5.2.7 Air Quality

This section assesses the effects of the NorthMet Project Proposed Action on air quality. Procedures for air quality assessments vary depending upon the level of emissions from a proposed project. The USEPA defines sources as “major” or “minor,” depending on their emissions levels of regulated pollutants (250 tpy of any criteria pollutant, 100,000 tpy of GHGs, 10 tpy of a single HAP, or 25 tpy of all HAPs). As presented in this section, the NorthMet Project Proposed Action has been defined as a synthetic minor source according to this definition, since the project will limit its emissions through permit restrictions to less than ~~below~~ the ~~above~~ emission levels stated above. However, at the request of several state and federal agencies, much of the analyses were conducted to address requirements for major sources. Discussions of the air quality assessment methodologies, air quality effects, and potential mitigation measures are addressed for criteria pollutants, air toxics, and amphibole fibers.

Summary

The NorthMet Project Proposed Action has been designed so that it is considered a synthetic minor source for air permitting purposes. However, the evaluation of the project in this SDEIS has treated it as a major source due to the sensitive nature of the project. Compliance with state and federal ambient air quality standards and growth increments, designed to protect human health and the environment, were evaluated using generally accepted state and federal threshold criteria. The NorthMet Project Proposed Action has been shown to not cause or contribute to significant air quality effects. Local and regional effects, up to 300-km from the project facilities, were evaluated to incorporate federally sensitive, pristine area resources such as BWCAW and Voyageurs National Park. Effects of dust from mining and ore transport are generally confined to areas disturbed by project activities. Control technologies similar to Federal Best Available Control Technologies (termed BACT-like~~s~~) were evaluated and applied to the project equipment in order to minimize the potential for air emissions. In particular, BACT-like controls were incorporated to reduce mercury emissions to levels that would not impede current State of Minnesota mercury emissions reduction goals. BACT-like fine-particulate matter emission controls were also incorporated to specifically control the release of more than 99.9 percent of amphibole fibers in the ore.

5.2.7.1 Methodology and Evaluation Criteria

The following subsections describe the air quality standards used in the assessments, local and federal regulations that affect the NorthMet Project Proposed Action, and modeling methodologies and specific modeling assessments conducted, as well as the criteria used to define significant effects from operation of the NorthMet Project Proposed Action.

5.2.7.1.1 Regulatory Setting

<u>Air Quality Standards</u>

The USEPA has established NAAQS for seven criteria air pollutants including NO_2, SO_2, CO, O_3, PM_{10}, $PM_{2.5}$, and lead. Primary standards are established to protect the public health; secondary standards are set to protect public welfare, including protection from damage to animals, crops, vegetation, visibility, and buildings.

The MPCA has also promulgated ambient air standards for the State of Minnesota, known as the MAAQS. In addition to the criteria pollutants, the MAAQS contain standards for TSP and hydrogen sulfide (H_2S). As with the NAAQS, the MAAQS primary standards are established to protect the public health; secondary standards are set to protect public welfare, including protection from damage to animals, crops, vegetation, visibility, and buildings.

The NAAQS and MAAQS are summarized in Table 5.2.7-1.

Table 5.2.7-1 Summary of NAAQS and MAAQS

Pollutant	Averaging Period	Standard Value (ppm)	Standard Value ($\mu g/m^3$)	Standard Type[1]	Notes
Carbon Monoxide	1-Hour	35	40,000	Primary	Not to be exceeded more than once per year
	1-Hour[2]	30	35,000	Primary	
	8-Hour	9	10,000	Primary and Secondary	
Nitrogen Dioxide	Annual Arithmetic Mean	0.05	100	Primary and Secondary	Not to be exceeded
	1-Hour	0.10	188	Primary	Not to Exceed the 98th Percentile of the Maximum Daily 1-hour Values Averaged Over a 3-year Period
Ozone	8-Hour	0.075	147	Primary and Secondary	4th Highest Daily maximum 8-hour average
Lead	Quarterly		0.15	Primary and Secondary	Rolling 3-month Average
Total Suspended Particulate (TSP)[2]	Annual Geometric Mean		75 60	Primary Secondary	Not to be exceeded
	24-Hour		260 150	Primary Secondary	Not to be exceeded more than once per year
PM_{10}	Annual Arithmetic Mean[2]		50	Primary and Secondary	Not to be exceeded
	24-Hour		150	Primary and Secondary	Not to be exceeded more than once per year on average over 3 years
$PM_{2.5}$	Annual Arithmetic Mean		12	Primary and Secondary	Not to exceed the 3-year average of the weighted annual mean concentrations
	24-Hour		35	Primary and Secondary	Not to exceed the 3-year average of the 98th percentile of 24-hour concentrations
Sulfur Dioxide	Annual Arithmetic	0.03 0.02	80 60	Primary Secondary[2]	Not to be exceeded

Pollutant	Averaging Period	Standard Value (ppm)	Standard Value (µg/m³)	Standard Type[1]	Notes
	Mean				
	24-Hour	0.14	365	Primary and Secondary	Not to be exceeded more than once per year
	3-Hour	0.5	1,300	Primary and Secondary	
	3-Hour[2]	0.35	915	Secondary	
	1-Hour[2]	0.5	1,300	Primary	
	1-Hour	0.075	196	Primary	Not to Exceed the 99th Percentile of the Maximum Daily 1-hour Values Averaged Over a 3-year Period
Hydrogen Sulfide[2]	½-Hour	0.05	70	Primary	Not to be exceeded over 2 times per year
	½-Hour	0.03	42	Primary	Not to be exceeded over 2 times in any 5 consecutive days

Source: MPCA 2013; USEPA 2013.

[1] Primary standards set limits to protect human health; secondary standards set limits to protect public welfare.
[2] MAAQS only.

Federal Regulations

Attainment Status

Under the CAA, the USEPA has defined all areas within the United States as one of two classifications, attainment or non-attainment. "Attainment areas" are those areas that either have collected ambient air quality data to demonstrate that they are in compliance or they do not have demonstrated non-compliance with the NAAQS, and so they are known as "unclassified areas." An area that does not meet NAAQS is considered to be a "nonattainment area" for that pollutant, and the USEPA requires the state to develop state implementation plans to control existing and future emissions in order to bring the area into compliance with the NAAQS. The NorthMet Project area has been designated by the USEPA as attainment for all air quality pollutants.

Prevention of Significant Deterioration Review

Under the CAA, the federal Prevention of Significant Deterioration (PSD) requirements provide for a pre-construction review and permit process for the construction and operation of a new or modified major stationary source in attainment areas. The review includes the following:

- BACT demonstration;
- ambient air quality analysis to assess potential project effects with NAAQS and PSD increments;
- an assessment of Air Quality Related Value (AQRV) of the direct and indirect effects of a project on general growth, soil, vegetation, and visibility for Class I regions within 300 km;
- an ambient monitoring program if no representative data are available; and

- public comment.

The USEPA's PSD program allows all attainment areas various levels of air quality protection and growth depending upon its designated class. Class I areas are special areas of natural wonder and scenic beauty—such as national parks, national monuments, and wilderness areas—where air quality should be given special protection. Class II areas are non-Class I areas that are allowed moderate growth and air quality degradation with Class II incremental limits. Class III areas are all non-Class I areas that are deemed unclassified and allow maximum growth and air quality degradation with no incremental limits. For attainment areas, the USEPA has promulgated PSD increments for four pollutants (NO_2, SO_2, PM_{10}, and $PM_{2.5}$) for both Class I and Class II regions. The increments are designed to allow for ambient concentrations within an area to increase by the maximum allowable amount above baseline concentrations. Class I PSD increments are designed to keep pristine areas clean and have more restrictive allowable increment thresholds. Class II PSD increments are designed to allow further growth within the rest of the country. Table 5.2.7-2 provides a summary of the Class I and Class II PSD increments.

Table 5.2.7-2 Summary of Allowable Prevention of Significant Deterioration Class I and Class II Increments

	Allowable Increment (µg/m^3)	
Pollutant, Averaging Period	**Class I Region**	**Class II Region**
SO_2, 3-hour	25	512
SO_2, 24-hour	5	91
SO_2, Annual	2	20
NO_2, Annual	2.5	25
PM_{10}, 24-hour	8	30
$PM_{2.5}$, 24-hour	2	9
$PM_{2.5}$, Annual	1	4

The NorthMet Project area is located within a Class II attainment area, as designated by the USEPA. In relation to the NorthMet Project Proposed Action, the federal CAA defines a source as a major source in an attainment area if it has any criteria pollutant emissions above 250 tpy or 100,000 tpy of GHG emissions. Because the NorthMet Project Proposed Action is proposing to limit its actual emissions below "major source" thresholds for the federal PSD program, the NorthMet Project Proposed Action is not subject to PSD requirements and, thus, modeling of PSD increment consumption requirements do not specifically apply for permitting. For the purposes of this SDEIS, NorthMet Project Proposed Action effects have been compared to the PSD Class I (generally pristine areas) and Class II (remaining areas) increments, as requested by several agencies, to ensure that the NorthMet Project Proposed Action is not contributing to any significant air quality effects.

Air Quality Related Values

In addition to PSD increments, major PSD sources that are located within 186 miles (300 km) of a Class I area may be required by the FLM to evaluate effects on AQRVs, which may include flora/fauna, visibility, water quality, soils, and odor for a specific Class I area. The NorthMet Project area is within 186 miles (300 km) of four Class I areas: BWCAW and Rainbow Lakes Wilderness (administered by the USFS) and Voyageurs National Park and Isle Royale National

Park (under the administration of the National Park Service). Although the NorthMet Project Proposed Action is agreeing to emission limits to avoid being a major PSD source, an evaluation of the applicable AQRV was conducted for comparison in this SDEIS. Table 5.2.7-3 provides the distances to each Class I area from the NorthMet Project area.

Table 5.2.7-3 NorthMet Project Setting Relative to Class I Regions

Class I Region	Distance from NorthMet Project Area (km/mi)
BWCAW	34/21
Voyageurs National Park	82/51
Rainbow Lakes Wilderness	142/88
Isle Royale National Park	218/135

New Source Performance Standards

The federal New Source Performance Standards are technology-based standards that are applicable to new or modified stationary sources of regulated emissions. The New Source Performance Standards program has defined emission limitations for approximately 70 source categories that are designated by size, as well as type of process. A comprehensive list of the applicable regulations for this facility would be included as part of the air quality permit. The following is a partial list of standards that apply to the NorthMet Project Proposed Action; these could vary depending on the final assessment of the permit application by the MPCA:

- Subpart A – General Provisions, which provides for general notification, recordkeeping, and monitoring requirements.
- Subpart LL – Standards of Performance for Metallic Minerals Processing Plants, which covers particulate and opacity emission limits for any new, modified, or reconstructed sources.
- Subpart OOO – Standards of Performance for Nonmetallic Mineral Processing Plants, which limits particulate emissions and opacity from new, modified, or reconstructed sources processing nonmetallic mineral (e.g., limestone or construction rock).
- Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines, which limits NO_x, PM, CO, fuel oil sulfur content, and opacity for new, modified, and reconstructed stationary compression ignition internal combustion engines.
- Subpart Dc – Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units which, depending on fuel type, can regulate PM and/or SO_2 emissions from new, modified, or reconstructed boilers.

Air Conformity Determination

A conformity determination must be conducted by the lead federal agency if a federal action would generate emissions exceeding the conformity threshold levels (de minimis) of the pollutant(s) for which a Class I or Class II region is designated as a nonattainment area or as a maintenance area. Since the NorthMet Project area is classified as in attainment for all criteria pollutants, a General Conformity Determination is not required.

State of Minnesota Regulations

Nonferrous Mineland Reclamation rules, *Minnesota Rules* part 6132.800, administered by the MDNR, require the control of dust from areas disturbed specifically by mining operations.

Also, the MPCA has promulgated rules concerning the control and permitting of all sources (not just for mining operations) throughout Minnesota. The following regulations are evaluated for the NorthMet Project Proposed Action.

Prevention of Significant Deterioration Review

Minnesota Rules, part 7007.3000, incorporate by reference the federal PSD requirements that provide for a pre-construction review and permit process for the construction and operation of a new or modified major stationary source in attainment areas.

The NorthMet Project Proposed Action is designed to limit emissions below major source thresholds (i.e., to be permitted as a synthetic minor source). Thus, for permitting purposes, the NorthMet Project Proposed Action would not be considered a major source for PSD (BACT demonstration, PSD increment assessment, and AQRV assessment would not be required via *Minnesota Rules*, part 7007.3000). However, ~~as stated earlier,~~ a comprehensive analysis of NAAQS, MAAQS, PSD Class I and II increments, and AQRV is allowed, under Minnesota Rules, part 7007.0100(7)(k) and (v), ~~was performed~~ as part of the evaluation of effect. An evaluation of pollution control technology was conducted for the Mine Site and Plant Site (Barr 2007l, Barr 2007o, Barr 2011, Barr 2012).

Minnesota Standards of Performance

A comprehensive list of Minnesota Standards of Performance would be identified in the air quality permit. The following is a list of Minnesota Standards of Performance applicable to the NorthMet Project Proposed Action. This list may change, depending upon the final assessment of the permit application by the MPCA.

Control of Fugitive PM (*Minnesota Rules*, part 7011.0150), which applies to bulk material handling operation, roads, and other fugitive sources. The rule prohibits the release of "avoidable amounts" of PM, and facilities are required to take reasonable precautions to prevent the discharge of visible fugitive emissions beyond the property line.

Standards of Performance of Stationary Internal Combustion Engines (*Minnesota Rules*, part 7011.2300). This applies to the emergency fire water pumps and the emergency generators, and limits SO_2 emissions to 0.5 pound per million British thermal units (lb/MMBTU) heat input.

Standards of Performance for Post-1969 Industrial Process Equipment (*Minnesota Rules*, part 7011.0715). This would apply to all new ore-handling equipment and other new sources that would generate PM emissions for which a standard of performance has not been promulgated in a specific rule. Due to the remote location of the NorthMet Project area (i.e., any source that is not in the Minneapolis-Saint Paul Air Quality Control Region or the City of Duluth, and which is located not less than 0.25 mile from any residence or public roadway), the required control equipment efficiency standard would be 85 percent.

Standards of Performance for Existing Indirect Heating Equipment (*Minnesota Rules*, part 7011.0510). The rule limits the PM emissions to between 0.4 and 0.6 lb/MMBTU, limits SO_2

emissions to between 1.6 and 4.0 lb/MMBTU, and limits opacity to 20 percent. This may apply to existing indirect heaters if used in the mining and processing operations.

Standards of Performance for New Indirect Heating Equipment (*Minnesota Rules*, part 7011.0515). The rule limits emissions of PM to between 0.1 and 0.4 lb/MMBTU, SO_2 emissions to between 0.8 and 4.0 lb/MMBTU, NO_x emissions to between 0.2 to 0.7 lb/MMBTU, and opacity to 20 percent. This may apply to new indirect heaters that may be used in the mine processing operations.

Standards of Performance for Fossil-Fuel-Burning Direct Heating Equipment (*Minnesota Rules*, part 7011.0610). The rule limits PM emissions based upon process throughput and limits opacity to 20 percent. This may apply to process heaters that may be used in the mine processing operations.

Standards of Performance for Pre-1969 Industrial Process Equipment (*Minnesota Rules*, part 7011.0710). The rule limits mass PM emissions based upon process weight and limits opacity to 20 percent. Alternatively, due to the remote location of the NorthMet Project area, compliance can be demonstrated with a pollution control equipment efficiency of 85 percent. This may apply to existing ore-handling equipment that may be used in the mine processing operations.

Standards of Performance for Stationary Compression Ignition Internal Combustion Engines (*Minnesota Rules*, part 7011.3520). The rule incorporates federal Standards of Performance for Stationary Compression Ignition Internal Combustion Engines under 40 CFR, Part 60, Subpart IIII. This may apply to fire water pumps and emergency generators that may be used in the mine processing operations.

Stationary Reciprocating Internal Combustion Engines (*Minnesota Rules*, part 7011.8150). The rule incorporates federal National Emissions Standards for Hazardous Air Pollutants under 40 CFR, Part 63, Subpart ZZZZ. This may apply to fire water pumps and emergency generators that may be used in the mine processing operations.

5.2.7.1.2 Evaluation Criteria

Various state and federal air quality standards and emissions standards have been established to minimize degradation of air quality. The criteria used for the evaluation of potential effects on air quality from the NorthMet Project Proposed Action or an alternative are whether it would cause an exceedance of NAAQS or MAAQS.

In addition to legally applicable statutory or regulatory requirements, the following criteria also were considered in evaluating effects from the NorthMet Project Proposed Action:

- consumption of PSD increments as defined by the CAA Title I, PSD rule;
- adverse effects to visibility in Class I areas;
- adverse effects to other AQRV in Class I areas; and
- adverse effects to human health as determined by an Air Emissions Risk Analysis (AERA) (MPCA 2013b).

5.2.7.1.3 Proposed Action Emissions

From an air quality perspective, emissions from the NorthMet Project Proposed Action would be expected to occur from the mining operations at the Mine Site and ore/concentrate processing at the Plant Site. Although the emission generating activities at these two sites are separated geographically, they are joined by the rail line that would be used to transport ore from the Mine Site to the Plant Site. As such, the three components constitute a single project for permitting purposes, and, thus, the total emissions from both sites are summed for the purposes of this analysis.

At the Mine Site, emissions were estimated for material handling sources associated with excavation, portable crushing and screening operations, blast hole drilling, use of unpaved roads, and vehicle exhaust.

Material handling includes the loading of overburden, waste rock, lean ore, and ore into trucks with shovels or loaders. After it is hauled, the ore would be dumped into the Rail Transfer Hopper and the overburden, waste rock, and lean ore would be unloaded at the appropriate stockpile or pit. The crushing and screening operations would be used to break up and separate the larger rocks from soil and gravel in the overburden to produce rock suitable for construction purposes. Haul trucks would travel over unpaved roads from the excavation site to the rail loading and stockpiling areas. Fugitive emissions would be generated as part of these operations. In order to minimize fugitive emissions, the NorthMet Project Proposed Action will utilize several control measures. These include minimization of drop distances for ore-screening, truck loading/unloading, and rail-loading; water and other dust suppressants on haul roads (90 percent control); water sprays for rock crushing and screening; down-hole watering during blasting operations; and environmental observations and recording. In addition, two ambient air quality monitors are proposed to minimize fugitive dust effects at the mine.

At the Plant Site, point source emissions are predicted to occur from the crushing plant, flotation operation autoclaves and other hydrometallurgical processes, process consumables handling, and combustion. In addition, fugitive emissions are expected to occur from raw materials handling, Plant Site roads, the Tailings Basin, and from vehicle use of Dunka Road. Water spraying or other dust suppression would be used on all unpaved roads at the Plant Site, resulting in an 80 percent reduction in associated fugitive emissions.

PolyMet is proposing to accept emission limits below the major source threshold (stationary sources less than 250 tpy for criteria pollutants and 100,000 tpy for GHGs) so as to be classified as a synthetic minor PSD source and therefore not be subject to PSD requirements including modeling attainment with PSD increments for permitting purposes. As demonstrated in Table 5.2.7-4, below, the NorthMet Project Proposed Action does not have projected actual emissions above major PSD thresholds on an annual basis. PSD required modeling analyses, however, were performed for this SDEIS to assess its effect to ensure that the minor-source NorthMet Project Proposed Action does not cause or contribute to significant effects.

Criteria Pollutants

Criteria pollutant emissions are expected from both the Mine Site and Plant Site. Detailed information on the emission calculations for each site source is available as separate documents (Barr 2012a; Barr 2013). Table 5.2.7-4 summarizes the NorthMet Project Proposed Action maximum emissions for the Mine Site, Plant Site, and total emissions from PSD-regulated stationary sources for comparison with PSD Major Source Thresholds.

Table 5.2.7-4 Annual Criteria Air Pollutant Emissions for Prevention of Significant Deterioration-regulated Stationary Sources

Pollutant	Plant Site Projected ~~Actual~~ Controlled Emissions (tpy)	Mine Site Projected Controlled Emissions (tpy)	Total Projected Controlled Emissions (tpy)	PSD Major Source Thresholds (tpy)
NO_x	117	5	122	250
SO_2	7	0.8	8	250
TSP	201	9	210	250
PM_{10}	192	4	196	250
$PM_{2.5}$	190	2	192	250
VOC	50	0.2	50	250
Lead	0.~~0~~	0.~~0~~	0.~~0~~	250
CO	127	2	129	250

In accordance with PSD permitting requirements, for this assessment, mobile emissions and fugitive emissions sources are not included in the determination of a major source. Under PSD requirements, fugitive sources are only included if the stationary source is defined as one of 28 named source categories. The NorthMet Project Proposed Action is not included in any of the USEPA-listed source categories; therefore, fugitive sources are not included in the determination of a major source. However, to assess modeled air effects, mobile and fugitive emissions from the operations were evaluated. The non-PSD-regulated mobile source emissions and fugitive emissions are summed in Table 5.2.7-5. Due to the size of the ore rock being transported, the design of the railcars, and the short distance of transport from the Mine Site to the Plant Site, the ore fines are expected to be coarse in nature. Thus, no significant reactive airborne fugitive dust from the rail transport is expected (MDNR 2011) and is not included in the fugitive emissions. Any spillage of the ore fines is expected to be within 2 meters of the rail line, along the path, and any effects of the reactive ore on the ground has been addressed in Section 5.2.3.

Table 5.2.7-5 Annual Air Pollutant Emissions for non-Prevention of Significant Deterioration-regulated Mobile Sources and Fugitive Sources

Pollutant	Plant Site Projected ~~Actual~~ Controlled Emissions (tpy)	Mine Site Projected ~~Actual~~ Controlled Emissions (tpy)	Total Projected ~~Actual~~ Controlled Emissions (tpy)
NO_x	58	321	379
SO_2	0	2	2
PM_{10}	238	462	700
$PM_{2.5}$	31	77	108

Hazardous Air Pollutants Emissions

Small amounts of potentially toxic compounds, which are referred to as HAPs, are expected to be associated with the NorthMet Project Proposed Action. Table 5.2.7-6 provides the estimate of HAP emissions for the NorthMet Project Proposed Action stationary sources. These emission levels reflect potential emissions taking into account the proposed pollution control equipment for the NorthMet Project Proposed Action (controlled). As seen in the table, total emissions of a single HAP are below 10 tpy and the combined HAP emissions are below 25 tpy, indicating that the HAP emissions would not exceed USEPA major source thresholds for HAPs. Although HAP emissions from mobile sources were not included in the table to address emission thresholds, these emissions were used in assessing the potential effects on human health. The AERA itself is not limited to an assessment of HAPs, but is inclusive of any air toxic pollutant that screened in during the scoping process.

Table 5.2.7-6 Annual Hazardous Air Pollutant Emissions for Prevention of Significant Deterioration-regulated Stationary Sources

Pollutant	Plant Site Projected Controlled Emissions (tpy)	Mine Site Projected Controlled Emissions (tpy)	Total Projected Controlled Emissions (tpy)	Major Source Threshold (tpy)
Single HAP[1]	4~~7~~	2~~0.1~~	~~7~~6	10
Combined HAPs	14	3~~0.1~~	17~~4~~	25

[1] Nickel is the HAP with the highest emissions for the Plant Site;~~,~~ manganese has the highest emissions at the Mine Site. Highest single HAP emissions for the Proposed Action are the nickel emissions. Values in Table 5.2.7-6~~7~~ reflect nickel emissions.

Greenhouse Gas Emissions

Direct and indirect GHGs emissions would be associated with the NorthMet Project Proposed Action. Direct emissions are emitted from project sources; indirect emissions are from sources that are not part of the project, but are generated from activities that support the project (e.g., off-site electrical needs). These gases include primarily carbon dioxide (CO_2), N_2O, and methane (CH_4). GHG emissions are estimated based upon their global warming potential and are expressed in carbon dioxide equivalents (CO_2e). Global warming potential is the relative effect a specific compound has on the overall global warming effects. The global warming potential factors for the three pollutants are 1, ~~298~~310, and ~~25~~21, respectively. For this assessment, the CO_2e is estimated by multiplying the specific emissions by its global warming potential factor and then summing the results. Table 5.2.7-7 summarizes the controlled direct GHG emissions for the NorthMet Project Proposed Action. As seen from the table, total direct GHG emissions are less than 100,000 tpy of CO_2e and would not exceed the USEPA major source thresholds for GHGs.

Table 5.2.7-7 Annual Greenhouse Gas Emissions for Prevention of Significant Deterioration-regulated Stationary Sources

Pollutant	Plant Site Projected Controlled Emissions (tpy)	Mine Site Projected Controlled Emissions (tpy)	Total Projected Controlled Emissions (tpy)	Major Source Threshold (tpy)
CO_2	10,995~~75,312~~	1,740	12,735~~77,052~~	-
N_2O	0.3~~9~~	0.08	~~1.7~~0.3	-
~~CH_2~~CH_4	0.6~~5~~	0.02	~~0.7~~0.6	-
Total CO_2e[1]	**~~75,~~10,996~~615~~**	**1,740~~764~~**	**~~77~~12,736,~~379~~**	**100,000**

[1] CO_2e is used to assess PSD applicability.

Estimated annual maximum potential emissions of the NorthMet Project Proposed Action are based on the NorthMet Project Proposed Action as currently proposed running at maximum capacity (potential) (see Table 5.2.7-7). Expected annual GHG emissions from the NorthMet Project Proposed Action, as opposed to maximum potential emissions, are shown below in Table 5.2.7-8. Expected emissions are the sum of direct and indirect GHG emissions. ~~The total carbon footprint for the NorthMet Project Proposed Action is made up of both direct and indirect GHG emissions. The estimated maximum carbon footprint of the NorthMet Project Proposed Action is based on the NorthMet Project Proposed Action as currently proposed running at maximum capacity (potential). The e~~Expected GHG emissions from the NorthMet Project Proposed Action are calculated using The Climate Registry General Reporting Protocol (Climate Registry 2008) and the MPCA General Guidance for Carbon Footprint Development in Environmental Review (MPCA 2008). Emissions are calculated using default emission factors for specific fuels from the two documents. The annualized carbon footprint is summarized in Table 5.2.7-8; the lifetime carbon footprint is provided in Table 5.2.7-9.

For this analysis, emission estimates for the direct and indirect source equipment used generally accepted emission factors and estimation methods from the World Resource Institute Greenhouse Gas Protocol Standard, the Intergovernmental Panel on Climate Change (IPCC), and the MPCA General Guidance on Carbon Footprint in Environmental Review. Emissions estimates from secondary emissions sources generally utilized emissions factors that would represent estimates greater than actual values (high estimation) or best estimates of actual values based upon literature review (central tendency) (Barr 2009i).

Table 5.2.7-8 NorthMet Project Proposed Action Annual Greenhouse Gas Emissions

Pollutant	~~Potential~~ Expected Direct Emissions[1] (CO_2e – mtpy)[2]	~~Potential~~ Expected Indirect Emissions[3] (CO_2e – mtpy)	~~Potential~~ Expected Total Emissions (CO_2e – mtpy)
Mine Site Point Source	1,600	--	--
Mine Site Mobile Source	38,086	--	--
Plant Site Point Source	138,641	--	--
Plant Site Mobile Source	8,014	--	--
Terrestrial Carbon Loss	10,000		
Totals	**~~186~~196,341**	**511,000**	**~~697~~707,342**

[1] Maximum Potential Direct Emissions are all emissions from sources that are under direct control of the NorthMet Project Proposed Action and full maximum capacity.

[2] CO_2e is in metric tons per year (mtpy).
[3] Indirect emissions: Emissions that are a consequence of the activities of the reporting entity, but that occur at sources owned or controlled by another entity. For example, emissions that occur at a power plant as a result of electricity being generated and subsequently used by the NorthMet Project Proposed Action.

Table 5.2.7-9 NorthMet Project Proposed Action Lifetime Greenhouse Gas Emissions

Pollutant	Potential Direct Emissions[1] (CO_2e – mt~~py~~)[2]	Potential Indirect Emissions (CO_2e – mt~~py~~)[6]	Potential Total Emissions (CO_2e – mt~~py~~)
Mine Site Emissions[3]	793,734		
Plant Site Emissions[3]	2,933,181		
Construction Emissions[4]	94,186		
Reclamation Emission[5]	1,549,688		
Subtotals	**5,370,789**	**10,220,000**	**15,590,789**
Terrestrial Carbon Loss[7]	199,963	-	199,963
Totals	**5,570,752**	**10,220,000**	**15,790,752**

[1] Maximum Potential Direct Emissions are all emissions from sources that are under direct control of the NorthMet Project Proposed Action and full maximum capacity.
[2] CO_2e is in metric tons (mt)~~py~~.
[3] Based upon maximum annual emissions occurring for 20 years.
[4] Includes Phase I (flotation concentration production only) and Phase II (Hydrometallurgical Plant) construction.
[5] Based on 20-year closure period ~~for Plant Site~~ and 30~~60~~-year long-term closure period for the WWTF a d WWTP~~Mine Site~~.
[6] Indirect emissions: Emissions that are a consequence of the activities of the reporting entity, but that occur at sources owned or controlled by another entity. For example, emissions that occur at a power plant as a result of electricity being generated and subsequently used by the NorthMet Project Proposed Action.
[7] Terrestrial carbon loss includes: wetland carbon loss, 20 years of emissions from stockpiled peat, and emission from peat used in reclamation.

5.2.7.1.4 Predictive Modeling Approach

Detailed air dispersion modeling was conducted to evaluate compliance with NAAQS and MAAQS, to support PSD increment analysis, and to identify other potential effects on Class I and Class II areas. Although the NorthMet Project Proposed Action is not considered a major source for PSD considerations, the modeling analysis was conducted pursuant to the PSD regulations. The methods used for modeling are summarized below.

NAAQS, MAAQS, and Class II Increment Modeling Approach

To assess the effects on air quality, air dispersion modeling techniques were utilized. The MPCA prefers the AERMOD modeling system, and USEPA has included AERMOD as an approved guideline model. Meteorological data (2006 to 2010) from the Hibbing station and concurrent International Falls mixing height data, suitable for input to AERMOD, were used to evaluate the NorthMet Project Proposed Action. The AERMINUTE meteorological processor was used to develop the meteorological dataset for AERMOD. ~~The meteorological dataset was modified to allow wind speeds less than 0.5 m/s to be defined as calm conditions in AERMOD by substituting all wind speeds less than 0.5 m/s to 0.0 m/s.~~

The air quality modeling addressed individual point sources, as well as all sources of fugitive particulate matter. The modeling was conducted to determine the extent of effects from criteria pollutant emissions on ambient air quality and to identify the significant impact area for each pollutant. Modeling was conducted for PM_{10}, $PM_{2.5}$, NO_2, and SO_2 and their respective applicable averaging times at both the Mine Site and Plant Site (Barr 2012c; Barr 2012d). Ozone emissions were not modeled or analyzed for NAAQS due to the regional nature of ozone formation involving complex interaction of multi-pollutants. It should be noted that ozone is not emitted directly from any mining or ore-processing source. Emissions of lead and CO were not modeled ~~because~~ for the NorthMet Project Proposed Action following the MPCA-approved modeling protocols for the Plant Site and Mine Site. ~~would not result in appreciable lead emissions. CO emissions were not modeled due to the likelihood, as determined by the MPCA, that there would not be any concerns related to the outcome of the modeling for this pollutant.~~

NorthMet Project Proposed Action emissions were initially modeled and compared to their respective Significant Impact Limit (SIL), as provided in Table 5.2.7-10 for each of the pollutants and averaging times. The SIL is the threshold for a given pollutant and averaging time, where no further modeling analysis is required. Modeled ~~emissions~~ concentrations above the SIL do not define a significant effect in the context of the EIS; rather, where the modeled ~~emissions~~ concentrations are above the SIL, more refined modeling is required in order to evaluate compliance with PSD increments and NAAQS. The farthest distance from the source where the concentration is above the SIL defines the circular region that would require further affect modeling.

All point and fugitive sources associated with the Mine Site and Plant Site were included in the source input files for PSD Class II increment modeling, with the exception of the Plant Site unpaved roads, which were in operation at the baseline date. Additionally, data on the following nearby major increment-consuming (or increment-expanding) sources, which were determined and provided by the MPCA, were also included as source input:

- Northshore Mine;
- Mesabi Nugget Phase 1 Project;
- Mesabi Mining Project
- Cliffs Erie pellet yard; and
- Former LTVSMC processing plant.

Model inputs for these sources were provided by the MPCA. For comparison to the NAAQS, a background concentration was added to the modeled concentration. PM_{10} background concentrations represent the 2008 to 2010, 3-year average concentrations for the high-second-high 24-hour concentration and maximum annual average concentration from the Virginia, Minnesota air quality monitoring site. $PM_{2.5}$ background concentrations represent the 2008-2010 average concentrations for the highest 2nd high (H2H) 24-hour and annual average concentrations from the same station. Hourly SO_2 and NO_2 background concentrations are from 2008-2010 MPCA update data for use in modeling assessments (MPCA 2012) for sites outside Minneapolis.

Class I Area-Related Modeling Approach

An air quality modeling analysis was conducted to estimate effects of the NorthMet Project Proposed Action on air quality in Class I areas. The Class I AQRV analyses addressed PSD Class I increments for SO_2, PM_{10}, NO_2, sulfur and nitrogen deposition, and visibility impairment. Regional haze is addressed in Section ~~6.7.6~~6.2.3.8.8. The dispersion modeling analysis used standard USEPA long-range transport modeling methodologies and followed guidance as presented in: 1) USEPA's Guideline on Air Quality Models, the Interagency Workgroup on Air Quality Modeling Phase 2 report; 2) the Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I report (revised November 2010); and 3) the "FLM Recommendations on Class I Area Analyses" (Barr 2012). The analyses also incorporated suggestions and guidance received from the USFS and the National Park Service. The California Puff (CALPUFF) air quality modeling system (version 5.8, June 23, 2007 release) was used for all Class I area analyses.

Input options and data utilized in the models generally corresponded to default or USEPA-recommended values along with representative, NorthMet Project Proposed Action-specific source input parameters (Barr 2012). The CALPUFF modeling analysis used refined meteorological fields from the CALMET subprogram of CALPUFF, developed from the 5^{th} Generation NCAR/Penn State Mesoscale Model prognostic meteorological data for the available years 2002, 2003, and 2004. These were refined using concurrent surface, upper air, and precipitation data as outlined in the Final SDD. CALMET settings were based on the USEPA Office of Air Quality Planning and Standards memorandum "Clarification on EPA-FLM Recommended Settings for CALMET" (August 31, 2009). Hourly surface data from approximately 88 stations and precipitation data from 99 stations were used along with upper air data from four stations. No cloud data were used.

Pollutant emissions modeled in CALPUFF were SO_2, NO_X, PMC (coarse particulate matter), PMF (fine particulate matter), elemental carbon, secondary organic aerosols, and SO_4. Additionally, the pollutants SO_4, NO_3, and HNO_3 were modeled as products of the chemical transformation of SO_2 and NO_X. For the AQRV analysis, the MESOPUFF II scheme was used for the chemical mechanism to compute chemical transformation rates based on user-supplied background values for ozone and ammonia. Per MPCA guidance, the MESOPUFF II algorithm and secondary particulate formation were not used in the PM_{10} increment consumption evaluation. Finally, the CALPOST and POSTUTIL post-processing programs were used to generate values of pollutant concentration, deposition, and visibility.

For the increment consumption analysis, emissions were modeled as the worst case over the expected life of the NorthMet Project Proposed Action. For the AQRV analysis, four emissions scenarios, representing emissions at different stages of the NorthMet Project Proposed Action, were modeled. The scenarios differ only in mobile source emissions (which were not included in the increment analysis). The effects of all four scenarios on visibility within the Class I areas are presented in Section 5.2.7.2.1.

5.2.7.2 NorthMet Project Proposed Action

This section describes effects that may occur on local and regional air quality from implementing the NorthMet Project Proposed Action. Potential effects on visibility that could occur from increases in project emissions are also discussed. The results of the modeling are used to represent an upper bound for assessing potential effects from the NorthMet Project Proposed Action.

5.2.7.2.1 NAAQS and Prevention of Significant Deterioration Increment Impact Analysis

State and federal air quality rules prohibit emissions from a new facility that cause or contribute to an exceedance of MAAQS or NAAQS. To demonstrate NorthMet Project Proposed Action effects relative to NAAQS and PSD increments, an air dispersion modeling analysis for the NorthMet Project Proposed Action was conducted (Barr 2012c; Barr 2012d; Barr 2012e; Barr 2012f).

Initial Significant Impact Limit Analysis

The Mine Site and Plant Site are located 8 miles apart, but are connected by a private railway that was originally constructed to transport iron ore pellets from Cliffs Erie’s process plant to their ore dock. A portion of this railway is proposed to be used for the transportation of ore from the Mine Site to the Plant Site. Although the site may be permitted as a single facility, the Mine Site and Plant Site emission sources are not adjacent to each other but rather separated by a substantial (8 miles) distance. Therefore, it is appropriate and informative to perform individual air dispersion modeling for two distinct sets of receptors, one set surrounding the Mine Site and the second surrounding the Plant Site. For the Mine Site receptor grid, both Mine Site and Plant Site emissions were modeled explicitly. However, for the Plant Site receptor grid, only the emissions from the Plant Site were included, since previous modeling of the Mine Site emissions showed that effects were below the SIL in the region encompassing the Plant Site receptor grid. SILs have been established by the USEPA such that concentrations below these levels are not anticipated to contribute to a change in the overall effect when combined with other nearby source effects. The MPCA approved the exclusion of the Mine Site emissions in assessing the effects at the Plant Site receptor grid locations, as they would not likely contribute to a change in the overall effects. The results are discussed below.

The Plant Site PM_{10} emissions were modeled with all sources operating at full capacity in a single modeling run. This conservatively predicts (overestimates) the effects, as not all sources would be capable of operating simultaneously at full capacity. PM_{10} and $PM_{2.5}$ are the primary pollutants emitted from the Plant Site. Emissions of SO_2 and NO_X would be relatively small because the process is conducted at relatively low temperatures and would not include any continuously operating fuel combustion sources. The Mine Site emission rates are based on a daily average mining rate of 32,000 tons of ore.

Table 5.2.7-10 shows modeled effects at the Mine Site and Plant Site receptors compared to the SIL. The maximum modeled effects are maximums from either the Mine Site or the Plant Site analyses, since each analysis includes all NorthMet Project emissions, as defined above. The USEPA has developed SILs as a way to screen out, from further PSD analysis, pollutants that are not expected to cause any significant contribution to existing air quality levels. The emissions included are at 100 percent capacity for each averaging period.

The overall effects within the Plant Site receptor grid predicted higher maximum concentrations than the effects within the Mine Site receptor grid for all pollutants modeled. As seen in the table, maximum PM_{10} and $PM_{2.5}$ concentrations in both regions (and for all averaging periods) were above their respective SILs, so further analysis in those regions, for those pollutants, was conducted. For NO_2 and SO_2, the effects in the Plant Site receptor grid exceed their SILs for all averaging periods and additional analysis was conducted for this receptor region. The NO_2 and SO_2 effects in the Mine Site receptor grid are all below each respective SIL, and, thus, no additional analysis was conducted.

Table 5.2.7-10 Highest NorthMet Project Proposed Action Effects and Prevention of Significant Deterioration Class II Significant Impact Limits

Pollutant	Averaging Time	PSD Class II Significant Impact Limits (µg/m^3)	Plant Site Area Modeled Effects (µg/m^3) [1]	Mine Site Area Modeled Effects (µg/m^3)[1]
SO_2	1-hour	7.83	***103***	0.7
	3-hour	25	***85***	0.5
	24-hour	5	***35***	0.1
	Annual	2	***6***	0.01
PM_{10}	24-hour	5	***44***	***30***
	Annual	1	***12***	***6.3***
$PM_{2.5}$	24-hour	1.2	***17***	***10***
	Annual	0.3	***6***	***2.2***
NO_2	1-hour	7.52	***88***	5.3
	Annual	1	***3***	0.1

[1] Bold and italicized values exceed SIL.

Prevention of Significant Deterioration Class II Increment Analysis

Based upon the results of the SIL analysis, PSD Class II increment analyses were completed for PM_{10} for both the Mine Site and Plant Site receptor grid locations. In addition, a PSD Class II increment analysis was conducted for NO_2 and SO_2 only at the Plant Site receptors. Even though maximum $PM_{2.5}$ concentrations exceed the SILs, the minor source baseline date for increment analysis in St. Louis County has not been set. Therefore, no increment analysis can be conducted for this pollutant. However, modeling of $PM_{2.5}$ was conducted for comparison with the $PM_{2.5}$ NAAQS; the results are presented later in this section. The modeling included all NorthMet Project Proposed Action increment-consuming sources at maximum emission rates plus all nearby increment-consuming (and expanding) emissions sources, including the Cliffs Erie pellet yard, the former LTVSMC processing plant, Northshore Mine, and Mesabi Nugget. The results of the increment analyses are shown in Table 5.2.7-11, along with a comparison to the allowable Class II PSD increments.

Table 5.2.7-11 Results of Class II Prevention of Significant Deterioration Increment Analysis

Pollutant	Averaging Time	Plant Site Receptor Grid Modeled Effects (µg/m^3)(1) (3)	Mine Site Receptor Grid Modeled Effects (µg/m^3)(1) (3)	PSD Increment Limits (µg/m^3)
SO_2	3-hour	85~~11~~	NA	512
	24-hour	35~~1.9~~	NA	91
	Annual	6~~0.17~~	NA	20
PM_{10}(2)	24-hour	~~18~~27	27~~9~~	30
	Annual	~~3.0~~-0.1	6~~5~~	17
NO_2	Annual	3.2~~0.9~~	NA	25

[1] SO_2 concentrations were not modeled due to negligible incremental effect.
[2] Modeled PM_{10} concentrations are based on operating scenarios at year 8 and year 13.
[3] Plant Site modeled emissions include expansion credit and are evaluated at Plant Site boundary. Mine Site modeled emissions include Plant Site, Mesabi Nugget, Cliffs Erie pellet yard, and former LTVSMC processing plant and existing LTVSMC Tailings Basin.

The table displays the maximum predicted concentrations for each pollutant of concern and each averaging period for both the Mine Site and Plant Site receptor grid locations. Since the receptor grid locations for the Mine Site and Plant Site represent separate distinct regions, the maximum modeled effect for each modeling region is compared separately with the PSD Class II increment limit to assess potential significant effects. Overall, all modeled effects are below their respective PSD Class II limits; however, the maximum 24-hour PM_{10} effects in the Mine Site and Plant Site modeling regions approach the Class II increment (27~~9~~ µg/m^3 versus 30 µg/m^3).

Mine Site Receptors Analysis

The PM_{10} modeling was conducted for two operating scenarios corresponding to the ~~different Category 1 and Category 2 waste rock disposal~~temporary stockpile phase and the in-pit disposal/stockpile reclamation phase ~~operations~~ that would occur over the 20-year life of the mine. The worst case years for ~~disposal of Category 1 and Category 2~~temporary stockpile phase waste rock (year 8) and in-pit disposal (year 13) were chosen to represent the worst case for the entire mine life. NO_X and SO_2 would be primarily emitted by mobile sources. Due to the low modeled concentrations and constant emission rates for NO_X and SO_2, only one scenario (year 8) was modeled for these two criteria pollutants. ~~(i.e., worst-case emissions for the mobile sources were modeled with the year 8 mine configuration).~~ The modeling results for the Mine Site receptors, including sources from the haul road, material handling, mine pits, and diesel locomotives indicate that the highest modeled 24-hour H2H PM_{10} concentration was 27 µg/m^3 for the year 8 operating scenario and 29 µg/m^3 for the year 13 operating scenario (shown on Table 5.2.7.11). The H2H corresponds to not exceeding a standard more than once per year, as defined by the applicable standard. NO_2 and SO_2 effects from the NorthMet Project Proposed Action at the Mine Site were below the SILs, so no additional modeling including nearby sources was performed.

Plant Site Receptors Analysis

The Plant Site PM_{10} emissions were modeled with all sources operating at full capacity in a single modeling run (independent of operating year). This conservatively predicts (overestimates) the effects, as not all sources would be capable of operating simultaneously at full capacity. The operation at the Plant Site, including fugitive sources, building vents, limestone material handling, and vehicular traffic on unpaved roads results in a maximum increment concentration for PM_{10} of 18 µg/m^3 on the Plant Site boundary receptor grid, based on the 24-hour H2H modeling. Modeled effects for SO_2 and NO_X at the Plant Site receptors are also below the PSD Class II increments thresholds.

The data in Table 5.2.7-11 summarize the PSD increment modeling results and demonstrate that the NorthMet Project Proposed Action, in conjunction with all other neighboring PSD sources, would satisfy all state and federal increment requirements. The maximum concentrations for the Mine Site receptor grid and the Plant Site receptor grid are presented separately. Since the two receptor grids represent two separate AOCs, the maximum concentrations are not additive.

NAAQS and MAAQS Impact Analysis

The NAAQS modeling predicted the maximum effect of development at the Mine Site and Plant Site combined with activities at other regional sources. The highest total effects modeled, plus background concentrations, are compared to applicable MAAQS and NAAQS. Maximum emission rates were modeled for all NorthMet Project Proposed Action sources and key criteria pollutants (i.e., NO_X, SO_2, PM_{10}, and $PM_{2.5}$).

Table 5.2.7-12 summarizes the results of the NAAQS model analysis for the Mine Site and Plant Site separately. The modeled concentration from either the Mine Site receptors or the Plant Site receptors was added to the ambient background to assess total impact, since, in each area, modeling analysis included the entire NorthMet Project area and nearby sources. The highest 6th high (H6H) PM_{10} concentration for the 5-year modeling period was used for comparison to the NAAQS PM_{10} 24-hour standard. The highest 8th high (H8H) 1-hour NO_2 and 24-hour $PM_{2.5}$ concentration for the 5-year modeling period was used for comparison to the NAAQS NO_2 1-hour standard and the $PM_{2.5}$ 24-hour standard, respectively. The H8H concentration represents the 98th-percentile daily maximum concentrations modeled over a 5-year period, as defined by each standard. The highest 4th high (H4H) 1-hour SO_2 concentration for the 5-year modeling period was used for comparison to the 1-hour SO_2 NAAQS. The H4H concentration represents the 99th-percentile daily maximum 1-hour concentrations modeled over a 5-year period, as defined by the standard. The H2H 3-hour and 24-hour SO_2 concentrations were used for comparison with the 3-hour and 24-hour SO_2 NAAQS. Maximum annual average concentrations for NO_2, SO_2, PM_{10}, and $PM_{2.5}$ were compared against their respective annual average NAAQS.

Mine Site

The analysis for the Mine Site included potential emissions from the nearby sources included in the NAAQS analysis, specifically Mesabi Nugget, Cliffs Erie Pellet Yard, Northshore Mine, and the Plant Site. The sources to the west of the Mine Site (Mesabi Nugget, Cliffs Erie Pellet Yard, and the Plant Site) were modeled collectively in a separate modeling run to determine their maximum modeled effect on the Mine Site receptor grid (Barr 2012c).

The PM_{10} NAAQS modeling results conservatively added the maximum modeled emissions from the Mine Site and Plant Site and the maximum modeled effect from the other nearby sources to background concentrations for comparison to the NAAQS. Cumulative modeling and further analyses for NO_2 and SO_2 were not performed because the NO_2 and SO_2 concentrations at the Mine Site were shown to be well below the SILs.

The maximum effects from the Mine Site analysis are slightly higher for PM_{10} and slightly lower for $PM_{2.5}$ than the effects from the Plant Site summarized below in Table 5.2.7-12. The maximum predicted annual $PM_{2.5}$ concentration (Mine Site contribution plus background) was 10 $\mu g/m^3$ or approximately 83 percent of the corresponding NAAQS. The maximum predicted 24-hour $PM_{2.5}$ concentration was 32 $\mu g/m^3$ or approximately 91 percent of the short-term $PM_{2.5}$ standard. All other predicted concentrations are at or below 60 percent of the allowable levels, which demonstrates compliance with MAAQS and NAAQS.

Table 5.2.7-12 Results of Class II NAAQS Modeling

Pollutant	Averaging Time	Maximum Modeled – Plant Site (μg/m³)[1,2]	Maximum Modeled – Mine Site (μg/m³)[1]	Total (μg/m³)[2,3]	NAAQS and MAAQS (μg/m³)
SO_2	1-hour	*109~~893~~*	NA	109~~893~~	1,300[~~4~~3]
	1-hour	*109~~893~~*	NA	109~~893~~	196[~~5~~4]
	3-hour	*47~~784~~*	NA	47~~784~~	915
	24-hour	*40~~255~~*	NA	40~~255~~	365
	Annual	*7~~24~~*	NA	7~~24~~	60
PM_{10}	24-hour	80~~77~~	*88*	88	150
	Annual	*26~~19~~*	22	26~~2~~	50[~~6~~5]
$PM_{2.5}$	24-hour	*34*	32	34	35
	Annual	*11*[~~7~~6]	10	11	12
NO_2	1-hour	*177~~292~~*	NA	*177~~292~~*	188[~~8~~7]
NO_2	Annual	*21~~3~~*	NA	21~~3~~	100

[1] Maximum concentrations include background.
[2] Concentrations exceeding the standard are bolded and italicized.
[3] Total concentration displayed is the maximum modeled concentration, from either the Plant Site Receptors or Mine Site receptors, added to the background concentration.
[~~4~~3] MAAQS for 1-hour SO_2.
[~~5~~4] NAAQS for 1-hour SO_2.
[~~6~~5] The annual NAAQS for PM_{10} was rescinded on October 17, 2006.
[~~7~~6] The maximum modeled Plant Site concentration was calculated as the maximum design value as defined by the USEPA guidance (USEPA 2013).
[~~8~~7] NAAQS for 1-hour NO_2.

Plant Site

The NAAQS modeling on the Plant Site ambient boundary included all Plant Site and nearby sources plus emissions from the Tailings Basin and unpaved roads. Maximum predicted concentrations were added to background values to calculate maximum ambient air concentrations. All predicted concentrations are below allowable levels, and the results demonstrate compliance with all MAAQS and NAAQS~~, except for the 1-hour NO_2 and 1-hour SO_2 NAAQS. The maximum predicted ambient 1-hour NO_2 concentration was 292 μg/m³, which was predicted to occur to the southwest portion of the ambient air quality boundary, and exceeded the 1-hour NO_2 NAAQS (188 μg/m³). The Plant Site modeled contribution at the location of maximum effect is 0.002 μg/m³. Other receptors where concentrations were lower than the maximum but exceeded the 1-hour NO_2 NAAQS were predicted primarily on the western half of the receptor grid and were due to the nearby sources (see Figure 5.2.7-1). For all receptors that exceeded the 1-hour NO_2 NAAQS, the contributions from the Plant Site sources were less than the 1-hour NO_2 Significance Threshold of 7.5 μg/m³ and are considered to have no significant contribution to the predicted exceedances. Similarly, the maximum 1-hour SO_2 ambient concentration was predicted at the southwestern border of the ambient boundary with a value of 893 μg/m³ and exceeded the 1-hour SO_2 NAAQS of 196 μg/m³ (See Figure 5.2.7-2)~~.~~Figure 5.2.7-1 1 Hour NO2 Cumulative Impact NAAQS Results Page Intentionally Left Blank Figure 5.2.7-2 1 Hour SO2 Cumulative Impact NAAQS Results~~

~~Page Intentionally Left Blank~~

5.2.7.2.2 Prevention of Significant Deterioration Class I Modeling Analysis

Modeling analysis was conducted to assess the effects from the emissions of the NorthMet Project Proposed Action in four USEPA-designated Class I areas within the NorthMet Project area. Modeled effects were assessed against the PSD Class I Increment and AQRVs.

<u>Prevention of Significant Deterioration Class I Increment Modeling Results</u>

Maximum pollutant concentrations within the BWCAW, Voyageurs National Park, Isle Royale National Park, and Rainbow Lakes Wilderness Class I areas were estimated for each of three years and are provided in Table 5.2.7-13. As shown in the table, all of the concentrations, except for the maximum 24-hour PM_{10} concentration at BWCAW, are below their respective Class I SIL threshold. This indicates that the NorthMet Project Proposed Action contribution to increment consumption would be considered de minimus relative to other sources.~~not cause or contribute to significant effects for these pollutants and averaging times.~~ The exceedance of the PM_{10} 24-hour Class I SIL at BWCAW triggers an additional cumulative modeling analysis, including all nearby increment consuming and expanding PM_{10} sources. The cumulative analysis for this pollutant and averaging period are discussed in Section 6.2.7.

Table 5.2.7-13 Summary of Prevention of Significant Deterioration Class I Increment Analysis

Pollutant	Averaging Period	Year Evaluated 2002	2003	2004	Max (µg/m³)	Class I Inc (µg/m³)	Class I SIL (µg/m³)
Boundary Waters Canoe Area Wilderness							
SO_2	3-Hour	0.106	0.082	0.088	0.106	25	1
	24-Hour	0.020	0.025	0.021	0.025	5	0.2
	Annual	0.001	0.001	0.001	0.001	2	0.1
NO_2	Annual	0.037	0.036	0.029	0.037	2.5	0.1
PM_{10}	24-Hour	0.331	0.263	0.278	**0.331**	8	0.3
	Annual	0.016	0.020	0.015	0.020	4	0.2
Voyageurs National Park							
SO_2	3-Hour	0.014	0.010	0.020	0.020	25	1
	24-Hour	0.004	0.005	0.004	0.005	5	0.2
	Annual	0.000	0.000	0.000	0.000	2	0.1
NO_2	Annual	0.004	0.005	0.005	0.005	2.5	0.1
PM_{10}	24-Hour	0.072	0.131	0.081	0.131	8	0.3
	Annual	0.004	0.004	0.004	0.004	4	0.2
Isle Royale National Park							
SO_2	3-Hour	0.001	0.001	0.001	0.001	25	1
	24-Hour	0.000~~1~~	0.000	0.000	0.000	5	0.2
	Annual	0.000	0.000	0.000	0.000	2	0.1
NO_2	Annual	0.002	0.001	0.001	0.002	2.5	0.1
PM_{10}	24-Hour	0.031	0.018	0.019	0.031	8	0.3
	Annual	0.002	0.001	0.001	0.002	4	0.2
Rainbow Lakes Wilderness							
SO_2	3-Hour	0.003	0.003	0.003	0.003	25	1

Pollutant	Averaging Period	Year Evaluated 2002	2003	2004	Max ($\mu g/m^3$)	Class I Inc ($\mu g/m^3$)	Class I SIL ($\mu g/m^3$)
	24-Hour	0.001	0.001	0.001	0.001	5	0.2
	Annual	0.000	0.000	0.000	0.000	2	0.1
NO_2	Annual	0.002	0.002	0.002	0.002	2.5	0.1
PM_{10}	24-Hour	0.030	0.033	0.021	0.033	8	0.3
	Annual	0.002	0.001	0.002	0.002	4	0.2

In 2010, the USEPA promulgated a Class I increment for $PM_{2.5}$. However, the minor source baseline date for $PM_{2.5}$ has not been triggered for the NorthMet Project area. Therefore, a comparison of $PM_{2.5}$ concentration with the $PM_{2.5}$ Class I increment and SILs is not required and was not performed.

Class I Areas – Air Quality Related Values Impact Analysis

An air quality modeling analysis was conducted to estimate the effect of the NorthMet Project Proposed Action on air quality in Class I areas. The analysis addressed visibility impacts on the BWCAW, Rainbow Lakes Wilderness, Voyageurs National Park, and Isle Royale National Park. The Class I AQRV analyses also included sulfur and nitrogen deposition and SO_2 effects on soils, water, and vegetation. The results are discussed below.

Class I Visibility Analysis

A visibility/regional haze impact analysis was carried out for BWCAW, Voyageurs National Park, and Isle Royale National Park. The Rainbow Lakes Wilderness does not have an AQRV for visibility. The recommended methodology for assessing visibility impacts, according to 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 particle 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 represent potential adverse effects on visibility. These thresholds are 5 percent (a potentially detectable change) and 10 percent (a level that may represent an unacceptable degradation). In the revised FLAG guidance of 2010, the FLM also lists a threshold of less than 5 percent as "presumptive no adverse impact" when compared to the highest 98^{th} percentile daily predicted impact.

The FLAG 2010 guidance indicates that CALPOST Method 8 is now the preferred visibility impact calculation method for Class I AQRV analysis. Method 8 uses Class I area-specific monthly average relative humidity to calculate light extinction. Method 8 also compares visibility impacts with the 20 percent best pristine days. The previous preferred methodology, Method 2, used the CALPUFF-generated hourly relative humidity data to calculate light extinction. Method 2 compares visibility impacts on annual average pristine conditions. Since previous NorthMet Project Proposed Action modeling used the FLAG 2000 guidance, NorthMet Project Proposed Action visibility impact results calculated using both Method 8 and Method 2 are presented below for comparison.

Table 5.2.7-14 presents results of the initial CALPUFF visibility analysis following the previous FLAG methodology, Method 2, for each NorthMet Project Proposed Action scenario. The maximum change in light extinction for Voyageurs National Park and Isle Royale National Park is below the 5 percent threshold with changes predicted at 4.50 percent and 1.23 percent, respectively. The maximum change in light extinction at the BWCAW for the three years modeled was predicted to be 11.08 percent. The data in Table 5.2.7-14 indicate that calculated visibility impacts greater than 5 or 10 percent could occur at some point within the BWCAW on a small number of days each year.

Table 5.2.7-14 Class I Area Visibility Results for NorthMet Project Proposed Action (Method 2 Analysis)

Class I Area and Meteorological Data Year	Days with ≥5% Visibility Impact	Days with ≥10% Visibility Impact	Maximum Δb_{ext} (%)
	Scenario 1		
BWCAW 2002/2003/2004	8/1/0	1/0/0	11.08/7.88/4.66
Voyageurs National Park 2002/2003/2004	0/0/0	0/0/0	2.28/4.50/2.76
Isle Royale National Park 2002/2003/2004	0/0/0	0/0/0	1.12/1.13/1.23
	Scenario 2		
BWCAW 2002/2003/2004	7/1/0	1/0/0	10.88/7.75/4.56
Voyageurs National Park 2002/2003/2004	0/0/0	0/0/0	2.23/4.41/2.72
Isle Royale National Park 2002/2003/2004	0/0/0	0/0/0	1.10/1.11/1.20
	Scenario 3		
BWCAW 2002/2003/2004	7/1/0	1/0/0	10.99/7.82/4.61
Voyageurs National Park 2002/2003/2004	0/0/0	0/0/0	2.26/4.46/2.74
Isle Royale National Park 2002/2003/2004	0/0/0	0/0/0	1.11/1.12/1.22
	Scenario 4		
BWCAW 2002/2003/2004	3/1/0	0/0/0	9.44/6.80/3.97
Voyageurs National Park 2002/2003/2004	0/0/0	0/0/0	1.84/3.80/2.39
Isle Royale National Park 2002/2003/2004	0/0/0	0/0/0	0.93/0.93/0.99

Table 5.2.7-15 presents results of the initial CALPUFF visibility analysis following the current FLAG methodology, Method 8, for each NorthMet Project Proposed Action scenario. Method 8 requires the eighth-highest visibility impact to be compared with the 5 percent and 10 percent thresholds. The eighth-highest changes in light extinction for the BWCAW, Voyageurs National Park, and Isle Royale National Park are below the 5 percent threshold with changes predicted at 4.86 percent, 1.11 percent, and 0.44 percent, respectively, and demonstrate no expected adverse visibility impacts compared to pristine conditions. These results of the NorthMet Project Proposed Action reflect emission reduction measures to reduce the potential for visibility impacts in the BWCAQ, which include: upgrades to the insulation in the existing Crusher and Concentrator buildings, utilization of low-NOx space heating equipment, a plan to phase in vehicles that meet Tier 4 emission standards, use of efficient gen-set locomotives, the reduction of dust collector exhaust for heating demand reductions, use of appropriate pollution control equipment, and use of lower emitting fuels where feasible.

Table 5.2.7-15 Class I Area Visibility Results for NorthMet Project Proposed Action (Method 8 Analysis)

Class I Area and Meteorological Data Year	98% Days with ≥5% Visibility Impact	98% Days with ≥10% Visibility Impact	8^{th} Highest Δb_{ext} (%)
Scenario 1			
BWCAW 2002/2003/2004	0/0/0	0/0/0	4.86/3.92/3.85
Voyageurs National Park 2002/2003/2004	0/0/0	0/0/0	0.89/1.11/0.97
Isle Royale National Park 2002/2003/2004	0/0/0	0/0/0	0.44/0.21/0.23
Scenario 2			
BWCAW 2002/2003/2004	0/0/0	0/0/0	4.74/3.83/3.80
Voyageurs National Park 2002/2003/2004	0/0/0	0/0/0	0.85/1.09/0.96
Isle Royale National Park 2002/2003/2004	0/0/0	0/0/0	0.43/0.19/0.22
Scenario 3			
BWCAW 2002/2003/2004	0/0/0	0/0/0	4.80/3.87/3.83
Voyageurs National Park 2002/2003/2004	0/0/0	0/0/0	0.86/1.09/0.97
Isle Royale National Park 2002/2003/2004	0/0/0	0/0/0	0.43/0.20/0.22
Scenario 4			
BWCAW 2002/2003/2004	0/0/0	0/0/0	4.21/3.45/3.42
Voyageurs National Park 2002/2003/2004	0/0/0	0/0/0	0.74/0.97/0.82
Isle Royale National Park 2002/2003/2004	0/0/0	0/0/0	0.36/0.17/0.19

Effects on Soils, Waters, and Vegetation

<u>Deposition of Nitrogen and Sulfur</u>

Potential effects on soils, waters, and vegetation in Class I areas due to deposition of sulfur and nitrogen were evaluated based upon model-predicted annual deposition for the NorthMet Project Proposed Action emissions from the Mine Site and Plant Site. Impacts were evaluated according to the USFS publication "Screening Procedures to Evaluate Effects of Air Pollution on Eastern Wildernesses Cited as Class I Air Quality Areas." Criteria for assessment of deposition impacts are different for USFS areas (BWCAW and Rainbow Lakes Wilderness) and National Park System areas (Voyageurs National Park and Isle Royale National Park). The National Park Service has established a Deposition Analysis Threshold (DAT) of 0.01 kilograms per hectare per year (kg/ha/yr) for both sulfur and nitrogen deposition for Class I areas in the eastern United States. The DAT is a level below which adverse effects from a new or modified source are not anticipated and are considered insignificant. The USFS has established Green Line Values for assessing impacts of deposition at BWCAW and Rainbow Lakes Wilderness, which account for soil conditions and water chemistry in development of safe levels. The Green Line values represent the total pollutant loading below which there are no adverse effects (Barr 2012). As such, for BWCAW and Rainbow Lakes Wilderness, background deposition levels are added to the maximum NorthMet Project Proposed Action impacts from all scenarios to assess against Green Line Values. The current background nitrogen deposition for Rainbow Lakes Wilderness

(5.88 kg/ha/yr) is at the Green Line Value range for nitrogen (5 to 8 kg/ha/yr). All other background deposition values for BWCAW and Rainbow Lakes Wilderness are below their respective Green Line Values (see Table 5.2.7-16).

The CALPUFF results for each of the Class I areas were processed with CALPOST to calculate total annual deposition of sulfur and nitrogen at each receptor as a result of the NorthMet Project Proposed Action maximum annual average 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.

Terrestrial effects of nitrogen and sulfur deposition for the Class I areas are shown in Table 5.2.7-16. As stated earlier, Green Line Values (Wilderness Areas) are compared to the maximum modeled NorthMet Project Proposed Action deposition plus background; the DAT values (National Parks) are compared to the modeled NorthMet Project Proposed Action effects only. As seen from the table, the maximum predicted total sulfur and nitrogen deposition are all below Green Line Value ranges for BWCAW. The maximum predicted total sulfur deposition is also below the Green Line Value for Rainbow Lakes Wilderness. However, the maximum predicted total nitrogen deposition at Rainbow Lakes Wilderness (5.9 kg/ha/yr) is within the Green Line Value range of 5 to 8 kg/ha/yr. The nitrogen deposition contribution from the NorthMet Project Proposed Action emissions is 0.02 percent of the total nitrogen deposition impact (0.001 kg/ha/yr). Table 5.2.7-16 also compares the ambient annual and 3-hour SO_2 concentrations due to the NorthMet Project Proposed Action to the Green Line Values. Modeled concentrations of SO_2 in both wilderness areas are below the Green Line Values for SO_2 concentration.

Finally, Table 5.2.7-16 compares terrestrial impacts of sulfur and nitrogen deposition in the Class I areas to the DAT values. The maximum predicted total sulfur and nitrogen values are below the DAT value of 0.01 kg/ha/year.

Table 5.2.7-16 Terrestrial Effects of Annual Deposition of Sulfur and Nitrogen from the NorthMet Project Proposed Action in Class I Areas

Class I Area	Proposed Action Effects	Background Level	Total (Proposed Action + Background)	Terrestrial Green Line Value	Deposition Analysis Threshold
BWCAW					
Annual avg. SO_2 ($\mu g/m^3$)	0.001	1.2	1.2	5 $\mu g/m^3$	NA
3-hour max. SO_2 ($\mu g/m^3$)	0.105	10.8	10.9	100 $\mu g/m^3$	NA
Sulfur (kg/ha/yr)	0.000	2.85	2.9	5-7 kg/ha/yr	NA
Nitrogen (kg/ha/yr)	0.009	4.75	4.8	5-8 kg/ha/yr	NA
Rainbow Lakes Wilderness					
Ann. avg. SO_2 ($\mu g/m^3$)	0.000	1.6	1.6	5 $\mu g/m^3$	NA
3-hour max. SO_2 ($\mu g/m^3$)	0.003	14.4	14.4	100 $\mu g/m^3$	NA
Sulfur (kg/ha/yr)	0.000	2.98	3.0	5-7 kg/ha/yr	NA
Nitrogen (kg/ha/yr)	0.000	5.88	5.9	5-8 kg/ha/yr	NA
Isle Royale National Park					
Sulfur	0.000	NA	NA	NA	0.01 kg/ha/yr
Nitrogen	0.000	NA	NA	NA	0.01 kg/ha/yr
Voyageurs National Park					
Sulfur	0.000	NA	NA	NA	0.01 kg/ha/yr
Nitrogen	0.001	NA	NA	NA	0.01 kg/ha/yr

Table 5.2.7-17 summarizes the aquatic effects from sulfur and nitrogen deposition for the Class I areas. Green Line Values for aquatic effects at the wilderness areas are based upon total sulfur deposition, as well as total sulfur deposition plus 20 percent of the total nitrogen deposition (sulfur + 20 percent nitrogen). Maximum predicted values for these two measures for all scenarios were below the Green Line Value ranges for BWCAW. The maximum predicted total sulfur deposition and total sulfur plus 20 percent nitrogen deposition for Rainbow Lakes Wilderness are just below the Green Line Value, and nearly all of the effects are associated with the current background level. Aquatic effects at the National Parks are also compared to the DAT values. The modeled maximum annual nitrogen and sulfur deposition effects due to the NorthMet Project Proposed Action have levels below the respective National Park Service DAT levels for both Voyageurs National Park and Isle Royale National Park. The highest effects are predicted in Voyageurs National Park, with values approximately one-tenth of the incremental DAT level for sulfur and one-fifth of the incremental nitrogen DAT level.

Table 5.2.7-17 Aquatic Effects of Deposition of Sulfur and Nitrogen from the NorthMet Project Proposed Action in Class I National Park Areas

Class I Area	Proposed Action Effects (kg/ha/yr)	Background Level (kg/ha/yr)	Total (Proposed Action + Background) (kg/ha/yr)	Aquatic Green Line Value (kg/ha/yr)	Deposition Analysis Threshold (kg/ha/yr)
BWCAW					
Total Sulfur	0.000	2.85	2.85	7.5-8.0	NA
Total S + 20% of Total N	0.002	3.80	3.80	9-10	NA
Rainbow Lakes Wilderness					
Total Sulfur	0.000	2.98	2.98	3.5-4.5	NA
Total S + 20% of Total N	0.000	4.16	4.16	4.5-5.5	NA
Isle Royale National Park					
Total Sulfur	0.000	NA	NA	NA	0.01
Total N	0.000	NA	NA	NA	0.01
Voyageurs National Park,					
Total Sulfur	0.000	NA	NA	NA	0.01
Total N	0.001	NA	NA	NA	0.01

<u>SO_2 Effects on Flora and Fauna</u>

Potential SO_2 effects on flora and fauna in Class I areas were evaluated using the model-predicted concentrations from NorthMet Project Proposed Action emissions. The USFS has set screening criteria for potential air pollution effects on vegetation for SO_2 as a total annual average ambient concentration of 5 µg/m^3. As stated earlier, Green Line screening values "were set at levels at which it was reasonably certain that no significant change would be observed in ecosystems that contain large numbers of sensitive components."

Though the USFS screening levels were established specifically for Class I areas administered by the USFS (i.e., BWCAW and Rainbow Lakes Wilderness) the same criteria were applied to Voyageurs National Park and Isle Royale National Park, which are administered by the National Park Service but do not have published standards similar to the USFS. Table 5.2.7-18 compares maximum CALPUFF NorthMet Project Proposed Action impacts from all scenarios and existing background concentrations to the Green Line screening levels for each Class I area. The summation of the NorthMet Project Proposed Action and background contributions is well below the Green Line levels so no threat to sensitive vegetation in Class I areas is expected from direct SO_2 emissions produced by the NorthMet Project Proposed Action.

There are no established screening criteria for NO_2 and PM_{10} for effects on flora and fauna. As shown in Class I increment modeling results (Barr 2012), modeled maximum annual concentrations of NO_2 and PM_{10} from the NorthMet Project Proposed Action are below the secondary NAAQS standards (protecting vegetation), so it is not expected that there would be impacts on the Class I areas from these pollutants.

Table 5.2.7-18 Comparison of Projected Class I SO_2 Concentrations to Green Line Screening Criteria for Vegetation Effects

Class I Area	Background Air Concentration (µg/m³)	Max. Modeled Proposed Action Contribution (µg/m³)	Total Proposed Action Air Concentration (µg/m³)	Green Line Concentration (µg/m³)
	Annual	Annual	Annual	Annual
BWCAW	1.2	0.001	1.2	5
Isle Royale National Park	2.0	0.000	2.0	5
Rainbow Lakes Wilderness	1.6	0.000	1.6	5
Voyageurs National Park	0.7	0.000	0.7	5

5.2.7.2.3 Potential Estimated Human Health Risk from the Plant and Mine Sites

This section includes the assessment of potential human health effects from the NorthMet Project Proposed Action. Separate AERAs were conducted for the Mine Site and Plant Site due to the large distances (approximately ~~10 km~~6 miles) between the Mine Site and Plant Site sources. It should be noted that AERAs from the Mine Site and Plant Site are also considered cumulatively in Section 6.7.5.

Estimations of additional lifetime cancer risk, potential for non-cancer effects from chronic exposures, and potential non-cancer health effects from short-term exposures were conducted for both the maximum exposed individual (MEI) and the reasonable maximum exposed off-site worker (RME-OSW). In general, the MEI analysis assumes that a hypothetical receptor would live in the area of the estimated maximum concentration and be outdoors 24 hours per day, 365 days per year for their lifetime. In terms of the ingestion component, the MPCA's Multipathway Screening Factors used in the RASS assume 30 years of exposure for a resident and 40 years of exposure for a farmer, resulting in a reasonable maximum exposure (RME) for the ingestion portion of the multipathway risk. ~~The MEI represents a worst-case screening assessment that is designed to represent the upper limit bounds of potential incremental risk and assumes a continuous outdoor exposure of 24 hours per day, 365 days per year, for a period of 70 years.~~ This screening procedure is conservative and is intended as a regulatory tool to define whether more detailed analysis is warranted rather than estimating actual risk levels. The RME-OSW is designed to assess hypothetical risks to off-site workers and is based upon an outdoor exposure level of 8 hours per day, 250 days per year for a period of 25 years (USEPA 1993).

Mine Site Air Emissions Risk Analysis

An AERA was conducted for the Mine Site in January 2008 for the DEIS.~~ and results were reported in the scoping EAW (May 2005). The 2005 AERA included specific chemicals for potential evaluation as defined in MPCA's AERA Guidance (MPCA 2004). In addition, a multi-media screening assessment was conducted to assess the potential for inclusion of sulfuric to supplement the risk assessment.~~Sulfuric acid aerosol emissions were screened out of the quaqntitative assessment for potential acute inhalation effects by scaling the Plant Site 2005 modeled acute inhalation hazard quotients to the current potential sulfuric acid emissions. ~~NorthMet Project Proposed Action changes since May 2005 resulted in the AERA being revised for the DEIS following an updated version of the AERA guidance (MPCA 2007).~~ A Supplemental AERA was conducted, as part of the project changes defined with the current

NorthMet Project Proposed Action (Supplemental Air Emission Risk Analysis – Mine Site, Barr 2013~~2~~). The screening human health risk analysis followed the MPCA-accepted November 2011 Work Plan (Work Plan_AERA Supplement for NorthMet Mine Site, Barr 2011). As identified in the Mine Site AERA, the quantitative evaluation identified 11 chemicals for evaluation (CFEs), which are summarized in Table 5.2.7-19. The identified CFEs include seven risk driver chemicals from the 2007 AERA (arsenic compounds, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, manganese compounds, nickel compounds, NO_2, and dioxins/furans). The remaining four compounds are from the 2007 AERA that now have toxicity values (acetaldehyde, cobalt compounds, crystalline silica, and diesel particulate).

Table 5.2.7-19 Chemicals for Evaluation of the Incremental Human Health Risk Assessment for the Mine Site

Chemical	Total Mine Site Emissions (Year 8) (lb/hr)	Total Mine Site Emissions (Year 8) (tons/yr)	Total Mine Site Emissions (Year 13) (lb/hr)	Total Mine Site Emissions (Year 13) (tons/yr)
Acetaldehyde	2.44~~4.11~~E-05	~~2.34~~1.40E-06	~~4.11~~2.44E-05	~~2.34~~1.40E-06
Arsenic	0.0013	0.0004	0.0014	0.0005
Cobalt	0.0036	0.0025	0.0040	0.0027
Crystalline Silica	0.5820	0.3952	0.6467	0.4339
Dibenzo(a,h)anthracene	3.15E-06	2.58E-06	3.15E-06	2.58E-06
Diesel Particulate Matter	0.3143	0.2258	0.3143	0.2258
Indeno(1,2,3-cd)pyrene	3.68E-06	3.01E-06	3.68E-06	3.01E-06
Manganese	0.0638	0.0450	0.0702	0.0488
Nickel	0.0245	0.0152	0.0266	0.0166
Oxides of Nitrogen	14.6284	9.3759	14.6284	9.3759
Dioxins/Furans (as 2,3,7,8-TCDD TEQ)	4.12E-10	3.73E-10	4.12E-10	3.73E-10
Number of CFEs	11			

Estimations of additional lifetime risk and potential non-cancer effects from chronic (long term) exposures were conducted for the MEI concept for both residential and farmer receptors. The resident is assumed to inhale outdoor air, and ingest soil and produce grown at a site of maximum air concentration. The farmer scenario assumed inhalation of outdoor air, ingestion of soil and produce, and also includes ingestion of meat and dairy products grown at the location of maximum air concentration.

Air dispersion modeling was conducted for the Mine Site to assess the potential for exposure of potential receptors to the CFE, using the AERMOD model with 5 years of hourly meteorological data from the Hibbing weather station. The assessment was conducted for the years 8 and 13, which were determined to be the years of highest air emissions. Direct and indirect risk estimates were made for inhalation and bioaccumulative toxic pollutant ingestion, respectively, using the MPCA Risk Analysis Screening Spreadsheet, which estimates potential incremental cancer and noncarcinogenic human health ~~risks~~ effects for ~~both acute and~~ long-term exposure~~effect~~s.

Acute risks were estimated for the ambient air at and beyond the Mine Site property boundary (See Large Figure 4 in Barr 2013j). Because of the historical and present mining and industrial land use around the Mine Site, the reasonable future land use for residential and farming was considered in assessing chronic risks for areas (i.e., receptors) outside of the former LTVSMC processing plant air boundary (See Large Figure 5 in Barr 2013k). The former LTVSMC processing plant ambient air boundary encompasses most of the industrial land use in the Hoyt Lakes area and no farmers or residents are expected to be present within this area either presently or for the foreseeable future.

The results of the Mine Site assessment demonstrate that the chronic additional lifetime cancer and noncarcinogenic MEI impacts, as well as the acute noncarcinogenic MEI health effects from direct exposure (inhalation) ~~and indirect exposure (bioaccumulative toxic pollutant ingestion)~~ at the Mine Site property boundary for off-site workers were below guidance levels~~, and the acute noncarcinogenic inhalation health effects were also below the guidance level~~ (Supplemental Air Emission Risk Analysis – Mine Site, Barr 2012). The MEI inhalation pathway additional lifetime cancer risk at the ~~former LTVSMC processing plan~~Mine Site~~t~~ ambient air boundary was estimated from the assessment of year 13 emissions with a maximum value of 5E-06, which is below the MDH guideline value of 1E-05. The maximum sub-chronic and acute non-cancer MEIs were calculated to be 0.~~8~~ 7 and 0.2 respectively, which are both below the guidance level of 1.0.

The MEI multi-pathway (direct and indirect) cancer risk was estimated to be 1E-05 for farmers using the Mining/Industrial District boundary. This is at the MDH additional lifetime cancer risk guidance level of 1E-05. The major risk drivers were dioxins and dibenzo(a,h)anthracene associated with potential emissions from diesel fuel combustion in mine vehicles. It should be noted that maximum multi-pathway additional lifetime cancer risk is located at the Mining/Industrial District boundary. The nearest small farms are located 6.5 miles from the Mine Site.

The MEI multi-pathway additional lifetime cancer risk for a hypothetical nearby resident at the Mining/Industrial District boundary was 8E-07, which is below the MDH guidance value of 1E-05. The major risk drivers for cancer endpoints for this receptor were nickel compounds, arsenic compounds, and dioxins.

The non-cancer chronic MEI multi-pathway hazard index (HI) for the farmers and residents were each calculated to be 0.04, which is below the MDH guidance value of 1.0. Due to the variation (i.e., each compound has a unique concentration where health effects are expected for a target organ) in estimating the health effects for noncarcinogenic effects, the HI is the sum of the individual ratios of the maximum concentration divided by the chemicals' health benchmark and compared to a general guidance value for chronic HI as 1.0. Thus, the ~~potential health effects~~chronic non-cancer results ~~impacts~~ for both farmer and residents assessed under the MEI concept are ~~approximately at 40~~ four percent of the chronic guidance level, where health effects would be expected to occur.

The acute non-cancer MEI HI was predicted at the Plant Site operating boundary with a value of 0.8, as compared to the MDH's acute HI guidance level of 1.0. This screening value sums all of the acute HIs for all pollutants regardless of their toxic endpoint (specific target organ) and the specific locations of maximum modeled air concentrations of the compounds. The risk drivers for the maximum acute MEI were NO_2 from the natural gas combustion. When adjusting HIs for the various locations of the maximum modeled annual average air concentration for risk driver pollutants (i.e., risk driver pollutant concentrations differ in space), the maximum acute MEI HI for the off-site worker was reduced to 0.8, below the acute guidance level. Table 5.2.7-20 provides a summary of the Mine Site risk assessment.

Table 5.2.7-20 Summary of the Incremental Human Health Risk Assessment for the Mine Site

Exposure Route	Exposure Scenario	MEI Receptor	Potential Noncancer Health Effects (HI)[1]	Potential Cancer Effects (Risk Estimate)[2]
Inhalation Exposure Only	Acute (1-hour)	Mine Site Property Boundary	0.80	NA
	Chronic (> 1 year)	Mine Site Property Boundary	0.20	5E-06
Multipathway Exposure	Chronic (> 1 year)	Farmer	0.04	1E-05
		Resident	0.04	8E-07

[1] HI is the sum of individual non-cancer chemical risks for acute or chronic exposure. Incremental non-cancer (chronic and acute) guideline value is 1.0.

[2] Potential human health risks from carcinogenic chemicals (summed for all chemicals) were estimated using the MPCA's Risk Assessment Screening Spreadsheet. Incremental cancer risk guideline value is 1E-05.

Plant Site Air Emission Risk Analysis

As with the Mine Site, an AERA was conducted for the Plant Site and results were reported in the scoping EAW (May 2005). The 2005 AERA included specific chemicals for potential evaluation as defined in MPCA's AERA Guidance (MPCA 2004). Sulfuric acid aerosol emissions were screened out of the qua~~q~~ntitative assessment for potential acute inhalation effects by scaling the 2005 modeled acute inhalation hazard quotients to the current potential sulfuric acid emissions. NorthMet Project Proposed Action changes since May 2005 resulted in the AERA being revised for the DEIS. A Supplemental AERA was conducted, as part of the changes defined with the current NorthMet Project Proposed Action (Supplemental Air Emission Risk Analysis – Plant Site, Barr ~~2012~~2013). The screening human health risk analysis followed the MPCA-accepted August 2011 Work Plan (Work Plan_AERA Supplement for NorthMet Plant Site, Barr 2011). As identified in the Plant Site AERA, the quantitative evaluation identified 10 CFEs, which are summarized in Table 5.2.7-21. The identified CFEs include three risk driver chemicals from the 2007 AERA (arsenic compounds, nickel compounds, and ~~NO_x~~NO_2) and four compounds from the 2007 AERA that now have toxicity values (acetaldehyde, cobalt compounds, crystalline silica, and diesel particulate). The remaining three were added either because of increased emissions (hydrochloric acid and manganese) or new emissions from mobile diesel sources included in the analysis (dioxins/furans).

Table 5.2.7-21 Chemicals for Evaluation of the Incremental Human Health Risk Assessment for the Plant Site

Chemical	Emissions 2011 (lb/hr)	Emissions 2011 (tpy)
Acetaldehyde	1.66E-05	9.49E-07
Arsenic	3.03E-03	7.75E-04
Cobalt		5.44E-03
Crystalline Silica		1.30E+00
Diesel Particulate Matter		4.47E-02
Hydrochloric Acid	2.45E+00	2.90E-02
Manganese		5.91E-02
Nickel	1.33E-01	1.36E-01
Oxides of Nitrogen	1.10E+01	
Dioxins/Furans (as 2,3,7,8-TCDD TEQ)		1.12E-10
Number of CFEs		10

Similar to the Mine Site AERA, air dispersion modeling was conducted to assess the CFE, using the AERMOD model with 5 years of hourly meteorological data from the Hibbing weather station. Direct and indirect risk estimates were made for inhalation and bioaccumulative toxic pollutant ingestion, respectively, using the MPCA Risk Analysis Screening Spreadsheet, which estimates potential incremental cancer and noncarcinogenic human health risks for both acute and long-term effects.

Acute risks were estimated for the ambient air at and beyond the NorthMet Project area ownership boundary for off-site workers. Because of the historical and present mining and industrial land use around the Plant Site, the reasonable future land use for residential and farming was considered in assessing chronic risks for areas (i.e., receptors) outside of the former LTVSMC processing plant air boundary. The former LTVSMC processing plant ambient air boundary encompasses most of the industrial land use in the Hoyt Lakes area and no farmers or residents are expected to be present within this area for the foreseeable future.

Initially, a screening level human health risk is conducted where all CFEs maximum concentrations are assumed to occur at the same location. A refinement to the risk assessment is the calculation of maximal potential health effects paired in both space and time. That is, when the health effect impacts are calculated for all pollutants at each receptor and meteorological condition modeled. The results of the Plant Site assessment demonstrate that the chronic additional lifetime cancer and noncarcinogenic effects are at or below guidance levels and the acute noncarcinogenic health effects are also below the guidance level, when adjusted for locational differences (Supplemental Air Emission Risk Analysis – Plant Site, Barr 2012).

The MEI multi-pathway additional lifetime cancer risk at the former LTVSMC processing plant ambient air boundary was estimated to be 1E-05 for farmers and 5E-06 for a hypothetical nearby residents, which is below the MDH guidance level value of 1E-05. Similarly, the RME-OSW inhalation additional lifetime cancer risk at the NorthMet Project area boundary was predicted at 1E-05, also at the MDH additional lifetime cancer risk guidance level. The major risk drivers for these estimated cancer endpoints were cobalt, nickel, and dioxins/furans (farmers only).

The non-cancer chronic MEI multi-pathway HI for the farmers and residents were each calculated to be 0.2, primarily from the potential ~~NO_x and~~ nickel emissions. Due to the variation (i.e., each compound has a unique concentration where health effects are expected for a target organ) in estimating the health effects for noncarcinogenic effects, the HI is the sum of the individual ratios of the maximum concentration divided by the chemicals' reference exposure level and compared to a general guidance value for chronic HI as 1.0. Thus, the ~~potential health effects~~chronic non-cancer results for ~~on~~ both farmer and residents assessed under the MEI concept are ~~approximately~~ at 20 percent of the chronic guidance level, where health effects would be expected to occur. The chronic HI for the RME-OSW receptor was predicted to be 1, which is at the chronic guidance level.

The results of the acute residential non-cancer MEI HI were predicted at the ~~Plant Site operating~~former LTVSMC processing plant ambient air boundary with a value of 0.5, as compared to the MDH's acute HI guidance level of 1.0. This screening value sums all of the acute HIs for all pollutants regardless of their toxic endpoint (specific target organ) and the specific locations of maximum modeled air concentrations of the compounds. The risk drivers for the maximum acute MEI were NO_2 from the natural gas combustion and nickel from the Hydrometallurgical Plant. When adjusting HIs for the various locations of the maximum modeled annual average air concentration for risk driver pollutants (i.e., risk driver pollutant concentrations differ in space), the maximum acute MEI HI for the off-site worker was 1.0, at the acute guidance level. Table 5.2.7-22 provides a summary of the Plant Site risk effects.

Table 5.2.7-22 Summary of the Incremental Human Health Risk Impacts for the Plant Site

Exposure Route	Exposure Scenario	MEI Receptor	Potential Noncancer Health Effects (HI)[1]	Potential Cancer Effects (Risk Estimate)[2]
Inhalation Exposure Only	Acute (1-hour)	Off-Site Worker Plant Site Property Boundary	1.0	NA
	Acute (1-hour)	Resident at former LTVSMC ambient air boundary	0.5	NA
	Chronic (> 1 year)	Mine Site Property Boundary	1.0	1E-05
Multipathway Exposure	Chronic (> 1 year)	Farmer	0.2	1E-05
		Resident	0.2	5E-06

[1] HI is the sum of individual non-cancer chemical risks for acute or chronic exposure. Incremental non-cancer (chronic and acute) guideline value is 1.0.
[2] Potential human health risks from carcinogenic chemicals (summed for all chemicals) were estimated using the MPCA's Risk Assessment Screening Spreadsheet. Incremental cancer risk guideline value is 1E-05.

5.2.7.2.4 Greenhouse Gases Impact Analysis

The science, policy, and regulatory frameworks regarding GHGs are continually evolving and are often subject to differing interpretation. For the purposes of the SDEIS, the information presented below is intended to provide the current understanding through June 15, 2012 with subsequent information regarding climate change updated in the FEIS.

Global Effects

According to the IPCC, since preindustrial times,~~evidence has led IPCC scientists to conclude there is a high likelihood that~~ human activities, particularly the burning of fossil fuels, have resulted in increases in the concentrations of GHGs in the earth's atmosphere ~~since preindustrial times~~ (IPCC 2007). It is estimated that 40 percent of a pulse emission of CO_2 remains in the atmosphere for approximately 100 years. Approximately 15 to 30 percent of the emissions are expected to remain after 1,000 years and 10 to 15 percent are expected to remain after 10,000 years. The estimated mean lifetime of emitted fossil CO_2 is between 30,000 and 50,000 years (Archer 2005). As such, the atmospheric GHG levels are likely to continue to rise over the next few decades. ~~The body of evidence has led scientists to conclude with 90 percent certainty that higher levels of atmospheric GHG tend to warm the planet.~~GHGs absorb in the infrared part of the electromagnetic spectrum. At elevated atmospheric concentrations, they act to warm the lower atmosphere and surface of the earth. ~~Globally, an "unequivocal" warming of 1.3°F (plus or minus 0.3°F) occurred between 1905 and 2005 (IPCC 2007). Other data have shown that the global average temperature has increased by about 1.2 to 1.4°F since 1890, with the 14 warmest years of the past century occurring between 1997 and 2012 (NASA 2013).~~

The IPCC's most recent report (IPCC 2007) found that, under a business-as-usual scenario, globally averaged surface temperature would increase 2.5 to 10.4°F between 1990 and 2100.

Globally, an "unequivocal" warming of 1.3°F (plus or minus 0.3°F) occurred between 1905 and 2005 (IPCC 2007). Other data have shown that the global average temperature has increased by about 1.2 to 1.4°F since 1890, with the 14 warmest years of the past century occurring between 1997 and 2012 (NASA 2013). The observed increases in global average surface temperature may also be seen in the records of average annual temperatures at the regional and state level. Over the past century, temperatures in the United States have risen at an average rate of 0.11°F per decade, with the past 25 years showing temperature increases of approximately 0.56°F per decade (NOAA 2007). The annual average temperature of Minnesota has increased approximately 1°F in the last century, from 43.9°F (1888 to 1917 average) to 44.9°F (1963 to 1992 average) (MPCA 2009). The winter season has brought even more dramatic increases of up to five degrees in parts of northern Minnesota (MPCA 2009). Much of the warming observed in Minnesota has occurred over the last few decades. The observed rate and total increase in temperatures appear more extreme when the more recent years on record are averaged.

Climate changes can involve changes in temperature as well as changes in other meteorological conditions, such as precipitation patterns and shifts in seasons. These changes could affect forest ecosystems, water resources, other unique ecosystems, agriculture, and human health over the next century. Future emissions scenarios, using an ensemble of results from multiple global climate models, suggest an increase in annual precipitation of 10 to 15 percent over the next 70 to 90 years in the Great Lakes Region (USGCRP 2009), although regional results from these models are more uncertain than global results. The current modeling also suggests that winter and spring precipitation would increase 20 to 25 percent; summer rainfall declines 5 to 10 percent in the model results.

Although the degree of effect is uncertain, particularly when analyzed at the regional and local levels, water resources could be affected by changes in climate patterns. Due to increased temperature, evaporation would likely increase which could reduce levels in lakes, rivers, and streams up to 12 inches (MDNR 2009). Increased precipitation could also affect flooding conditions. In addition, severe weather patterns could be affected, resulting in more frequent maximum 25- and 100-year precipitation events and flood patterns. Warmer temperatures may shorten winter seasons, resulting in decreased ice cover on the lakes and streams, as well as early ice breakup in the spring.

If Minnesota's climate becomes drier, forest areas near the prairie-forest border could be replaced with grassland ecosystems (Frelich and Reich 2009). Minnesota's forested areas could decrease by 50 to 70 percent (MPCA 2003). On the other hand, if increased precipitation occurs, resulting in a wetter climate over long periods of time, the current conifers would be replaced with hardwood trees. ~~due to adaption.~~ Pine, birch, and maple forests would be replaced with oak, elm, and ash.

Minnesota's wetland and bog ecosystems may also face changes due to increased precipitation. Variation in wet periods, dry periods, and severe storm frequency could lead to changes in wetland type and distribution that includes wetland losses in some areas and wetland gains in other areas.

~~Climate change could have a dramatic effect on agriculture due to increased water demand from increased evaporation. However, it may also increase the potential growing season of certain crops within the region, creating a further increase in the use of water resources. In addition, increased growing seasons may increase~~Due to the negative effects of peak daytime temperatures during anthesis and grain filling on crop growth, climate change could have a d~~g~~ramatic effect on agriculture. However, climate change will also lengthen the growing season of certain crops within the region, leading in some instances to increased, rather than decreased, agricultural productivity. ~~d~~Droughts, floods, and damage from insects~~,~~ and invasive weeds, ~~which w~~could increase the challenges by farmers in the day-to-day management of~~ing~~ farms and livestock.

Increased temperatures could increase the potential for heat-related illnesses and insect-borne diseases. Changes in air quality health effects could occur due to the increased temperatures. The potential for higher VOC and ozone levels may occur, ~~as well~~ as increased temperatures may increase duration and frequency of stagnation conditions that would allow air pollution to build up.

Regulatory Actions

The USEPA has issued regulations under the CAA, and in some cases other statutory authorities, to address issues related to climate change. In addition, MPCA has recently modified its air permit rules to incorporate new federal permit requirements for GHG emissions and currently requires an evaluation of GHG emissions in the environmental review process for projects that must obtain stationary source air permits.

On October 30, 2009, the Final Mandatory Greenhouse Gas Reporting Rule was published requiring suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and facilities that emit 25,000 or more mtpy of GHGs to submit annual emission reports to USEPA. The gases covered by the proposed emissions reporting rule are CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, and other fluorinated gases including nitrogen trifluoride and hydrofluorinated ether. The proposed rule required that the first annual GHG emission report be submitted on March 31, 2011, for 2010 emissions. The first reporting deadline was extended to September 20, 2011.

In response to the 2007 United States Supreme Court ruling in Massachusetts v EPA, 549 US 497 (2007), on April 17, 2009 the USEPA Administrator signed a Proposed Endangerment and

Cause or Contribute Findings for Greenhouse Gases under the Section 202a of the CAA. The Administrator found that current and projected concentrations of the mix of six key GHGs in the atmosphere threaten the public health and welfare of current and future generations. The Administrator further found that the combined emissions of CO_2, CH_4, N_2O, and HFCs from motor vehicles and motor vehicle engines contribute to rising atmospheric concentrations of these key GHGs and hence are a threat to public health and welfare. These findings were a prerequisite to finalizing the GHG standards for light-duty vehicles. On April 1, 2010, USEPA and the DOT's National Highway Safety Administration issued the first national rule limiting GHG emissions from cars and light trucks. This rule confirmed that January 2, 2011 ~~is~~ was the ~~earliest data~~first date that a 2012 model year vehicle meeting these rule requirements may be sold in the U.S.

Based upon the above and USEPA's "PSD Interpretive Memo" (identifying that a pollutant is subject to regulation either by a specific provision in the CAA or a regulation adopted by USEPA), USEPA issued a final rule on May 13, 2010 that set GHG thresholds for permits for new and existing sources under New Source Review PSD permit and Title V operating permit requirements, known as the Greenhouse Gas Tailoring Rule. Currently, under the rule and beginning on July 1~~, 2011, through June 30, 2013~~, new sources, such as the NorthMet Project Proposed Action, with greater than 100,000 tpy of GHG or existing facilities that increase their GHG emissions by more than 75,000 tpy are subject to PSD and would require BACT for GHG emissions.

Concurrent with USEPA actions, a series of Congressional proposals ~~have been~~were developed that, had they been passed, would have ~~the effect of shaping~~changed the U.S. climate policy. GHG emissions legislation considered during the 109th and 110th sessions (January 2005 to January 2007, and January 2007 to January 2009, respectively) of the U.S. Congress ranged from carbon taxes to cap-and-trade and from energy efficiency requirements to moratoriums on coal-fired power plant approvals. Of the legislation proposed during the 109th and 110th Congresses, n~~N~~otable recent legislative actions include the following:

- Lieberman-Warner Climate Security Act of 2007 (S. 2191);
- Boxer-Lieberman-Warner Climate Security Act Substitution Amendment of 2008 (S. 3036);
- American Clean Energy and Security Act of 2009 (Waxman-Markey – H.R. 2454);
- Clean Energy Jobs and American Power Act of 2009 (Kerry-Boxer (S. 1733)); and
- Kerry-Lieberman American Power Act of 2010.

None of these bills have passed both houses of Congress.

At the state level, efforts to curb statewide and regional GHG emissions are underway. More than half of U.S. states have joined in regional efforts to reduce GHG emissions. In 2007, as part of the Midwestern Greenhouse Gas Reduction Accord, Minnesota committed (along with Illinois, Iowa, Kansas, Michigan, Wisconsin, and the Province of Manitoba, Canada) to long-term GHG reduction targets of 60 to 80 percent below 2005 emission levels. Participants have agreed to pursue the implementation of a regional cap-and-trade system as well as a consistent regional GHG emissions tracking system.

In May 2008, the Governor of Minnesota signed legislation requiring the Minnesota Department of Commerce (MDC) and the MPCA to track and report GHG emissions. In 2007 legislation was passed and signed into law that established GHG emissions reduction ~~and directed that interim reduction recommendations be developed, including a~~targets for 2015 and 2025 of 15 percent ~~reduction target for 2015 and a~~ and 30 percent, respectively, and directed the Department of Commerce to develop interim reduction recommendations through a length stakeholder process. The 2015 and 2025 goals were designed as milestones toward meeting the State's goal of reducing GHG emissions to a level at least 80 percent below 2005 levels by 2050. ~~reduction target for 2025, which could be in effect during the lifetime of the NorthMet Project Proposed Action. The interim goals are designed as milestones toward meeting the State's goal of reducing GHG emissions to a level at least 80 percent below 2005 levels by 2050.~~ Developments in Minnesota's climate change and GHG policy would likely continue as Minnesota strives to meet the goals established in the Next Generation Energy Act of 2007.

On January 13, 2013, the MPCA adopted permanent rules to implement the new GHG permit requirements set by the USEPA. These rules set Part 70 permit thresholds for GHGs at 100,000 tpy. The rule changes also modify requirements for capped and registration permits and insignificant activities. The MPCA has implemented USEPA's final decision to defer including biogenic CO_2 emissions in permitting through permanent rulemaking for biogenic sources for PSD and Title V purposes.

In addition to policies directed at reducing statewide GHG emissions, Minnesota has instituted policies requiring the evaluation of GHG emissions as a part of the environmental review process for certain proposed actions that require stationary source air emissions permits. In July 2008, MPCA issued a General Guidance for Carbon Footprint Development in Environmental Review. The MPCA guidance requests that proposers, in the course of environmental review under MEPA, prepare a GHG inventory for proposed actions that would require stationary source air emissions permits.

NorthMet Project Proposed Action and Climate Change

The NorthMet Project Proposed Action results in direct on-site emissions of GHGs and off-site indirect emissions associated with power generation. There are no analytical or modeling tools to reliably evaluate the incremental impact of a proposed action's discrete GHG emissions on the global and regional climate. In addition, there are no analytical or modeling tools to reliably evaluate any cascading impacts, or cumulative effects, from a particular proposed action's GHG emissions on natural ecosystems and human economic systems in a given state or region.

The total potential direct annual emissions from the NorthMet Project Proposed Action are projected to be 19~~8~~6,~~243~~ 342 mtpy of CO_2e. This is 0.12 percent of the statewide emissions for Minnesota, 0.003 percent of the United States emissions, and 0.00038 percent of the annual global emission estimations. Combining the direct and indirect emissions from the NorthMet Project Proposed Action (697,342 mtpy CO_2e), the total represents 0.44 percent, 0.01 percent, and 0.0014 percent of the annual statewide, U.S., and global emissions, respectively (Greenhouse Gas and Climate Change Evaluation, Barr 2012). It is possible that, due to global demand for copper, nickel, and precious metals, some of these emissions will occur regardless of the development of the NorthMet Project Proposed Action.

With climate change, average annual temperatures in Minnesota may increase 3 to 5°F over the lifetime of the facility. There may also be a 5 to 15 percent increase in precipitation over the life of the operation (20 years) and reclamation (60 years) (Regional Climate Trends and Scenarios for the U.S. National Climate Assessment Part 3: Climate of the Midwest, NOAA 2013). Increased temperatures and precipitation may have effects on wetlands, forests, and other cover types that are likely to affect carbon storage and sequestration in these ecosystems. ~~Overall climate change could also affect visibility.~~ There could be localized impacts due to meteorological changes. ~~Although, over its life, the NorthMet Project Proposed Action would emit GHGs to the atmosphere, it is possible that, due to global demand for copper, nickel, and precious metals, some of these emissions will occur regardless of the development of the NorthMet Project Proposed Action.~~ Even though a quantitative assessment of the effects could not be conducted, proposed reclamation and mitigation activities described in Section 5.2.7.4.3 can offset some of the carbon emissions caused by NorthMet Project Proposed Action. Overall climate change could also affect visibility.

5.2.7.2.5 Mercury Deposition Impact Analysis

Total potential mercury emissions to air are estimated to be 4.6 lbs/year from the Plant Site. Regarding mercury, the Band representative(s) identified that all increases in mercury contributions to the environment constitute a risk to human and ecosystem health that is an issue for consideration in the SDEIS. The primary sources of air emissions are expected to be two emission units that are part of the hydrometallurgical process: the autoclave vent and the autoclave flash vent. The combined air emissions from these two units are estimated to be 4.1 lbs/year. Most of the remaining estimated mercury emissions (0.5 lb/year) are from natural gas used to fuel a package boiler and for space heating. Less than 0.1 lb/year are estimated to be released by the mining, crushing, and milling processes and through wind erosion from the Tailings Basin. Additional information regarding each of these emission sources is summarized in *Mercury Emission Control Technology Review Version 2* (Barr 2012g). Overall, about 95 percent of the mercury originating in the ore is expected to remain within—or be adsorbed to—the tailings and the hydrometallurgical residue, where it would remain isolated from further transport to the environment.

The low percentage of estimated mercury released to the air is primarily because the oxidizing conditions in the autoclave would cause most of the mercury that is released from the concentrate into the exhaust gas to be in either the oxidized (Hg^{+2}) or particle-bound (Hg(p)) form. Oxidized mercury is water soluble and would be captured in the facility's wet scrubber system. Particle bound mercury would be collected in any device designed to control particulate emissions, such as the autoclave scrubber system. As a result, most of the mercury emitted to the air would be in the elemental (Hg^0) form. Detailed calculations for all Plant Site emission units are provided in UpdatedCalcsPlant Ver7.0_2_26_13 (Barr 2013).

An evaluation was conducted for the potential deposition of mercury related to the Plant Site air emissions to assess the NorthMet Project Proposed Action's potential effects on mercury concentrations in fish and the potential health risks to a hypothetical recreational fisher, as well as a subsistence fisher consuming locally caught fish. The analysis was conducted for five nearby lakes: Heikkilla Lake, Colby Lake, and Whitewater Lake (located within 10 km of the Plant Site) and Wynne Lake and Sabin Lake (located within 12 km of the Plant Site). The analysis used the MPCA's Mercury Risk Estimation Method to assess the potential incremental change in fish mercury concentrations and the potential incremental risks to human health. For the NorthMet Project Proposed Action, mercury uptake into fish, with subsequent subsistence fishers consuming locally caught fish, has been raised by the Bands for consideration in the SDEIS.

Only the Plant Site's potential mercury air emissions were evaluated, as they represent essentially all of the NorthMet Project Proposed Action-related mercury air emissions (Barr 2013). The Mine Site AERA did not assess potential local mercury deposition because potential emissions are less than 1.0 lb/yr (Barr 2012a).

The results of the analysis from the two mercury speciation scenarios on the five nearby lakes estimated that the potential incremental increase in mercury concentrations in the top predator fish would range from 0.001 ppm (Scenario 2, Whitewater Lake) to 0.016 ppm (Scenario 1, Wynne Lake), depending upon the lake and scenario evaluated (see Revised Table 4, Barr 2013). Scenario 1 assumed that the oxidized and particle-bound mercury released would be 50 percent and 25 percent of the total mercury, respectively. Scenario 2 assumed maximum control efficiency for these fractions, reducing the total percentage released to 10 percent for each. It should be noted that due to the conservatively higher oxidized and particle-bound mercury speciation assumption in Scenario 1, the effects for Scenario 1 are greater than the mercury effects for Scenario 2 for each lake evaluated. These are small compared to the existing Hg concentrations in the top predator fish (95th percentile), which range from 0.35 ppm at Whitewater Lake to 1.34 ppm at Wynne Lake. The NorthMet Project Proposed Action incremental risk quotients for a recreational fisher ranged from 0.013 (Scenario 1) at Whitewater Lake to 0.081 at Wynne Lake; both are below the incremental risk guideline level of 1.0. The incremental risk quotients for subsistence and tribal anglers ranged from 0.098 (Whitewater Lake) to 0.606 (Wynne Lake) for Scenario 1, also below the incremental risk guidance level. Finally, the incremental risk quotients for the subsistence fisher (Treaty Protected catch rate) ranged from 0.132 (Scenario 1, Whitewater Lake) to 0.538 (Scenario 1, Wynne Lake), again below the incremental risk guidance level.

It should be noted that all of the lakes' mercury background concentrations result in a background risk quotient above 1.0 without any incremental increase from the NorthMet Project Proposed Action, which is a common occurrence in Minnesota lakes. Widespread contamination of fish from atmospheric pollution is why Minnesota established a statewide mercury TMDL. The TMDL seeks to reduce atmospheric deposition everywhere in the state in order to make the state's lakes and streams fishable, as required by federal regulations.

In September 2009, the MPCA published Guidelines for New and Modified Mercury Air Emission Sources. The guidelines were developed to limit the mercury emissions from new and expanding sources in order to meet the TMDL goal of total statewide mercury emissions of 789 lbs/year by 2025. In 2012, MPCA revised the guidelines (MPCA 2012), which includes the following requirements that apply to the NorthMet Project Proposed Action:

- Define and employ BACT on mercury emitting sources. If best controls reduce emissions by less than 90 percent, the new source would be subject to periodic review for opportunities for improved control efficiency and must comply with the following TMDL requirements.
- Conduct environmental analysis for a proposed action and associated cumulative effects.
- For facilities where the MPCA determines a project's mercury emissions will not impede the statewide mercury emissions reduction goals within the mercury TMDL, an emissions limit

will be placed into the facility's permit and the project is not be required to submit a mitigation plan.

The NorthMet Project Proposed Action ~~complied with these requirements by~~ selected~~ing~~ a two-stage ~~emissions~~ mercury control system that~~ as the BACT system for the autoclave, which~~ is expected to achieve 25 percent control for elemental mercury and 90 percent control for particle bound and oxidized mercury~~capable of reducing the mercury emissions over 90 percent~~ (Barr 2012g). Because the total mercury control is less than 90 percent control, PolMet moved forward with the remaining TMDL requirement. In addition, PolyMet has conducted a cumulative effects analysis on the local mercury deposition and bioaccumulation in fish (Barr 2012g) and the assessment of the cumulative effects is provided in Section 6.7.5.

MPCA has conducted a review of the NorthMet Project Proposed Action mercury emissions and has determined that it will not impede the reduction goals (MPCA 2013c). Thus, no minimization and mitigation plan will be required for the NorthMet Project Proposed Action.

5.2.7.3 NorthMet Project No Action Alternative

Since this alternative would not involve introducing new emission sources, the NorthMet Project No Action Alternative would have no additional effects on air quality either regionally or locally. Therefore, air quality would be substantially similar to existing conditions.

5.2.7.4 Mitigation Measures

If, during permitting, it is determined that mitigation measures are necessary, the measures described in this section could be considered. PolyMet has proposed the following mitigation measures to reduce effects on air quality associated with GHGs.

5.2.7.4.1 Greenhouse Gas Reduction Measures

Review of Current Mitigation Included In the NorthMet Project Proposed Action

The NorthMet Project Proposed Action incorporates both energy and production efficiency to reduce associated GHGs (Barr 2009i). The potential to minimize and reduce GHG emissions from changes in existing land cover (i.e., release of carbon tied up in terrestrial biomass, soils, or peat and the loss of carbon sequestration capacity from the environment) are also discussed (Barr 2009i). The following provides a summary of the reduction measures.

PolyMet proposes a hydrometallurgical process, rather than a pyrometallurgical process, which would result in reduced energy usage. The hydrometallurgical process is expected to reduce the NorthMet Project Proposed Action's energy demand by 50 percent over comparable pyrometallurgical processes. However, while energy use is reduced by one-half, GHG emissions do not decline per unit of production from what would be expected from a pyrometallurgical process, principally because of the large load of non-energy process emissions associated with hydro processing.

PolyMet also proposes to use premium efficiency motors in selected locations rather than standard motors. Motor efficiencies typically vary between 85 and 96 percent, depending upon the size and load of the motor. Gravity transport of process slurries would also be used where possible, instead of pumps. PolyMet proposes to configure the processing plant such that the overall power factor for the facility is as close to one (energy input to energy output) as practical, which would help minimize electricity use.

The primary production excavators and two of the three blast-hole drills would be electric rather than diesel powered, eliminating a direct source of GHG emissions. PolyMet would purchase new gen-set locomotives, which are more efficient and use less fuel than conventional locomotives. Space heating in the former LTVSMC processing plant is a major contributor to total direct GHG emissions and PolyMet would employ natural gas heaters. Per unit of useful energy, the combustion of natural gas results in lower CO_2e emissions than does the combustion of other fuels. Of the three feasible space heating options, electric heating, propane-fired heating, and natural gas-fired heating, natural gas-fired heating would result in aggregate in CO_2 emissions that would be about 80 percent lower than those for electric heating and 66 percent lower than those for propane-fired heaters.

PolyMet evaluated additional methods to reduce the NorthMet Project Proposed Action's GHG emissions but found the additional methods infeasible (Barr 2009i). The methods evaluated included electric drive mine haul trucks, electric locomotives, newer mill technology, flotation alternatives, and the use of waste heat from autoclaves for space heating.

Additional Mitigation

To mitigate GHG effects associated with a change in existing land cover (i.e., secondary effects), PolyMet would provide compensatory wetland mitigation ~~implement a wetland mitigation plan implement a wetland mitigation plan~~ (see Section ~~4~~5.2.3 of this SDEIS) for ~~reasonably foreseeable~~direct effects on wetlands as well as for indirect effects to fragmented wetlands. One of the components ~~goals. The primary goal of the planned wetland~~ of the compensatory mitigation is to restore high-quality wetland communities of the same type, quality, function, and value as those affected by the NorthMet Project Proposed Action. Given site limitations and technical feasibility, it is impracticable to replace all affected wetland types with an equivalent area of in-kind wetlands. Off-site wetland compensation of 1,631.4 acres wetland restoration and/or preservation, and 225.0 acres of upland buffer have been planned~~.~~. This off-site mitigation would take place at three sites in northern Minnesota. Based upon the proposed wetland mitigation plan~~Wetland Management Plan~~, the proposed wetland replacement would likely meet and/or exceed all types of wetlands, other than deep marsh and the final ratios would be determined during wetland permitting. However, the excess replacement would contribute to some degree to compensation of the NorthMet Project Proposed Action's effects on deep marsh wetlands.

5.2.7.4.2 Rail Car Ore Transport Fugitive Dust Mitigation Measures

Rail cars have been designed to centralize the ore fines to the central portion of the rail car to minimize the potential for spillage during transport. Due to the natural moisture content and large size of the ore being mined, fugitive dust from rail car transport is expected to be minimal. Three additional fugitive dust control measures have been identified as part of the Mine Site Fugitive Emission Control Plan. These include the minimizing the drop distance of the ore into the railcars, reporting dusty conditions during loading and transport, and conducting one observation per train to evaluate rail car loading conditions. In addition, annual training will be conducted for all locomotive workers on methods to minimize fugitive dust during ore transport and loading.

5.2.7.4.3 Voluntary Mitigation Measures

Based upon the emissions defined in Section 5.2.7.1.3, the majority of the NO_x and SO_2 emissions are associated with mobile sources, (diesel trucks, locomotives, mining equipment). Although the analysis of these pollutants showed that the NorthMet Project Proposed Action would not cause or significantly contribute to air quality exceedences, a voluntary anti-idle program could further reduce these emissions, as well as PM and GHG. Although there is no regulatory requirement for a program, PolyMet is considering the implementation of an idling reduction policy that will consider the size, fuel type and function of each type of vehicle, as well as weather conditions and anticipated duration of vehicle stoppage. The policy would need to account for extreme weather conditions in order to avoid potential construction or production delays from the inability of vehicles to restart once turned off. In addition, vehicle owner's poli~~z~~cies and maintenance requirements would have to be incorporated for heavy construction equipment and light vehicles that are not owned and operated by PolyMet. The results of such a policy would beneft by reducing environmental impacts, improving worker health and safety, and reducing fuel usage and engine wear. ~~For the NorthMet Project Proposed Action, the Band representative(s) identified that GHG effects beyond air emissions as an issue for consideration in the SDEIS.~~

5.2.7.5 Amphibole Mineral Fibers

5.2.7.5.1 Environmental Consequences

Background

The NorthMet Project Proposed Action would mine ore from the Duluth Complex, which may contain amphibole fibers. Taconite ore mined from the Biwabik Iron Formation at the Northshore Mine and processed at the Silver Bay plant, has received public attention with regard to potential releases of fibers formed from amphibole mineral crystals, a class of silicate minerals containing iron and magnesium such as those found with taconite ore on the east end of the Mesabi Iron Range in northeast Minnesota. The Biwabik Iron Formation slopes under the Duluth Complex at the mine site from northwest to southeast. The proposed pit bottom is greater than 100 feet above the Biwabik Iron Formation at the closest point. ~~Whereas amphibole minerals have been found in the Duluth Complex, the Duluth Complex does not contact the Biwabik Iron Formation at the NorthMet Deposit.~~

~~Regulation of amphibole mineral fibers in Minnesota is based on the landmark 1974 Reserve Mining court case (*United States. v. Reserve Mining Company*, 380 F. Supp. 11, 17 [D. Minn. 1974]). Northshore Mining's Silver Bay processing plant was formerly operated by Reserve Mining Company. In the 1974 ruling, which addressed the dumping of taconite tailings from the Silver Bay plant into Lake Superior, the U.S. District Court for the District of Minnesota found that based on the science available at the time, evidence existed regarding the potential for exposure to amphibole mineral fibers to cause cancer and other health effects. This led to the construction of a Tailings Basin in 1980.~~

~~As discussed below, the Court's~~The State of Minnesota's definition of amphibole mineral fibers incorporates asbestos and non-asbestos amphibole fibers. The term "asbestos" is a regulatory and commercial term designating mineral products that possess high tensile strength, ability to be separated into long, thin, flexible fibers, low thermal and electrical conductivity, high mechanical and chemical durability, and high heat resistance. The fibers can be woven into various commercial products because of their flexibility. Asbestos refers to the fibrous variety of several naturally occurring silicate minerals. ~~The Court found, based on the science available at that time, that since it can be difficult to tell the difference between asbestos and non-asbestos amphibole fibers under the microscope, release of fibers from the facility should be minimized to reduce the potential for health effects. Scientific work, including whether there exists the potential for health effects, on the question of exposure to non-asbestos amphibole mineral fibers, is still ongoing at the present time.~~

Regulatory definitions for classifying fibers vary. The USEPA defines the dimensions of an asbestos fiber as a particle 5 micrometers (µm) in length or longer with an aspect ratio of at least 20:1 (USEPA 1993). A µm is one millionth (10^{-6}) of a meter. The National Institute for Occupational Safety and Health (NIOSH) defines an "occupational fiber" as a particle 5 µm in length or longer with an aspect ratio of at least 3:1 (NIOSH 1994). Minnesota agencies define a Minnesota regulated fiber (MN-fiber) as an amphibole or chrysotile mineral particle with an aspect ratio of 3:1 or greater with no limit on length (MDH Methods 851 and 852). ~~This definition, which includes amphibole mineral fibers that can either be asbestos or non-asbestos, is consistent with the findings of *United States v. Reserve Mining Company*.~~

Asbestos Fibers

Asbestos is made up of fiber bundles with two or more of the following features:

- parallel fibers occurring in bundles;
- fiber bundles displaying splayed ends;
- matted masses of individual fibers; and
- fibers showing curvature.

Bundles have splaying ends and are extremely flexible. These long, thin fibers, called "fibrils," often less than 0.5 µm in width, can be easily separated from each other, which is one of the most important characteristics of asbestos (Mine Safety and Health Act [MSHA] 2005). The mean aspect ratio for fibers can range from 20:1 to 100:1 or higher for fibers longer than 5 µm. Asbestos exposure has been identified as the cause of both malignant and non-malignant diseases.

The USEPA Integrated Risk Information System has classified asbestos as a Group A Human Carcinogen (USEPA 2008). This classification means that there is sufficient human and animal carcinogenicity data to support the weight-of-evidence characterization of asbestos as a human carcinogen from the inhalation route of exposure. The Group A classification is based on observations in occupationally exposed workers of increased mortality and incidence of lung cancer, mesothelioma, and gastrointestinal cancer. Evidence of carcinogenicity via the ingestion pathway was not supported in the animal studies reviewed for the USEPA Integrated Risk Information System classification in 1988 (USEPA 2008). In 2011, USEPA released a draft report, *Toxicological Review of Libby Amphibole Asbestos in Support of Summary Information on the Integrated Risk Information System Iris (USEPA 2011)* to characterize the hazards by exposure to Libby Amphibole Asbestos for carcinogenicity and noncancer health effects. The USEPA Scientific Advisory Board completed a comprehensive review of the report and provided recommendations on January 30, 2013. As part of the recommendations, the SAB recommended additional review be conducted to re-evaluate the uncertainty factors, including recent cohort studies conducted on amphibole fibers in Minnesota (USEPA 2013). A review of the toxicological literature for asbestos was performed for the MDNR (ERM 2009). A brief description of potential human health effects from inhalation exposure to asbestos fibers, summarized from this toxicological literature review, follows.

Lung cancers caused by asbestos are mainly bronchial carcinomas and are indistinguishable from those caused by smoking or other agents (Doll and Peto 1985). Carcinomas do not generally form until several years after the initial exposure. Mesothelioma is a form of cancer almost always associated with a previous exposure to asbestos. The cancer forms in the mesothelium, most commonly in the pleura, the outer lining of the lungs and chest cavity. Symptoms take 15 to 50 years after exposure to appear and include shortness of breath and coughing. There is no cure for human mesothelioma (Suzuki and Yuen 2002).

Asbestosis is a disease associated with occupational levels of exposure to asbestos (Atkinson 2006). Most patients with asbestosis suffer from shortness of breath and a dry cough (Mossman and Churg 1998). It is characterized by chronic inflammation of the parenchymal tissue of the lungs. Asbestosis appears to be associated with a high level of aggregate exposure, either a very high level over a short period or a low level for an extended period (Atkinson 2006). Historically, asbestosis progresses even after workers are no longer exposed to asbestos dust (Atkinson 2006).

The disease pathway of lung cancer and asbestosis from asbestos exposure is through inhalation. Another disease pathway under investigation is ingestion. The Agency for Toxic Substances and Disease Registry (ATSDR), a federal public health agency of the U.S. Department of Health and Human Services presents a summary of the non-respiratory cancers and asbestos exposure. The conclusion of the ATSDR summary is that epidemiological studies do not clearly or consistently show a strong link between non-respiratory cancers and exposure to asbestos in humans. Four relevant animal studies are found in the literature. Three of the studies were conducted to investigate the effects on the digestive tract of rats of ingestion of asbestos fibers. One of the studies investigated the effects of milled taconite ore on the digestive tract of hamsters. One of the rat studies concluded that there were no health effects. One of them reported no statistically significant health effects, but cautioned that evidence from the study suggests that asbestos fibers are “not inert” in the digestive tract. The third rat study found that the asbestos inhibited the uptake of certain sugars in the digestive tract. The hamster study concluded that no deleterious health effects and no tumors were observed in the subjects. Because there is a lack of evidence suggesting an ingestion of asbestos is a disease pathway, there is no subsequent analysis on the risk of asbestos ingestion.

There are two groups of minerals that can crystallize as asbestos: serpentine and amphibole. Serpentine and amphibole minerals can have fibrous and nonfibrous structures. While there are approximately 100 minerals that may contain asbestos fibers, there are six regulated types of asbestos. The six regulated minerals and their associated mineral group are:

- Chrysotile (Serpentine);
- Crocidolite (Reibeckitte) (Amphibole);
- Amosite (Cummingtonite-grunerite) (Amphibole);
- Anthophyllite Asbestos (Amphibole);

- Tremolite Asbestos (Amphibole); and
- Actinolite Asbestos (Amphibole).

From a mineral perspective, amphibole minerals are distinguished from each other by the amount of sodium, calcium, magnesium, and iron that they contain.

A mineral can be analyzed for asbestos using a microscope. Chrysotile asbestos is easily identified by microscopic analysis because of its distinct particle shape. For amphiboles, the distinction between asbestos and non-asbestos fibers is not clear. Amphibole particles have a spectrum of shapes from blocky to prismatic to acicular to asbestiform. According to USGS (2001), asbestiform refers to a specific type of mineral fibrosity in which crystal growth is primarily in one dimension and the crystals form as long, flexible fibers. Amphiboles also break (or cleave) into smaller fragments when finely ground. Long, thin cleavage fragments resemble asbestos fibers. An analyst can compare amphibole particle shapes to asbestos reference materials and determine whether a sample is asbestiform with a fair degree of certainty. However, according to USGS (2001), "…unless a fiber bundle has splaying ends, it is impossible to determine if a single long, thin particle grew that way (as asbestos) or is a cleavage fragment" (USGS 2001). It is more difficult to classify individual fibers as asbestiform or cleavage fragments because individual fibers do not exhibit all the characteristics of a population. According to USGS (2001), a cleavage fragment is a particle formed by comminution (i.e., crushing, grinding, or breaking) of minerals, often characterized by parallel sides. Cleavage fragments tend to be roughly twice as thick as asbestos fibers (Addison and McConnell 2008). The aspect ratio distributions (i.e., length-to-width ratio) of a population of cleavage fragments and a population of asbestos fibers can overlap. This overlap means that some fibers may be classified as either cleavage fragments or asbestos fibers (Millette 2006). The State of Minnesota does not distinguish cleavage fragments from other fibers if they meet the 3:1 aspect ratio.

Non-Asbestos Fibers

The toxicological literature review prepared for the MDNR (ERM 2009) also discussed non-asbestos fibers. A brief summary follows.

Palekar et al. (1979) found non-asbestiform particles to be cytotoxic (meaning toxic to cells); however, epidemiological studies have found limited potential for carcinogenesis from cleavage fragments. Gamble and Gibbs (2008) provided a review of several epidemiological studies regarding exposure to cleavage fragments including several involving taconite miners. They found that there was no statistically significant increase in either lung cancer or mesothelioma from exposure to taconite mining. Ilgren (2004) reviewed animal and human studies and came to the same conclusion. Additionally, Gylseth et al. (1981) performed a study in which non-asbestiform amphibole dust in the lungs of taconite miners was examined. Whereas Gylseth et al. (1981) concluded that exposure to the miners constituted a minor carcinogenic risk, they could not exclude exposure to taconite as a contributing factor to the lung cancer found in the miners examined. Asbestosis and mesothelioma latency periods of 15 to 50 years are not uncommon, creating uncertainties in the interpretation of studies performed to date. It should be noted that taconite is mined in the Biwabik Formation, whereas the ore proposed to be mined for the NorthMet Project Proposed Action is from the Duluth Complex, which is not in contact with the Biwabik Formation at the NorthMet Deposit.

Other Considerations

The MDH considers the role of amphibole fibers in the induction of asbestos-related health effects to be uncertain at this time and they assume that amphibole fibers have the potential for an as yet undetermined toxicity and potency relative to amphibole asbestos.

The October 2005 SDD for the NorthMet Proposed Action EIS identified that the "… EIS will provide information about the presence of fibers in the NorthMet deposit." Since February 2006 fibers-related information has been submitted to the Minnesota State Agencies (MDNR; MPCA; MDH) for their review and consideration. The report entitled *NorthMet Mine and Ore Processing Facilities Proposed Action, Fibers Data Related to the Processing of NorthMet Deposit Ore* (2007), hereafter referred to as the "2007 Mineral Fibers Report," provided the bulk of the fibers-related data and information.

The Northshore Mine and Silver Bay processing plant have been associated with releases of amphibole mineral fibers to the air and water. The NorthMet Project area is in close proximity to the existing Northshore Mine. Ore in intrusive rocks to be mined from the NorthMet Deposit in the Duluth Complex is 700 million years younger than the taconite ore obtained from the Northshore Mine in the Biwabik Iron Formation and was formed under different conditions (Barr 2007).

The MEQB has reported that the Duluth Complex contains minor amounts of amphibole minerals, but did not identify chrysotile as a mineral of concern (MEQB 1979). The MEQB (1979) identified that the concentration of asbestiform amphibole minerals in the Duluth Complex ore is expected to be low, "…less than 0.1 ppm by weight in the mineralized areas of the Duluth Complex…." Composite samples using ore from the NorthMet Deposit collected during flotation pilot plant studies in 2000 conducted for PolyMet (SGS 2004) provided results for amphibole and serpentine minerals representative of the MEQB (1979) conclusions. Recognizing the differences between the NorthMet Deposit versus the Biwabik Iron Formation, the MPCA, MDNR, and MDH requested that PolyMet provide additional information on fiber-related data for its mining and processing operations in the NorthMet Deposit.

PolyMet conducted additional flotation pilot testing in July and August 2005. Collected samples considered to be representative of the head feed, tailings, and flotation process water associated with processing ore from the NorthMet Deposit were prepared for analysis by Transmission Electron Microscopy by additional grinding of the ore and tailings samples with mortar and pestle to produce a very fine powder. Stevenson (1978) states that the finer a material is ground, the higher the number of "fibers" identified by MDH counting rules (MDH Methods 851 and 852). According to the laboratory conducting this analysis, this only affects fiber counts, not the identification of asbestiform fibers since asbestiform fibers have high tensile strength and flexibility (Barr 2007).

Amphibole and serpentine mineral fibers are of primary interest for the NorthMet Project Proposed Action. Overall, amphibole mineral fibers were found to represent a relatively small percent of the mineral fibers associated with the processing of NorthMet Deposit ore (Flotation Pilot Testing in July and August 2005); amphibole mineral fibers were approximately 9 percent of the fibers identified from all collected samples of ore, tailings, and process water. Serpentine mineral fibers were not identified in samples of ore, tailings, or process water collected from the flotation pilot testing. However, PolyMet's petrographic observations indicate that serpentine minerals are about 2 percent of the minerals associated with the waste rock from the NorthMet Project Proposed Action.

Data provided in the 2007 Mineral Fibers Report indicates that about 95 percent of the mineral fibers identified in samples collected from the flotation pilot testing were 3 microns or smaller in size, with most being less than 2 microns in size. Therefore, $PM_{2.5}$ (fine particulate) could be used as a surrogate for all mineral fibers, including amphibole and serpentine mineral fibers.

These data suggest a low probability of asbestos fiber generation from the proposed operations. However, with the presence of amphibole minerals in the Duluth Complex and the presence, albeit low, of MN-fibers from analysis of NorthMet Deposit samples, the potential exists for the release of amphibole mineral fibers from the proposed operations, which could pose a potential public health risk of uncertain magnitude.

5.2.7.5.2 Evaluation Criteria

There are many factors that contribute to carcinogenesis and disease from exposure to asbestos and non-asbestos fibers via inhalation. The literature review prepared for the MDNR (ERM 2009) summarizes the results of many toxicological studies presenting varying conclusions as to the significance of fiber aspect ratios, fiber lengths, and cleavage fragments in the expression of human health effects. However, in the case of amphibole cleavage fragments, the literature review suggests a minor carcinogenic risk though some researchers could not exclude exposure as a contributing factor to lung cancer. In addition, the MDH is currently updating an epidemiological study of workers in Minnesota's iron mining industry. There have been 58 cases of mesothelioma documented among the 72,000 workers in the study (MDH 2008).

Based upon a scientific review study on asbestos and elongated mineral particles conducted by NIOSH, the MDH has reported that males within the area of the taconite mining and milling industry had more than two times the mesothelioma rate than the rest of the state and that females had a lower mesothelioma rate than the state average; strongly suggesting an industrial etiology. However, the findings from the epidemiological case studies have suggested that the excess of mesothelioma observed among the taconite miners may have been from exposure to commercial asbestos, rather than from the nonasbestiform amphibole elongated mineral particles generated during the iron ore processing (NIOSH 2011).

The University of Minnesota is directing a $4.9 million research effort (known as the Minnesota Taconite Workers Health Study), funded by the State of Minnesota, which will lead to a greater understanding of taconite worker health issues, including an epidemiological investigation into causes of excess cases of mesothelioma among taconite workers. The program has 5 core design studies which include: occupational exposure assessment, mortality study, incidence studies, respiratory health survey of taconite workers and spouses, and environmental study of airborne particulates (UMN 2012). ~~The research is known as the Minnesota Taconite Workers Health Study. The program has 5 core design studies which include: occupational exposure assessment, mortality study, incidence studies, respiratory health survey of taconite workers and spouses, and environmental study of airborne particulates (UMN 2012).~~ The program reports progress annually to the Minnesota State Legislature and there are reports filed for each year beginning in 2009 with the most recent in April 2013. The 2013 mortality study update reports that the risk of workers contracting mesothelioma increases by about 3% per year worked in those with more, compared to those with less, work time; however, the occupational exposure update of the same report concludes that the mine sources of amphibole elongate mineral particles are not major components of total elongate mineral particles – in other words, the worker exposure resulting in the increase in mortality is primarily due to commercial asbestos exposure and not the rock being mined (UMN 2013).

Although a risk assessment protocol for evaluating asbestos by type and dimensions has been developed for the USEPA by Berman and Crump (2003), it may never be formally adopted. This model does not consider fibers shorter than 10 µm in length. To date, there is no accepted methodology for performing a formal health risk assessment for the quantitative assessment of human health effects from airborne fibers emitted from the proposed operations.

However, amphibole minerals are present in the Duluth Complex and in close proximity to the NorthMet Deposit. Thus, there remains an uncertain level of potential health risk from airborne amphibole fibers for the NorthMet Project Proposed Action. Several measures of regulatory requirements will assist in minimizing emissions of fibers. Compliance with the requirements for blasting, found Minnesota Administrative, Chapter 6132, will minimize fugitive dust from blasting operations. Dust suppression plan for the tailings basins will be evaluated and approved by the MPCA as part of the air permit. In addition, the NorthMet Project Proposed Action will be required to comply with Federal Mine Safety and Health Administration's regulations for mining operations that include implementation of standards for asbestos exposure to minimize worker exposure.

5.2.7.5.3 NorthMet Project Proposed Action

This section describes the likelihood of exposures to airborne amphibole mineral fibers from the proposed mining and processing operations. For the NorthMet Project Proposed Action, the Band representative(s) identified potential exposure to mineral fibers as an issue for consideration in the SDEIS. MN-fibers identified in samples collected from the 2005 flotation pilot testing of material representative of processing NorthMet Deposit ore (Barr 2007d) were predominately less than 2.5 µm in aerodynamic diameter (99.6 percent less than 2.5 µm), placing them in the fine fraction of particulate matter ($PM_{2.5}$). A small fraction of these fibers were identified as amphibole (approximately 9 percent).

Although not calculated from the flotation pilot testing data (Barr 2007d), the probability of amphibole mineral fibers released from the NorthMet Project Proposed Action is not zero. Potential airborne fibers could contain asbestos fibers, which have known health effects. However, based on the samples analyzed from the NorthMet Deposit (Barr 2007d) and from other data collected by the MEQB (1979) for the Duluth Complex, the probability of amphibole asbestos being released to air is very low. Non-asbestos amphibole mineral fibers in these emissions have less well known health effects; however, these fibers are regulated as MN-fibers under the MPCA permits. These fibers have been regulated by MPCA air and water permits at the Northshore Mining Company (formerly Reserve Mining Company) operation in Silver Bay since the Reserve decision. The MPCA and the MDH have emphasized additional control of fine particles to minimize potential exposure to amphibole mineral fibers.

PolyMet's June 2007 Fibers Data Report (Barr 2007a) included an assessment of alternative control technologies for the proposed Plant Site operations. These data were taken from a BACT-like analysis for $PM_{2.5}$ for the Plant Site prepared for PolyMet (Barr 2007c). At the time that the BACT report was submitted (February 2007), PolyMet's intention was to permit the project as a PSD major source, so the Plant Site would have been subject to BACT requirements for PM_{10}.

In a September 2007, Supplemental Fibers Data Report (Barr 2007b), PolyMet incorporated project changes made in a July 2007 Supplemental Detailed Project Description (Barr 2007g) to further reduce particulate matter and fugitive dust emissions from the Plant Site and Mine Site, as well as additional changes related to particulate matter control and monitoring for amphibole MN-fibers following August 2007 discussions.

PolyMet also submitted updated control technology reviews in October 2007 (RS58A Draft-02) and in February 2012 (Barr 2012h). In the time since the previous report, PolyMet had decided to propose permitting the project as a synthetic minor source with respect to PSD regulations. This means that BACT requirements do not apply. However, PolyMet agreed to install “BACT-like” pollution control equipment in the crushing plant for fine particulate matter. The control technology report includes the determination of BACT-like controls using the top-down BACT approach.

Under the USEPA’s PSD regulations, BACT is defined at 40 CFR 52.21(b)(12) as:

> **Best available control technology** means an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under CAA that would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic effects and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques. This includes fuel cleaning or treatment or innovative fuel combustion techniques for control of such a pollutant. In no event shall application of BACT result in emissions of any pollutant that would exceed the emissions allowed by any applicable standard under 40 CFR parts 60 and 61. If the Administrator determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of BACT. Such standards would, to the degree possible, set forth the emissions reduction achievable by implementation of such design, equipment, work practice or operation, and would provide for compliance by means which achieve equivalent results.

Since MN-fibers are predominately in the $PM_{2.5}$ size range a $PM_{2.5}$ BACT-like analysis for the proposed PolyMet operations was performed in accordance with the USEPA’s “top-down” approach (USEPA 1990), where control technologies are ranked in order of effectiveness, and starting with the most stringent technology, each are evaluated until a technology cannot be ruled out on technological or economic grounds. At the time this review was conducted, $PM_{2.5}$ was not regulated under PSD and the NorthMet Project Proposed Action is not subject to PSD, so BACT does not apply. Rather, the analysis was done to determine the best control for $PM_{2.5}$ and thus for fibers.

The vast majority of potential emissions of MN-fibers for the NorthMet Project Proposed Action would occur from the ore crushing operations at the Plant Site, with minor potential emissions from the Tailings Basin and the Mine Site (Barr 2007). The Tailings Basin would be operated to minimize all fugitive particulate emissions by management to minimize exposed beach areas, and wind erosion fugitive dust by treatment of the Tailings Basin roads and inactive beach areas. The deposition of wet tailings would keep the active work area wet and prevent wind erosion. Capillary action near the pond edge is expected to keep the fines wet and minimize the potential for entrainment of the fines into the air.

The potential for the release of amphibole mineral particles to the air at the Mine Site is low because the ore would not be crushed at the Mine Site and the unpaved road surfaces would be constructed of material that is not likely to contain amphibole minerals. PolyMet's decision to use larger haul trucks at the Mine Site, as well as the incorporation of an updated mine plan into the emission calculations, has reduced the estimated fugitive particulate emissions, further reducing the potential for emissions of airborne amphibole mineral particles.

PolyMet is proposing to permit the NorthMet Project Proposed Action as a synthetic minor source with respect to PSD regulations. Therefore, a BACT determination, required under PSD, does not apply. Recent BACT determinations were reviewed and evaluated to identify the best controls currently used in the metallic ore processing industries for fine particulates (Barr 2012h). As a result, the NorthMet Project Proposed Action would install emission controls in the crushing plant, such that the emissions of fine particulate matter from the ore crushing and associated material handling sources are controlled consistent with recent BACT determinations. The controls would include the use of fabric filters (baghouse or cartridge) designed to reduce emissions to 0.0025 grams per dry standard cubic foot at each unit (Barr 2011). These controls would be applied to all emission sources within the coarse crushing operations (10 units), the drive house (2 units), the fine crushers (8 units), and the concentrator (15 units).

In addition to these controls, the NorthMet Project Proposed Action would also use high-efficiency particulate air (HEPA) filters following the fabric filters on selected units. The HEPA filters would be used when exhaust air from the fabric filters is routed back into the building to provide an added level of assurance that worker exposure to inhalable dust is minimized. In this case, the venting of exhaust air back into a building provides a benefit of reducing the heating fuel demand that offsets the additional cost and energy usage associated with re-routing of air back into a building (Barr 2012h). The combination of the cartridge and HEPA filters for fine particulates has a removal efficiency of 99.97 percent. Six units within the coarse crushing operations and nine units within the concentrator would utilize the HEPA filters year-round. Eight of the 10 units within the drive house and fine crusher operations would utilize the HEPA filters during heating season only (Barr 2011).

~~As stated earlier, due to the size of the MN fibers, $PM_{2.5}$ can be used as a surrogate in evaluating effects. The modeled $PM_{2.5}$ concentrations, presented in Section 5.2.7.4, include all other nearby sources, and demonstrate compliance with all ambient air quality standards.~~ T~~hus, t~~he use of HEPA filters, during non-essential operations, would provide little air quality benefits for reducing exposure to fine particulates outside the facility boundary. In addition, the modeled $PM_{2.5}$ effects demonstrate that the $PM_{2.5}$ concentrations, which are in the same size range as the amphibole fibers, rapidly decrease in magnitude in all directions. As such, the operational and air pollution equipment controls for the NorthMet Project Proposed Action represent the highest feasible level of fine particulate matter control and, coupled with Hoyt Lakes being 5 miles from the Plant Site, further reduce the potential for public exposure to airborne amphibole mineral fibers.

Potential project-related asbestos fibers emissions could occur from the discharge of the Mine Site WWTF during Post Closure. During the mining operation, the Mine Site WWTF for the proposed project is designed to utilize a greensand filter and no discharge of the system will occur offsite. The design of the WWTF during Post Closure is to utilize the greensand filter, prefilters, and an RO system prior to offsite discharge. The USEPA has developed drinking water standards for asbestos that drinking water utilities must comply based upon information on the EPA Website: http://water.epa.gov/drink/contaminants/basicinformation/asbestos.cfm, and the asbestos drinking water standard is 7 million fibers per liter (MCL). The EPA has provided proven methods of water treatment to meet the 7 MCL requirement, including coagulation/filtration, direct and diatomite filtration, and corrosion control. Currently, the City utilizes sand filters, coagulation and settling and have been in compliance with the asbestos standards. Colby Lake is the only lake in the area used for drinking water by the City of Hoyt Lakes. When the mine site is converted to the RO system, it will operate in the same fashion to the City's treatment system. As such, the discharge water will likely be in compliance with the federal asbestos standard.

Baseline ambient air monitoring for mineral fiber concentration is currently being done at Hoyt Lakes. The monitoring location was approved by the MPCA and the monitoring is being conducted according to MPCA methodology. Ambient air monitoring for mineral fibers would also be conducted for one year following facility start-up. The mineral fibers data collected after the facility start-up would enable MPCA ample data to compare ambient concentrations, including NorthMet Project Proposed Action emissions, with the baseline conditions.

-Page Intentionally Left Blank-