative Impacts	0.7	0.1	0.07	2×10^{-06}
MDH Guideline Values	1	1	1	1×10^{-05}
Cumulative Impact Decision	No Impacts	No Impacts	No Impacts	No Impacts

*Hazard Index and Cancer Risks are reported to one significant figure only as stated in the U.S. EPA's Risk Assessment Guidance for Superfund (RAGS), Volume I – Human Health Evaluation Manual (Part A).

The combined acute hazard indices from the proposed Mesaba and Laskin facilities result in a maximum acute cumulative hazard index of 0.7. The combined sub-chronic hazard indices from the two facilities result in a maximum cumulative hazard index of 0.1. The combined chronic hazard indices from both facilities result in a maximum cumulative hazard index of 0.07.

The combined cancer risks from both facilities results in a maximum cumulative cancer risk of 2×10^{-06} .

Based on the most current data and risk analyses performed for the Mesaba and Laskin facilities, maximum acute, sub-chronic and chronic hazard indices, and cancer risk will not exceed MDH threshold values. A Step 2 evaluation is not required for these two facilities.

Mesaba One/Mesaba Two, Mesabi Nugget, and PolyMet

Because the buffer zones of the Mesaba, Mesabi Nugget and PolyMet facilities overlap, a combined evaluation of all three facilities is conducted. The Step 1 evaluation of the Mesaba, Mesabi Nugget and PolyMet facilities is summarized in Table 3. The area potentially impacted by these facilities is shown on Figure 2 as Area B.

Table 3
East Range Mesaba/Mesabi Nugget/PolyMet
Cumulative Risk – Step 1

Facility	Potential Inhalation Hazard Index/Averaging Period*			Potential Inhalation Cancer Risk
	Acute (1-hour)	Sub-Chronic (1-month)	Chronic (annual)	
Mesaba	0.5	0.1	0.03	3×10^{-07}
Mesabi Nugget	1	0.04	0.9	7×10^{-06}
PolyMet	0.7	0.005	1	1×10^{-05}
Potential Cumulative Impacts	2	0.1	2	2×10^{-05}
MDH Guideline Values	1	1	1	1×10^{-05}
Cumulative Impact Decision	Potential Impacts	No Impacts	Potential Impacts	Potential Impacts

*Hazard Index and Cancer Risks are reported to one significant figure only as stated in the U.S. EPA's Risk Assessment Guidance for Superfund (RAGS), Volume I – Human Health Evaluation Manual (Part A).

The combined acute hazard indices from all three facilities result in a maximum cumulative hazard index of 2. The combined sub-chronic hazard indices from the three facilities result in a maximum cumulative hazard index of 0.1. The combined chronic hazard indices from all three facilities result in a maximum cumulative hazard index of 2.

The combined cancer risks from all three facilities result in a maximum cumulative cancer risk of 2×10^{-05} .

Based on the most current risk analyses performed for the Mesaba, PolyMet, and Mesabi Nugget facilities, maximum acute and chronic hazard indices and cancer risk exceed the MDH threshold values. A Step 2 evaluation will be conducted for these averaging periods. The maximum sub-chronic hazard index does not exceed MDH threshold values and will not be carried forth into Step 2 of this evaluation.

East Range – Step 2 Results

In Step 2 of the cumulative impacts approach, cancer risk and hazard indices calculated at receptors in specific areas that will most likely be exposed to emissions from more than one facility (rather than maximum risk values used in Step 1) are evaluated.

According to information in the PolyMet and Mesabi Nugget AERAs, air emission risk analyses for both of these facilities are calculated using the MPCA RASS. In this method, a maximum total air concentration from all sources is entered for each pollutant. The RASS spreadsheet does not include the geographical location of the entered concentrations. Geographical refinement of risk using RASS requires entering the concentrations of pollutants at specific receptor locations, rather than the maximum

values. Based on the information available to SEH from the MPCA to date, refinement of the maximum hazard index and cancer risk cannot be conducted for either the PolyMet facility or the Mesabi Nugget facility. Therefore, maximum hazard index/cancer risk values must be used for these two facilities in all evaluation steps.

The AERA for Mesaba One and Mesaba Two calculates health indices using the Q/CHI method (Q = emission rate; CHI = Critical Health Index) for acute and sub-chronic time periods. The Industrial Risk Assessment Program (IRAP) is used to calculate cancer risk and chronic hazard indices. IRAP incorporates algorithms in accordance with the U.S. EPA Human Health Risk Assessment Protocol (HHRAP). Both of these methods allow for the geographical examination of inhalation hazard index/cancer risk. In Step 2, hazard index/cancer risk calculated in or near the overlap of facility screening-level buffer zones are used for Mesaba One and Mesaba Two. The results from the East Range Step 2 evaluation are summarized in Table 4.

Table 4
East Range Mesaba/Mesabi Nugget/PolyMet
Cumulative Risk – Step 2

Facility	Potential Inhalation Hazard Index/Averaging*		Potential Inhalation Cancer Risk
	Acute (1-hour)	Chronic (annual)	
Mesaba	0.2	0.01	1 X 10 ⁻⁰⁷
Mesabi Nugget	1	0.9	7 X 10 ⁻⁰⁶
PolyMet	0.7	1	1 X 10 ⁻⁰⁵
Potential Cumulative Impacts – all facilities	2	2	2 X 10 ⁻⁰⁵
MDH Guideline Values	1	1	1 X 10 ⁻⁰⁵
Cumulative Impact Decision – all facilities	Potential Impacts	Potential Impacts	Potential Impacts
Mesaba Contribution	10%	0.5%	1%

*Hazard Index and Cancer Risks are reported to one significant figure only as stated in the U.S. EPA's Risk Assessment Guidance for Superfund (RAGS), Volume I – Human Health Evaluation Manual (Part A).

The combined acute hazard indices from all three facilities result in a cumulative hazard index of 2. The combined chronic hazard indices from all three facilities result in a cumulative hazard index of 2. The combined cancer risks from all three facilities result in a cumulative cancer risk of 2 X 10⁻⁰⁵.

Based on the most current risk analyses, taking into account geographical location of risk for Mesaba One and Mesaba Two only, acute and chronic hazard indices and cancer risk exceed the MDH threshold values. The acute risk drivers in this scenario are the Mesabi

Nugget facility (HI = 1) and PolyMet facility (HI = 0.7.) The chronic non-cancer risk drivers are also the Mesabi Nugget facility (HI = 0.9) and PolyMet facility (HI = 1) The cancer risk driver is the PolyMet facility (1E-05.)

Because the inhalation risks posed by the risk drivers are at or near the MDH threshold values, additional risk from any facility will cause an exceedance of the threshold values. The contribution of Mesaba One and Mesaba Two to inhalation risk is 10 percent or less in all three cases.

The cumulative risks are relatively small, particularly considering the fact that no geographical refinement of the risks could be applied for two of the three facilities. In addition, cumulative impacts from all three facilities occur in a very limited area (Area B) Land use in this area is primarily mining. The conservative assumptions used to derive the maximum risks (i.e, those of a farmer or residential scenario) are not appropriate for a refined inhalation risk determination in this area (occupational scenario) and greatly overestimate cumulative impact.

East Range – Step 3 Results

Because the geographical buffer zone overlap of all three facilities on the East Range is so small and because none of the facilities being evaluated are operational at this time, it is prudent to evaluate the cumulative effects from each separate facility combined with Mesaba One and Mesaba Two. The results from the East Range Mesaba Project/Mesabi Nugget Step 3 evaluation are summarized in Table 5 and the results from the Mesaba Project/PolyMet Step 3 evaluation are summarized in Table 6.

**Table 5
East Range Mesaba/Mesabi Nugget
Cumulative Risk – Step 3**

Facility	Potential Inhalation Hazard Index/Averaging*		Potential Inhalation Cancer Risk
	Acute (1-hour)	Chronic (annual)	
Mesaba	0.2	0.01	1 X 10 ⁻⁰⁷
Mesabi Nugget	1	0.9	7 X 10 ⁻⁰⁶
Potential Cumulative Impacts – Mesaba/Mesabi Nugget	1**	0.9	7X 10 ⁻⁰⁶
MDH Guideline Values	1	1	1 X 10 ⁻⁰⁵
Cumulative Impact Decision – all facilities	Minimal Impacts	No Impacts	No Impacts
Mesaba Contribution	20%	1%	1%

*Hazard Index and Cancer Risks are reported to one significant figure only as stated in the U.S. EPA’s Risk Assessment Guidance for Superfund (RAGS), Volume I – Human Health Evaluation Manual (Part A).

**The sum of the hazard indices is actually greater than one. However, because the hazard index is reported to one significant figure and that value is at the MDH threshold, the cumulative impacts decision is stated as minimal rather than exceeding the limit or having no impacts.

The combined acute hazard indices from the Mesaba and Mesabi Nugget facilities result in an acute cumulative hazard index of 1. The combined chronic hazard indices from both facilities result in a cumulative hazard index of 0.9. The combined cancer risks from both facilities result in a cumulative cancer risk of 7×10^{-06} . The contribution of Mesaba One and Mesaba Two to the acute inhalation risk is 20 percent and 1 percent for both chronic non-cancer and cancer risk.

Table 6
East Range Mesaba/PolyMet
Cumulative Risk – Step 3

Facility	Potential Inhalation Hazard Index/Averaging*		Potential Inhalation Cancer Risk
	Acute (1-hour)	Chronic (annual)	
Mesaba	0.2	0.01	1×10^{-07}
PolyMet	0.7	1	1×10^{-05}
Potential Cumulative Impacts – Mesaba/PolyMet	0.9	1**	$1 \times 10^{-05**}$
MDH Guideline Values	1	1	1×10^{-05}
Cumulative Impact Decision – all facilities	No Impacts	Minimal Impacts	Minimal Impacts
Mesaba Contribution	22%	1%	1%

*Hazard Index and Cancer Risks are reported to one significant figure only as stated in the U.S. EPA's Risk Assessment Guidance for Superfund (RAGS), Volume I – Human Health Evaluation Manual (Part A).

**The sum of the hazard indices and cancer risks are actually greater than the MDH values. However, because hazard index and cancer risk are reported to one significant figure and that value is at the MDH threshold, the cumulative impacts decision is stated as minimal rather than exceeding the limit or having no impacts.

The combined acute hazard indices from the Mesaba and PolyMet facilities result in a cumulative hazard index of 0.9. The combined chronic hazard indices from both facilities result in a cumulative hazard index of 1. The combined cancer risks from both facilities result in a cumulative cancer risk of 1×10^{-05} . The contribution of Mesaba One and Mesaba Two to the acute inhalation risk is 22 percent and 1 percent for both chronic non-cancer and cancer risk.

Taking into account geographical location of risk for Mesaba One and Mesaba Two only, acute, sub-chronic, and chronic hazard indices and cancer risk will not exceed MDH threshold values for the Mesaba plant combined with either the Mesabi Nugget or PolyMet facilities.

Conclusions

Cumulative impacts due to inhalation of air toxics from reasonably foreseeable projects in the vicinity of Mesaba One/Mesaba Two have been examined using conservative assumptions and are found to be at or below levels of concern set by the Minnesota Department of Health.

Data Refinements

To the extent better data become available for Mesaba One/Mesaba Two, Laskin Energy Center, Mesabi Nugget, PolyMet Mining, and MSI projects, subsequent revisions of this Air Toxics Inhalation Risk analysis will be revisited to determine whether the above conclusions are maintained. In general, risks associated with such emissions are found to decrease as the analysis of air toxic impacts become more refined.