PolyMet Mining Inc.

Work Plan for a Supplemental Air Emissions Risk Analysis (AERA) for the NorthMet Mine Site

Version 2: November 14, 2011

INTRODUCTION

In January 2008 an AERA for the Mine Site [1] was submitted to the Minnesota Pollution Control Agency (MPCA) in support of the draft Environmental Impact Statement (DEIS). The Mine Site is located within an area zoned as a Mineral Mining/Industrial District that prohibits residential or farming activities. The potential incremental risks in the January 2008 AERA at the Mine Site property boundary were below guideline values. Applicable potential risks to a hypothetical resident at the boundary of the Mineral Mining/Industrial District were also below guideline values. Risk results were described in the DEIS.[2]

The project is now as described in the Draft Alternative Summary Memo (March 4, 2011) prepared by the Lead Agencies and the NorthMet Project Description Version 3 submitted by PolyMet on September 13, 2011. The changes relative to the project evaluated in the DEIS are not expected to introduce new chemicals to the process. An updated chemical list and emission inventory will be completed for the revised project and compared to the chemical list and emission estimates in the January 2008 AERA.

This document is being provided as a stand-alone document for review and it will be integrated into the NorthMet Project Air Data Package after acceptance by the Lead Agencies. Any discrepancy between this document and the NorthMet Project Air Data Package will be resolved in favor of this document.

BACKGROUND

The January 2008 Mine Site AERA included the following components:

- Estimates of air emissions from Mine Site sources, including fugitive dust (e.g., truck hauling of waste rock and ore, stockpiles, loading/unloading trucks and railcars, portable rock crushing and screening), combustion sources (e.g., truck tailpipe emissions, locomotives and space heaters) and fuel tanks
- Chemicals For Potential Evaluation (CFPE) = 52 (Table 1); Chemicals quantitatively evaluated = 32 (Table 2)

- Receptor Types Evaluated
    - Maximum Off-Site Receptor (assumed to be a worker); assumed exposure to maximum modeled air concentrations at the Mine Site Property Boundary: Potential acute (1-hr), subchronic and chronic inhalation risks were estimated at the PolyMet property boundary. For chronic risk, assumed outdoor exposure 24 hours a day, 365 days per year.
    - Potential Resident/Farmer Receptor; assumed exposure to maximum modeled air concentrations at the Mining District or Industrial Land Boundary: Continuous outdoor exposure in one location 24 hours a day, 365 days per year (MPCA's RASS incorporates exposure durations of 30 years for a resident and 40 years for a farmer).

      Note: A local mercury deposition analysis was not conduced for the Mine Site because potential mercury emissions from Mine Site sources were estimated to be less than one pound per year. Therefore, a Fisher receptor was not assessed in the January 2008 AERA for the Mine Site.

- Risk Estimation Methodology
    - Screening multi-pathway risks. AERMOD dispersion modeling; maximum modeled air concentrations input to the MPCA Risk Assessment Screening Spreadsheet (RASS).
- Incremental Risk Results (Table 3)
    - Maximum Off-Site Receptor, Mine Site Property Boundary. Estimates of potential inhalation risks (cancer, noncancer chronic, noncancer acute) were well below guideline values.
    - Resident/Farmer Receptor, at the Mining District or Industrial Land Boundary. Multipathway (inhalation + indirect) risks.
        - Cancer – Farmer Receptor. Estimated risk for a farmer receptor was 3E-05, above the incremental guideline value of 1E-05. The risk driver chemicals (individual risk 1E-06 or greater) were PAHs and dioxins/furans (2,3,7,8-TCDD equivalents).
        - Cancer – Resident Receptor. Estimated risk for a resident was 7E-07, below the guideline value of 1E-05.
        - Noncancer chronic. Estimated risks were well below the guideline value of 1.0. No chemicals were identified as risk drivers (all individual chemical risk < 0.1) (Appendix A, January 2008 AERA for the Mine Site).

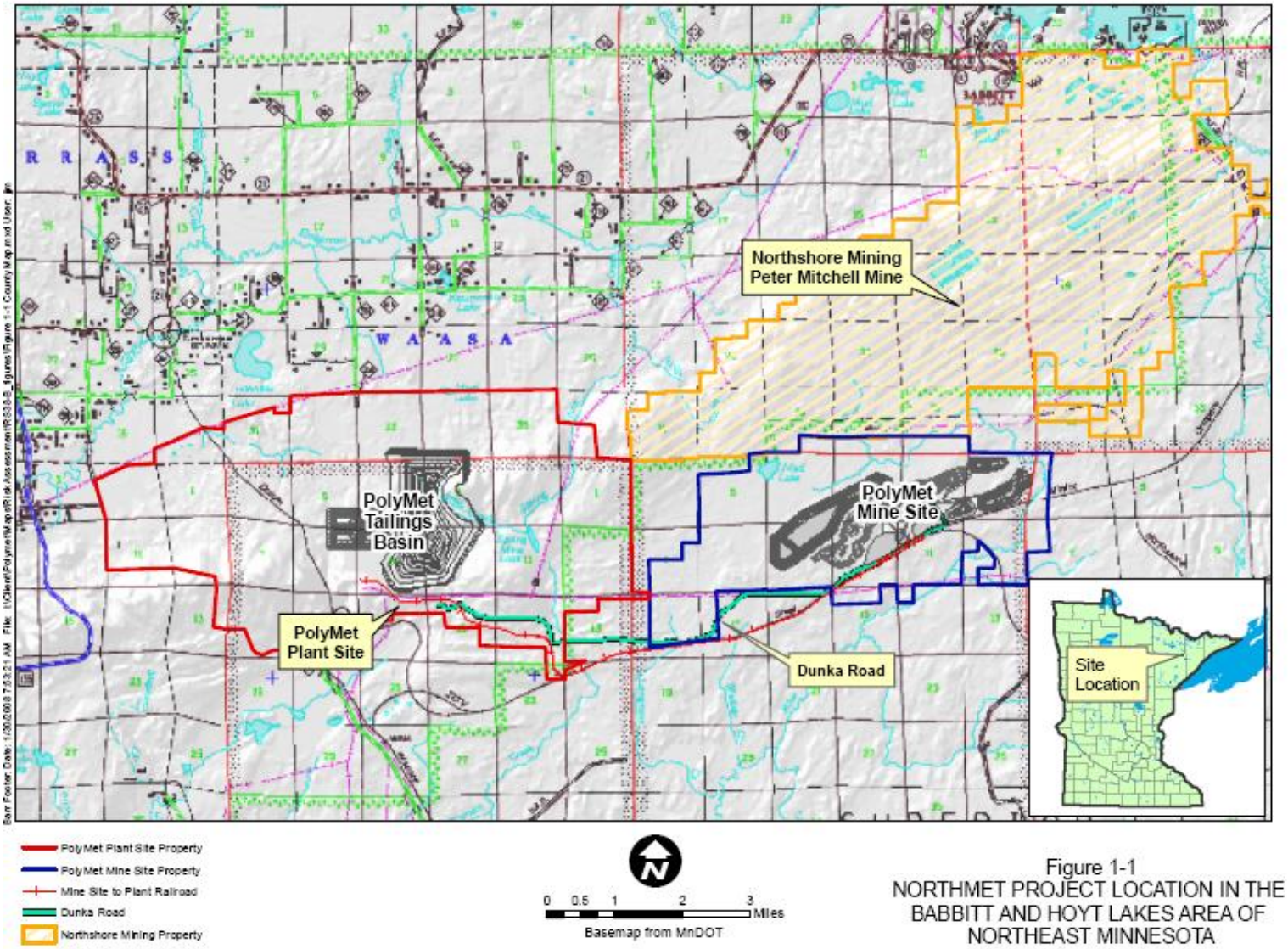

Figure 1: Location of the NorthMet Mine Site in Relation to the Plant Site and Nearby Existing Mining Operations
(from: January 2008 Mine Site AERA)

Table 1
Chemicals Identified as Potentially Emitted from the Mine Site for the January 2008 AERA
(Chemicals for Potential Evaluation; CFPE)
(from Table 2-1, January 2008 Mine Site AERA)

Table 1 **Chemical Name**	**CAS No.**	**Mine Site Total Potential Emissions (Year 8) [1]**		**Mine Site Total Potential Emissions (Year 16) [1]**		**NOTES**
		(lb/hr)	**(tons/yr)**	**(lb/hr)**	**(tons/yr)**	
1,3 Butadiene	106-99-0	0.0026	0.0113	0.0026	0.0113	HAP
2-Methylnaphthalene	91-57-6	0.0006	0.0025	0.0006	0.0025	
Acenaphthene	83-32-9	2.72E-04	0.0012	2.72E-04	0.0012	[2]
Acenaphtylene	203-96-8	0.0008	0.0036	0.0008	0.0036	[2]
Acetaldehyde	75-07-0	0.0156	0.0681	0.0156	0.0681	HAP
Acrolein	107-02-8	0.0023	0.0102	0.0023	0.0102	HAP
Anthracene	120-12-7	1.55E-04	0.0007	1.55E-04	0.0007	[2]
Antimony compounds	7440-36-0	0.0040	0.0102	0.0040	0.0101	HAP
Arsenic compounds	7440-38-2	0.0060	0.0167	0.0060	0.0164	HAP
Barium compounds	7440-39-3	0.0726	0.1862	0.0719	0.1805	
Benzene	71-43-2	0.0479	0.2071	0.0479	0.2071	HAP
Benzo(a)anthracene	56-55-3	6.40E-05	2.78E-04	6.40E-05	2.78E-04	[2]
Benzo(a)pyrene	50-32-8	1.63E-05	7.07E-05	1.63E-05	7.07E-05	[2]
Benzo(e)pyrene	192-97-2	3.25E-06	1.43E-05	3.25E-06	1.43E-05	[2]
Benzo(b)fluoranthene	205-99-2	5.85E-05	2.53E-04	5.85E-05	2.53E-04	[2]
Benzo(g,h,i)perylene	191-24-2	3.46E-05	1.50E-04	3.46E-05	1.50E-04	[2]
Benzo(k)fluoranthene	205-82-3	1.52E-05	6.60E-05	1.52E-05	6.60E-05	[2]
Beryllium compounds	7440-41-7	0.0009	0.0023	0.0009	0.0023	HAP
Boron compounds	7440-42-8	0.0857	0.2041	0.0876	0.2092	
Cadmium compounds	7440-43-9	0.0030	0.0078	0.0030	0.0080	HAP
Chromium compounds (as chromium III)	7440-47-3	0.1146	0.2949	0.1152	0.2932	HAP
Chrysene	218-01-9	8.45E-05	0.0004	8.45E-05	0.0004	[2]
Cobalt compounds	7440-48-4	0.0496	0.1292	0.0497	0.1275	HAP
Copper compounds	7440-50-8	0.3680	1.0932	0.3840	1.1527	
Dibenz(a,h)anthracene	53-70-3	2.18E-05	9.43E-05	2.18E-05	9.43E-05	[2]
Fluoranthene	206-44-0	3.17E-04	0.0014	3.17E-04	0.0014	[2]
Fluorene	86-73-7	0.0010	0.0043	0.0010	0.0043	[2]
Fluorides (as F)	N/A	0.0588	0.1564	0.0588	0.1544	
Formaldehyde	50-00-0	0.0349	0.1522	0.0349	0.1522	HAP
Hafnium	7440-58-6	4.28E-05	1.87E-04	4.33E-05	1.90E-04	
Indeno(1,2,3-cd)pyrene	193-39-5	2.56E-05	1.11E-04	2.56E-05	1.11E-04	[2]
Lead compounds	7439-92-1	0.0776	0.1859	0.0794	0.1908	HAP
Manganese compounds	7439-96-5	1.2153	3.1822	1.2386	3.2406	HAP
Mercury compounds	7439-97-6	7.35E-05	3.18E-04	7.34E-05	3.18E-04	HAP
Methane (CH4)	74-82-8	0.0181	0.0795	0.0181	0.0795	
Molybdenum compounds	7439-98-7	0.0021	0.0054	0.0021	0.0053	
Naphthalene	91-20-3	0.0092	0.0397	0.0092	0.0397	HAP

Table 1 **Chemical Name**	**CAS No.**	**Mine Site Total Potential Emissions (Year 8) [1]**		**Mine Site Total Potential Emissions (Year 16) [1]**		**NOTES**
		(lb/hr)	**(tons/yr)**	**(lb/hr)**	**(tons/yr)**	
Nickel compounds	7440-02-0	0.2522	0.6862	0.2522	0.6775	HAP
Nitrous Oxide (N_2O)	10102-44-0	4.0681	17.5989	4.0681	17.5989	
Oxides of Nitrogen (NOx) (as NO_2)	N/A	30.3425	611.2	30.3425	611.2	
Phosphorus compounds	7723-14-0	0.0532	0.2330	0.0413	0.1810	HAP
Phenanthrene	85-01-8	0.0028	0.0119	0.0028	0.0119	[2]
Propylene	115-07-1	0.1584	0.6841	0.1584	0.6841	
Pyrene	129-00-0	3.25E-04	0.0014	3.25E-04	0.0014	[2]
Selenium compounds	7782-49-2	0.0096	0.0273	0.0096	0.0270	HAP
Sulfuric Acid Mist (as a mixture, with SO_3)	7664-93-9	0.0075	0.0325	0.0075	0.0325	
Tellurium	13494-80-9	0.0212	0.0555	0.0212	0.0548	
2,3,7,8-TCDD equivalents	N/A	5.46E-09	2.36E-08	5.46E-09	2.36E-08	HAP [3]
Toluene	108-88-3	0.0172	0.0743	0.0172	0.0743	HAP
Vanadium compounds	7440-62-2	0.0459	0.1194	0.0458	0.1170	
Xylenes	1330-20-7	0.0118	0.0512	0.0118	0.0512	HAP
Zinc compounds	7440-66-6	0.6094	1.4567	0.6236	1.4939	
# of CFPE	52					
Total CFPE Emissions		37.8	638.3	37.8	638.4	

HAP = Hazardous air pollutant as defined by Section 112 of the 1990 Clean Air Act Amendments.

[1] Additional details on the emission estimates are provided in Stationary Point and Fugitive Source Emission Calculations for the NorthMet Project Mine Site (October 2007) and reformatted spreadsheet (December 2007). [3]

[2] Polycyclic organic matter (POM) is identified as a HAP by the 1990 Clean Air Act Amendments. Polycyclic aromatic hydrocarbons (PAHs) are a subset of POM. The individual PAH compounds are not identified as a HAP for this AERA.

[3] Emissions of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans were calculated as 2,3,7,8-TCDD equivalents based on published emission factors (factors calculated in Toxicity Equivalency Quotients, TEQs) and reflect the TEQ methodology used by the individual researchers at that time. No adjustment to the TEQ-based emission factor was made for this analysis.

Table 2
Chemicals Quantitatively Evaluated for Potential Incremental Human Health Risks
in the January 2008 Mine Site AERA
(Chemicals for Evaluation, CFE)
(From Table 2-2, January 2008 Mine Site AERA)

Chemical [1]	CAS #	Total Mine Site Emissions (Year 8) (lb/hr)	Total Mine Site Emissions (Year 8) (tons/yr)	Total Mine Site Emissions (Year 16) (lb/hr)	Total Mine Site Emissions (Year 16) (tons/yr)
1,3-Butadiene	106-99-0	0.0026	0.0113	0.0026	0.0113
Acetaldehyde	75-07-0	0.0156	0.0681	0.0156	0.0681
Acrolein	107-02-8	0.0023	0.0102	0.0023	0.0102
Antimony compounds	7440-36-0	0.0040	0.0102	0.0040	0.0101
Arsenic compounds	7440-38-2	0.0060	0.0167	0.0060	0.0164
Barium compounds	7440-39-3	0.0726	0.1862	0.0719	0.1805
Benzene	71-43-2	0.0479	0.2071	0.0479	0.2071
Benz(a)anthracene	56-55-3	6.40E-05	2.78E-04	6.40E-05	2.78E-04
Benzo(a)pyrene	50-32-8	1.63E-05	7.07E-05	1.63E-05	7.07E-05
Benzo(b)fluoranthene	205-99-2	5.85E-05	2.53E-04	5.85E-05	2.53E-04
Benzo(k)fluoranthene	205-82-3	1.52E-05	6.60E-05	1.52E-05	6.60E-05
Beryllium compounds	7440-41-7	0.0009	0.0023	0.0009	0.0023
Boron compounds	7440-42-8	0.0857	0.2041	0.0876	0.2092
Cadmium compounds	7440-43-9	0.0030	0.0078	0.0030	0.0080
Chrysene	218-01-9	8.45E-05	0.0004	8.45E-05	0.0004
Copper compounds	7440-50-8	0.3680	1.0932	0.3840	1.1527
Dibenzo(a,h)anthracene	53-70-3	2.18E-05	9.43E-05	2.18E-05	9.43E-05
Formaldehyde	50-00-0	0.0349	0.1522	0.0349	0.1522
Indeno(1,2,3-cd)pyrene	193-39-5	2.56E-05	0.0001	2.56E-05	1.11E-04
Lead compounds	7439-92-1	0.0776	0.1859	0.0794	0.1908
Manganese compounds	7439-96-5	1.2153	3.1822	1.2386	3.2406
Mercury compounds	7439-97-6	7.35E-05	3.18E-04	7.34E-05	3.18E-04
Naphthalene	91-20-3	0.0092	0.0397	0.0092	0.0397
Nickel compounds	7440-02-0	0.2522	0.6862	0.2522	0.6775
Oxides of Nitrogen (NOx) as NO_2	NA	30.3425	611.2	30.3425	611.2
Propylene	115-07-1	0.1584	0.6841	0.1584	0.6841
Selenium compounds	7782-49-2	0.0096	0.0273	0.0096	0.0270
Sulfuric Acid Mist (mixture with SO_3)	7664-93-9	0.0075	0.0325	0.0075	0.0325
PCDD/PCDF (TEQ basis) [2]	NA	5.46E-09	2.36E-08	5.46E-09	2.36E-08
Toluene	108-88-3	0.0172	0.0743	0.0172	0.0743
Vanadium (as vanadium oxide)	7440-62-2	0.0459	0.1194	0.0458	0.1170
Xylene (mixed isomers)	1330-20-7	0.0118	0.0512	0.0118	0.0512
Number of CFE	32				
CFE Emissions		32.8	618.2	32.8	618.3

[1] Worst case Mine Site emissions were identified to occur in Year 8 and in Year 16. Quantitative risks were estimated for both the Year 8 and the Year 16 emission scenario. Additional details on the emission estimates provided in Reference [3]: Stationary Point and Fugitive Source Emission Calculations for the NorthMet Project Mine Site (October 2007) and reformatted spreadsheet (December 2007).

[2] PCDD/PCDF (TEQ, I-TEQ basis) is the same as 2,3,7,8-TCDD equivalents presented in Table 2-1.

Table 3
Estimated Potential Incremental Human Health Risks from the January 2008 Mine Site AERA
(Adapted from Table 3-3, January 2008 Mine Site AERA)

Risk Category	PolyMet Mine Site Ownership Boundary (Year 8)	Mineral Mining/ Industrial District Boundary (Year 8)	PolyMet Mine Site Ownership Boundary (Year 16)	Mineral Mining/ Industrial District Boundary (Year 16)
	Potential Off-Site Receptor (MEI) [1]	Potential Resident/Farmer (MEI) [1]	Potential Off-Site Receptor {MEI) [1]	Potential Resident/Farmer (MEI) [1]
Cancer **[2]**				
Inhalation	3E-06	6E-07	4E-06	6E-07
Indirect Pathway – Farmer	N/A	3E-05	N/A	2E-05
Indirect Pathway – Resident	N/A	8E-08	N/A	7E-08
Total Multipathway – Farmer	N/A	3E-05	N/A	2E-05
Total Multipathway – Resident	N/A	7E-07	N/A	6E-07
Non-cancer Chronic **[3]**				
Inhalation	0.2	0.04	0.3	0.04
Indirect Pathway – Farmer	N/A	0.00007	N/A	0.00007
Indirect Pathway – Resident	N/A	N/A [\5]	N/A	N/A [5]
Total Multipathway – Farmer	N/A	0.04	N/A	0.04
Total Multipathway – Resident	N/A	0.04	N/A	0.04
Non-cancer subchronic **[3]**	0.003	N/A	0.003	N/A
Non-cancer Acute **[3], [4]**	0.2	N/A	0.1	N/A

MEI = Maximum Exposed Individual (potential exposure to the maximum modeled air concentration at a receptor location)
RASS = Risk Assessment Screening Spreadsheet
N/A = not applicable and not assessed
HQ = hazard quotient

[1] PolyMet's land holdings at the Mine Site are within an area zoned as Mineral Mining by the City of Babbitt or Industrial by St. Louis County. This zoning prohibits residential or farming development on the lands immediately adjacent to the PolyMet ownership boundary. Therefore, only potential inhalation risks to a potential off-site receptor (Maximum Exposed Individual) were estimated at PolyMet's ownership boundary and resident and farmer multipathway risks were not calculated. Potential multipathway risks for a potential resident and farmer receptor were calculated for areas approximately one kilometer to the southeast of the Mine Site ownership boundary, outside the Mineral Mining/Industrial District boundary. Risks were calculated based on estimated potential to emit emissions and mine layout for Year 8 of Mine Site operations, and for Year 16, respectively.

[2] Incremental cancer risk guideline value is 1E-05, Minnesota Department of Health (MDH)

[3] Incremental non-cancer (chronic, subchronic and acute) guideline value is 1.0, MDH.

[4] The USEPA factor of 75% is applied to the maximum modeled one-hour NO_x air concentration as a conservative estimate of the conversion of NO to NO_2.

[5] Multi-media factors not available for the Chemicals of Potential Interest; risks not estimated for a Resident receptor in MPCA's Risk Assessment Spreadsheet (RASS), version 20090704 used to estimate potential risks for the January 2008 Mine Site AERA.

SCOPE OF WORK (proposed) – Supplemental Air Emissions Risk Analysis, Mine Site

I PROJECT ONLY ASSESSMENT

Objective

Conduct a supplemental risk evaluation to the January 2008 AERA that incorporates the changes to the Mine Site operations and provides revised risk estimates for use in the Supplemental DEIS.

Chemicals to be Included in the Quantitative Analysis

Evaluate risks associated with the following chemicals:

- Risk driver chemicals from the January 2008 Mine Site AERA (Appendix A) (Table 4)
    - A "risk driver chemical" is a chemical with an individual cancer risk of 1E-06 or greater or an individual noncancer risk (hazard quotient) of 0.1 or greater.
        - Incremental cancer risk of 1E-06 or greater: nickel, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, dioxins/furans as 2,3,7,8-TCDD equivalents.
        - Incremental noncancer risk of 0.1 or greater: manganese, nickel, NO_2
- Chemicals not evaluated in the January 2008 Mine Site AERA because no toxicity values were available, but now have toxicity values available (Table 4) and may be associated with diesel fuel combustion or waste rock or ore handling: diesel particulate, crystalline silica

Table 4
Chemicals to be Evaluated in the Supplemental AERA for the Mine Site

Chemical	Reason Included	Update Assessment for:		
		Cancer	Noncancer Chronic	Noncancer Acute
Diesel Particulate	Toxicity Value Now Available	N/a	X	N/a
Dioxins/furans (diesel fuel combustion)	Risk Driver January 2008 AERA	X	N/a	N/a
Manganese	Risk Driver January 2008 AERA	N/a	X	N/a
Nickel compounds	Risk Driver January 2008 AERA	X	X	X
Nitrogen oxides (NOx) (as NO_2)	Risk Driver January 2008 AERA	N/a	N/a	X
PAHs (diesel fuel combustion)				
Dibenzo(a,h)anthracene	Risk Driver January 2008 AERA	X	N/a	N/a
Indeno(1,2,3-cd)pyrene	Risk Driver January 2008 AERA	X	N/a	N/a
Silica, crystalline (silicon dioxide)	Toxicity Value Now Available	N/a	X	N/a

N/a = risk category not applicable; toxicity value not available.

Receptor Types and Assumed Exposure

Two receptor types will be evaluated (same as in the January 2008 AERA).

- Maximum Off-Site Receptor. Assumed exposure to the maximum modeled air concentration for the one hour and annual averaging time periods at the Mine Site property boundary.
    - Acute (one-hour) inhalation risks
    - Chronic inhalation risks (outdoors for 24 hours/day, 365 days per year) (MPCA AERA guidance indicates exposure duration in the RASS for inhalation risk is for 70 years).
- Potential Resident/Farmer Exposure. Assumed exposure to the maximum modeled air concentration for the one hour and annual averaging time periods at the Mineral Mining/ Industrial District boundary.
    - Acute (one-hour) inhalation risks
    - Chronic multi-pathway risks (outdoors in one location for 24 hours per day, 365 days per year; AERA guidance assumes 35 years for a resident, 40 years for a farmer, 70 years for inhalation risk)

Estimated Emissions and Sources

Emission estimates for Mine Site sources, including fugitive dust (from haul roads, loading/unloading of waste rock and ore, crushing and screening of construction rock) and diesel combustion emissions (from haul trucks and locomotives), will be updated to reflect any changes in operations. Estimates of potential emissions for toxic air pollutants will be based on the approach used to estimate criteria pollutant air emissions for use in Class II modeling.

Revised emissions of toxic air pollutants will be compared to emission estimates evaluated in the January 2008 AERA. The percent change in emissions will be used to assess whether other chemicals evaluated in the January 2008 AERA should be evaluated as potential risk driver chemicals in the Supplemental AERA. Changes in emissions will be assessed for significance by a screening calculation.

Revised Incremental Risk = January 2008 risk + January 2008 risk x % change in emissions

If the revised potential incremental cancer risk for a chemical is 1E-06 or greater, or the revised noncancer risk is 0.1 or greater, then that chemical will be added to the list of chemicals to be evaluated in the Supplemental risk analysis.

Emission sources that have the potential to emit the risk driver chemicals will be modeled. The Supplemental AERA will assess potential emissions from the Mine Site under typical operating scenarios. For example, upset conditions or breakdown/malfunction emission scenarios will not be evaluated.

Some minor sources of emissions that are expected to be operated infrequently are proposed to be excluded from modeling.

- *Emergency diesel generator* – An emergency diesel generator will be located in the wastewater treatment facility (WWTF; EU 332) and will be used at the Mine Site to provide backup in case of a power failure. The major pollutant to be emitted from this generator is NO_X. Some particulate metals may also be emitted. Due to the infrequent use and relatively short operating time potential emissions from these diesel generators are expected to be small and they will not be modeled in the AERA.
- *Mobile diesel generator* (EU 344) – A mobile diesel generator will provide temporary power to large excavators and drill rigs used in the mine pits. These large excavators and drill rigs will be electric powered for their primary operation, but will need a temporary power supply in order to move from one location to another. This generator is only sized to provide power for locomotion to the equipment, not to operate it for its primary function (drilling or loading haul trucks). It will be operated infrequently, and when it is operated, one of the large pieces of electrical mining equipment will be out of service, effectively limiting emissions from normal mining activities. Given the low utilization of the generator and the circumstances under which it is operated, emissions from this source will not be modeled for the AERA.
- *Diesel fuel tanks* – Diesel fuel tanks can potentially emit VOCs. Due to the very small potential VOC emissions likely associated with these tanks they will not be modeled in the AERA.

Potential emissions from these minor sources will be included in the emission inventory. MPCA's AERA guidance allows emissions to be eliminated from quantitative analysis if they are less than 1% of total emissions on a pollutant by pollutant basis. Therefore, estimated emissions for the risk driver chemicals for these and all other individual sources will be compared to the MPCA's 1% threshold. If emissions for a risk driver chemical for a specific source exceed the 1% threshold, that source and the risk driver emissions will be included in the quantitative risk analysis.

Non-risk driver chemicals will be discussed qualitatively as needed in the AERA. The chemicals that are currently expected to be discussed qualitatively include iron, which will be included in the updated AERA report for the Mine Site.

Toxicity Values

The toxicity values in the MPCA's current version of the RASS, as of April 2011 (expected to be the same version of the RASS to be used for the Supplemental AERA for the Plant Site) will be used to estimate potential human health risks for the Supplemental AERA for the Mine Site.

For chemicals evaluated quantitatively in the January 2008 AERA, but are not listed in Table 4 of this Work Plan, chemical toxicity values used in the January 2008 AERA will be compared to current values. Changes in chemical toxicity values will be assessed for significance by a screening calculation.

Revised Risk = January 2008 risk + January 2008 risk x % change in toxicity value

If the revised potential incremental cancer risk for a chemical is 1E-06 or greater, or the revised noncancer risk is 0.1 or greater, then that chemical will be added to the list of chemicals to be evaluated in the Supplemental risk analysis.

In the case that a chemical has a change in emission rate and a change in toxicity value, the following screening calculation will be used to determine if the combined changes are significant enough to warrant further evaluation in this Supplemental AERA.

Revised Risk =Jan 2008 risk + Jan 2008 risk x %change in emissions x %change in toxicity value

If the revised potential incremental cancer risk for a chemical is 1E-06 or greater, or the revised noncancer risk is 0.1 or greater, then that chemical will be added to the list of chemicals to be evaluated in the Supplemental AERA.

Air Dispersion Modeling and Estimating Potential Incremental Human Health Risks

Any updates to building dimensions, stack dimensions, road locations, etc. for the project will be used in the modeling. The modeling for the AERA will follow closely with the Class II modeling and will use the Class II receptor grid and meteorological data. The most recent version of the AERMOD model will be used to estimate one-hour and annual air concentrations. Surface meteorological data from Hibbing,

MN (2006-2010) and concurrent mixing height data from International Falls will be used. The same procedures for modeling fugitive sources will be used for the AERA as for the Mine Site criteria pollutant modeling.

Maximum modeled air concentrations will be identified for each receptor and exposure time/duration. The modeled air concentrations will be input to the most recent version of the MPCA's Risk Assessment Screening Spreadsheet ("Concs" tab) and potential incremental risks estimated. The risk estimates will be compared to the MPCA risk management thresholds. If any risk category exceeds the risk management thresholds, appropriate refinements will be considered according to MPCA AERA guidance.

Local Mercury Deposition Analysis (not applicable)

A local mercury deposition analysis is excluded from the Mine Site AERA. Potential mercury emissions from the Mine Site are less than one pound per year, based on previously approved emission estimates (Table 2) and current draft emission calculations. Revisions to emission calculations are being discussed with MPCA staff. If revised estimates of potential mercury emissions are greater than one pound per year at the Mine Site as a result in the final updated emission inventory, mercury modeling will be reconsidered.

II CUMULATIVE INHALATION RISK EVALUATION

The MPCA has requested a cumulative inhalation risk assessment be performed as part of the Supplemental AERA. MPCA guidance [4] indicates that the cumulative analysis should focus on the location of the most impacted residential location from the proposed project. When reasonably foreseeable land use is considered, the nearest potential locations for a resident receptor are approximately 0.6 miles (1.0 kilometers) to the southeast of the Mine Site property boundary and 1.25 miles (2 kilometers) northwest of the Mine Site property boundary, respectively, at the Mineral Mining/Industrial District boundary (Figure 2 – see key for zoning district designations; Mineral Mining/Industrial Districts are pink, beige or salmon colored).

Two cities are located near the proposed Mine Site: Babbitt, approximately 6 miles (10 kilometers) north, and Hoyt Lakes, approximately 9 miles (16 kilometers) southwest. Estimates of potential cumulative risks for a receptor in either city will be lower than that estimated for the potential resident locations relatively close to the Mine Site property boundary. Therefore, cumulative risks estimated for the two potential resident receptor locations near the Mine Site will serve as surrogate estimates of potential risk to a resident of either Babbitt or Hoyt Lakes.

Other proposed or recently completed projects in the vicinity of the Mine Site include the following: NorthMet Plant Site, Mesabi Mining (formerly Mesabi Nugget Phase II), Mesabi Nugget Large Scale Demonstration Plant (environmental review and permitting completed), and the Cliffs Erie Pellet Yard (environmental review and permitting completed). Table 5 indicates that in most cases, these other projects are typically more than 10 km from the potential resident locations of interest near the Mine Site. At the larger distances, potential contributions of air emissions to the resident locations of interest are not likely to be significant. Additional discussion is provided for each project.

- NorthMet Plant Site. The Plant Site is located approximately 8 miles to the west of the Mine Site. The ambient air boundaries for the Mine Site and the Plant Site are adjacent, but the emission generating activities and the maximum modeled air concentrations are relatively far apart. The Supplemental AERA for the Plant Site [5] will provide updated modeled air concentrations on the Class II receptor grid. That receptor grid will overlap with the dispersion modeling receptor grid to be used for the Mine Site AERA. The modeled air concentrations and estimates of potential risk from the Supplemental AERA for the Plant Site will be used in assessing potential cumulative inhalation risks for the potential resident receptor locations near the Mine Site.

- The August 2009 AERA for the Mesabi Mining Project [6] included the proposed mining and crushing/concentrating of taconite ore and the recently built Mesabi Nugget Large Scale Demonstration Plan (LSDP). Modeling results from the Mesabi Mining Project were submitted to the MPCA and are considered to be publicly available. The modeling results (air concentrations; estimated inhalation risks) for receptor nodes nearest to the potential resident locations identified at the Mine Site (Figure 2) will be used in this cumulative evaluation.
- Cliffs Erie Pellet Yard. The construction permit for Cliffs Erie Pellet Yard has expired and emission related activities are restricted to currently permitted activities. Based on a review of the emission inventory for the facility, future activities will be limited to the storage and reclamation of previously mined and/or produced pellets, wasterock and tailings. The facility will not have the ability to unload railcars or process rock, ore or other material. Therefore, emissions will be limited to fugitive dust from truck loading and unloading, railcar loading (with a front end loader or similar), traffic on unpaved roads and similar activities. The Cliffs Erie Pellet Yard is not expected to be a significant source of emissions. Therefore, it is excluded from the cumulative inhalation risk evaluation at this time. If criteria pollutant modeling shows the Cliffs Erie Pellet Yard as a potentially significant contributor to impacts at the Mine Site, then it will be reconsidered for inclusion in the cumulative risk evaluation.

Projects more than 25 kilometers from the Mine Site, such as the Keetac Expansion Project, the Essar Steel Project and the Mesaba Energy Project (West Range site) near Keewatin and Nashwauk on the west end of the Iron Range, are not expected to be significant contributors to air concentrations in the Babbitt or Hoyt Lakes area. The risk report will reiterate this information.

Another emission source from the Hoyt Lakes area to be included in the cumulative analysis is Minnesota Power's Syl Laskin power plant. Facility emissions of selected air toxic pollutants (e.g., HCl, HF, PAHs, dioxins/furans) and NO_X (assessed as NO_2) were modeled for the cumulative inhalation risk analysis conducted for the Mesabi Mining Project.[6] Those modeling results were submitted to the MPCA and can be obtained from that agency. Of the air pollutants assessed for the Syl Laskin facility, only the estimated NO_X emissions (assessed as NO_2) were found to have estimated risks greater than the MPCA's significant threshold of 0.1 for noncancer risks; a maximum estimated noncancer acute inhalation risk of 0.12 for a hypothetical resident receptor at the former LTV Steel Mining Company ambient air boundary near mine area 2WX. [6] Therefore, only potential NO_2 air concentrations and inhalation risks from the Syl Laskin facility are proposed to be included in the cumulative analysis for the Supplemental AERA for the Mine Site.

Chemicals of interest for the cumulative inhalation evaluation are presented in Table 6 and primarily represent the risk driver chemicals from the NorthMet Project (Mine Site and Plant Site) and the Mesabi Mining Project. Table 6 provides a summary of the chemicals for each project or existing facility to be included in the cumulative inhalation risk evaluation.

Table 5
Estimated Distances of Potential Residential Receptors near the Proposed Mine Site to Projects and Operating Facilities in the Babbitt and Hoyt Lakes Areas

Potential Residential Receptor Location	Distance To:	Distance (approximate; (miles)	Distance (approximate; kilometers)
North/Northwest of the Mine Site [1]	Mine Site, nearest operations or pit	3	5
	Plant Site Operations	6	10
	Mesabi Nugget LSDP	8	13
	Mesabi Mining (crushing area)	7	13
	Mesabi Mining (mine area 2WX) [2]	9	16
	Laskin Energy Center	10	17
Babbitt (north of the Mine Site)	Mine Site, nearest operations or pit	5	9
	Plant Site	12	19
	Mesabi Nugget LSDP	14	23
	Mesabi Mining (crushing area)	13	22
	Mesabi Mining (mine area 2WX) [2]	15	26
	Laskin Energy Center	16	26
Southeast of the Mine Site [1]	Mine Site, nearest operations or pit	2	4
	Plant Site	10	17
	Mesabi Nugget LSDP	13	22
	Mesabi Mining (crushing area)	11	18
	Mesabi Mining (area 2WX)	12	20
	Laskin Energy Center	12	21

[1] The potential resident location to the north/northwest of the Mine Site and to the southeast of the Mine Site, respectively, are at the Mineral Mining/Industrial Land Boundary (see Figure 2 of this Work Plan).

[2] Mine Area 2WX is on the southeast portion of the Mesabi Mining Project area, just north of Colby Lake and just northwest of the town of Hoyt Lakes.

LSDP = Large Scale Demonstration Plant

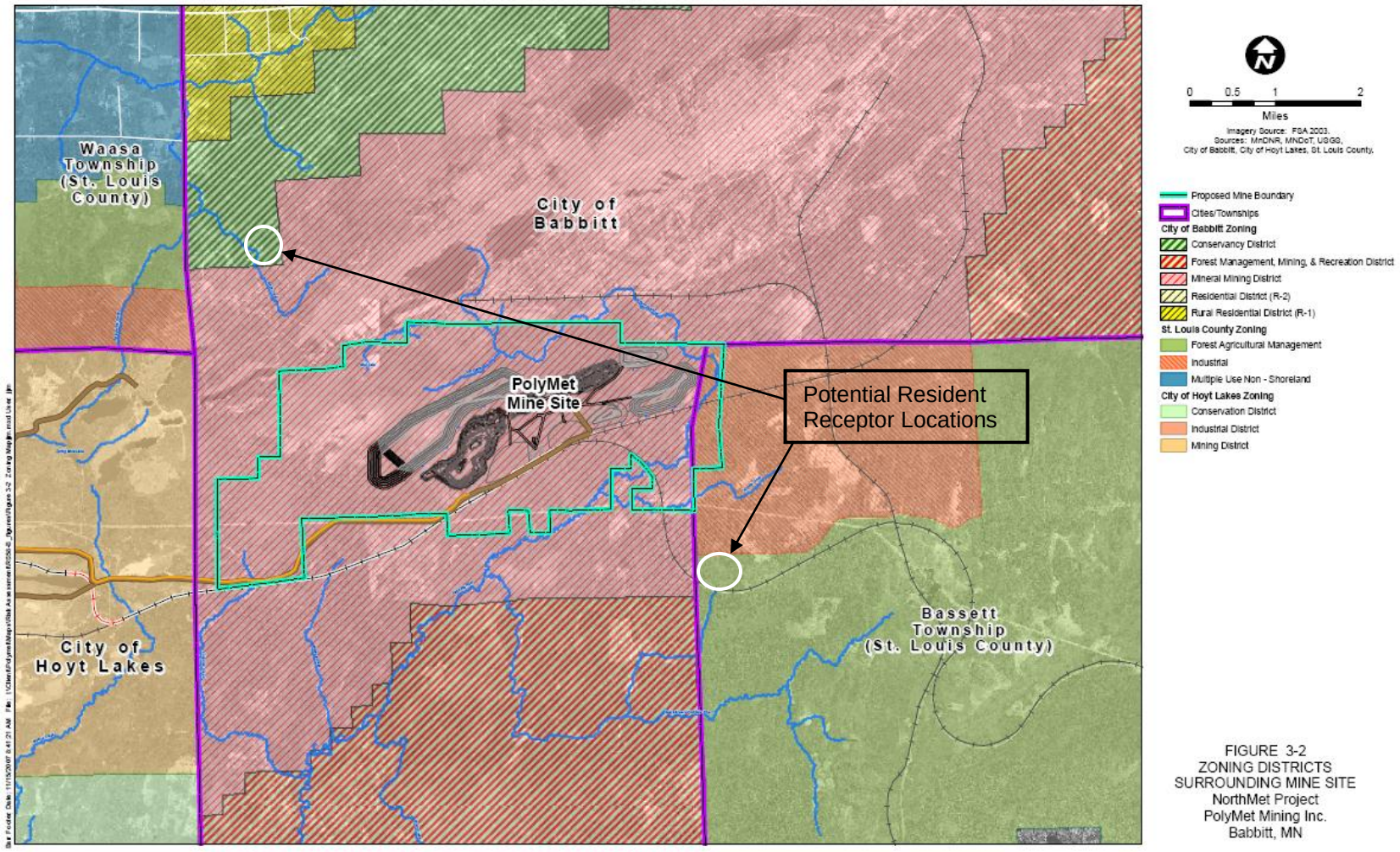

Figure 2. Location of the Mine Site in relation to the Mineral Mining/Industrial District Boundary and Potential Locations for a Resident Receptor

[Adapted from Figure 3-2 from the January 2008 Mine Site AERA]

Table 6
Risk Driver Chemicals to be Assessed in the Cumulative Inhalation Risk Evaluation to be Conducted for the Mine Site Supplemental AERA

("X" denotes the inhalation risk category to be evaluated)

Risk Driver Chemical (Inhalation) [1]	Project / Facility [2]	Cancer	Noncancer Chronic	Noncancer Acute
Arsenic compounds	Plant Site (tailings basin)	**X**	**X**	**X**
Diesel particulate	Mine Site Plant Site	**N/a**	**X**	**N/a**
Dioxins/furans	Mine Site Plant Site	**X**	**N/a**	**N/a**
Manganese compounds	Mine Site Plant Site Mesabi Mining	**N/a**	**X**	**N/a**
Nickel compounds	Mine Site Plant Site	**X**	**X**	**X**
NO_2	Mine Site Plant Site Mesabi Mining Syl Laskin Energy Center **[3]**	**N/a**	**N/a**	**X**
PAHs **[4]**	Mine Site	**X**	**N/a**	**N/a**
Silica, crystalline **[5]**	Mine Site Plant Site Mesabi Mining	**N/a**	**X**	**N/a**

N/a = toxicity value not available; risk category not applicable

[1] Risk driver chemical identified as a chemical having incremental cancer risk of 1E-06 or greater or incremental noncancer risk of 0.1 or greater.

[2] Other Projects / Facilities proposed for inclusion in the cumulative human health risk evaluation for the Mine Site:
a. Mesabi Mining (formerly the Mesabi Nugget Phase II project); The August 2009 AERA included emissions from the proposed mining and the Mesabi Nugget Large Scale Demonstration Plant (LSDP).
b. NorthMet Plant Site (updated AERA, 2011)
c. Minnesota Power, Syl Laskin Energy Center

[3] The Syl Laskin Energy Center was included in the air dispersion modeling and risk results for the cumulative inhalation evaluation conducted for the Mesabi Nugget Phase II Project; August 2009 Air Emissions Risk Analysis for the Post-Project Total Facility (LSDP Project + Mining). Emissions modeled for the Syl Laskin facility were NO_2, HCl, HF, PAHs and dioxins/furans. Maximum modeled air concentrations were input to the MPCA's RASS and only NO_2 was identified as a risk driver chemical for the Syl Laskin facility. NO_2 is the only chemical proposed to be evaluated from the Syl Laskin Energy Center as part of the cumulative analysis to be conducted for the Mine Site AERA.

[4] PAHs to be evaluated: dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene

[5] Crystalline silica to be assessed as part of the respective Supplemental Mine Site AERA and the Supplemental Plant Site AREA for the NorthMet Project. In addition, previously modeled air concentrations and estimated risks from the Mesabi Mining Project at the potential resident locations near the NorthMet Mine Site will be used in the cumulative analysis.

Table 7
Proposed Format for Estimating Potential Cumulative Inhalation Risks
for the Supplemental AERA to be Conducted for the Mine Site

Estimated Potential Risk	Cancer	Noncancer Chronic	Noncancer Acute
Background			
Ambient air monitoring (calculated by MPCA)			
Minnesota Power, Syl Laskin Energy Center (NO_2)			
Incremental			
Mine Site			
Plant Site			
Mesabi Mining Project (includes the LSDP)			
Total			

LSDP = Mesabi Nugget, Large Scale Demonstration Project

Reporting

A standard report will be prepared for the supplemental AERA that appropriately references to the January 2008 Mine Site AERA. Uncertainty in the risk analysis will be discussed, per MPCA (2007) guidance.

The cumulative inhalation risk results will be included as a separate section within the Supplemental Mine Site AERA report.

References

1. PolyMet Mining, 2008. Air Emissions Risk Analysis – Mine Site. Prepared by Barr Engineering Company. January 2008.
2. MDNR, 2009. Draft Environmental Impact Statement for the NorthMet Project. Risk results reported in Section 4.6. Minnesota Department of Natural Resources, St. Paul, MN. October 2009.
3. PolyMet Mining, 2007. Stationary Point and Fugitive Source Emission Calculations for the NorthMet Project Mine Site (October 2007) and reformatted spreadsheet (December 2007). Prepared by Barr Engineering Company.

4. MPCA, 2009. Guidance, How to Conduct a Cumulative Air Emissions Risk Analysis. Aq-9-21. March 2009.
5. MPCA, 2007. Air Emissions Risk Analysis (AERA) Guidance. Version 1.1, September 2007.
6. PolyMet Mining, 2011. Work Plan for a Supplemental Air Emissions Risk Analysis (AERA) to be conducted for the Plant Site. Prepared by Barr Engineering Company. April 2011 submittal to the MPCA; revised July 2011.
7. Mesabi Nugget, 2009. Air Emissions Risk Analysis for the Post-Project Total Facility (Phase I and Phase II). Prepared by Barr Engineering Company. August 2009. (Mesabi Nugget Phase II Project now referred to as the Mesabi Mining Project).
8. PolyMet Mining, 2007. Air Emissions Class II Area Cumulative Impacts Report. Prepared by Barr Engineering Company. March 2007.