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Technical Memorandum

To: Kristie Elickson, Minnesota Pollution Control Agency
From: Nadine Czoschke, Pat Sheehy, and Todd Fasking, Barr Engineering Company
Subject: Summary of updated AERA related risk value estimates in 2017
Date: August 17, 2017
Project: 23690862.09
c: Suzanne Baumann, Minnesota Pollution Control Agency; Kevin Pylka, PolyMet

PolyMet has submitted Air Emissions Risk Analysis (AERA) evaluations for both the Mine and Plant components of the Project with the Air Permit Application (Aug 2016). Supplemental evaluations have been completed since this submission including:

- an evaluation reflecting corrections to the bugs in the EPA approved model (AERMOD) and incorporating the WWTS modifications (May 2017),
- a demonstration of acute risk estimates at the NAAQs effective fenceline (June 2017), and
- an evaluation after an emissions true-up (August 2017)

All evaluations and submittals have demonstrated that the Project continues to meets risk guidance criteria. This memo provides, in the tables below, a summary comparison of the results from the AERA evaluations conducted in support of the permitting.

An evaluation using the NAAQS effective fenceline (acute exposure only) was performed in addition to and separate from this AERA evaluation at the request of MPCA. For that evaluation, receptors were placed between the effective fence line boundary and the AERA receptor grid. The effective fenceline grid is attached, however, the analysis update will be submitted in a separate memo.

AERA Updates

The following tables compare the evaluations described above for the different mine years for the full AERA receptor grid evaluations.

Tables 1a and 1b Mine Site Acute Hazard Summary

Year 8	Acute 2016	Acute 2017 - AERMOD bug fix	Acute 2017 - Aug Emissions True-Up
Arsenic	0.029	0.029	0.029
Copper	0.0012	0.0023	0.0023
Nickel	0.011	0.008	0.008
Nitrogen oxide	0.25	0.26	0.26
Sulfur dioxide	0.0023	0.0014	0.0014
Total	**0.3**	**0.3**	**0.3**

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Year 13	Acute 2016	Acute 2017 - AERMOD bug fix	Acute 2017 – August Emissions True-Up*
Arsenic	0.036	0.035	0.035
Copper	0.0023	0.0025	0.0025
Nickel	0.010	0.010	0.010
Nitrogen oxide	0.31	0.31	0.31
Sulfur dioxide	0.0015	0.0015	0.0015
Total	**0.4**	**0.4**	**0.4**

*Note: there were no emissions changes in the true-up for Mine Year 13. Estimates are equal to those from the AERMOD bug fix

Table 2a and 2b Mine Site Chronic Non-Cancer Hazard Summary

Year 8	Chronic Noncancer 2016	Chronic Noncancer 2017 - AERMOD bug fix	Chronic Noncancer 2017 - Aug Emissions True-Up
Arsenic	0.0074	0.0087	0.0087
Cobalt	0.077	0.080	0.080
Diesel exhaust particulate	0.016	0.019	0.02
Manganese	0.053	0.061	0.061
Nickel	0.23	0.22	0.22
Crystalline silica (PM4)	0.025	0.026	0.026
TCDD Equivalents, 2,3,7,8-	0.0000062	0.0000076	0.0000076
Total	**0.4**	**0.4**	**0.4**

Year 13	Chronic Noncancer 2016	Chronic Noncancer 2017 - AERMOD bug fix	Chronic Noncancer 2017 – Aug Emissions True-Up*
Arsenic	0.0074	0.0076	0.0076
Cobalt	0.077	0.065	0.065
Diesel exhaust particulate	0.016	0.019	0.019
Manganese	0.053	0.051	0.051
Nickel	0.23	0.21	0.21
Crystalline silica (PM4)	0.025	0.020	0.020
TCDD Equivalents, 2,3,7,8-	0.0000062	0.0000070	0.0000070
Total	**0.4**	**0.4**	**0.4**

*Note: there were no emissions changes in the true-up for Mine Year 13. Estimates are equal to those from the AERMOD bug fix

Table 3a and 3b Mine Site Cancer Risk Estimate Summary

Year 8	Cancer 2016	Cancer 2017 - AERMOD bug fix	Cancer 2017 - Aug Emissions True-Up
Arsenic	4.8E-07	5.60E-07	5.60E-07
Cobalt	4.1E-06	4.30E-06	4.33E-06
Dibenz[a,h]anthracene	4.6E-10	5.70E-10	5.66E-10
Indeno(1,2,3-cd)pyrene	1.9E-11	2.40E-11	2.36E-11
Nickel	1.6E-06	1.50E-06	1.47E-06
TCDD Equivalents, 2,3,7,8-	1.0E-07	1.20E-07	1.21E-07
Total	**6E-06**	**7E-06**	**6E-06**

Year 13	Cancer 2016	Cancer 2017 - AERMOD bug fix	Cancer 2017 – Aug Emissions True-Up*
Arsenic	4.8E-07	5.60E-07	5.60E-07
Cobalt	4.1E-06	4.30E-06	4.30E-06
Dibenz[a,h]anthracene	4.6E-10	5.70E-10	5.70E-10
Indeno(1,2,3-cd)pyrene	1.9E-11	2.40E-11	2.40E-11
Nickel	1.6E-06	1.50E-06	1.50E-06
TCDD Equivalents, 2,3,7,8-	1.0E-07	1.20E-07	1.20E-07
Total	**6E-06**	**7E-06**	**7E-06**

*Note: there were no emissions changes in the true-up for Mine Year 13. Estimates are equal to those from the AERMOD bug fix

Table 4 Plant Site Acute Hazard Summary

	Acute 2016	Acute 2017 AERMOD bug fix	Acute 2017 Aug Emissions True-Up
Arsenic	0.21	0.084	0.084
Copper	0.043	0.049	0.049
Hydrochloric acid	0.31	0.26	0.26
Hydrogen sulfide	0.066	0.068	0.068
Nickel	0.22	0.18	0.18
Nitrogen oxide (NO2)	0.32	0.26	0.26
Sulfuric acid	0.052	0.053	0.053
Sulfur dioxide	0.23	0.18	0.18
Total	**1**	**1**	**1**

Table 5 Plant Site Chronic Non-Cancer Hazard Summary

	Chronic Noncancer 2016	Chronic Noncancer 2017 AERMOD bug fix	Chronic Noncancer 2017 Aug Emissions True-Up
Arsenic	0.020	0.020	0.020
Cobalt	0.21	0.23	0.23
Diesel exhaust particulate	0.0034	0.0043	0.0043
Hydrochloric acid	0.0010	0.0010	0.0010
Hydrogen sulfide	0.017	0.029	0.029
Manganese	0.011	0.011	0.031
Nickel	0.61	0.82	0.82
Silica (crystalline, respirable, PM4)	0.057	0.045	0.057
Sulfuric acid	0.077	0.134	0.134
TCDD Equivalents, 2,3,7,8-	0.0000007	0.0000009	0.0000009
Total	**1**	**1**	**1**

Table 6 Plant Site Cancer Risk Estimate Summary

	Cancer 2016	Cancer 2017 AERMOD bug fix	Cancer 2017 Aug Emissions True-Up
Arsenic	4.5E-07	4.5E-07	4.5E-07
Cobalt	4.0E-06	4.4E-06	4.4E-06
Dibenz[a,h]anthracene	1.2E-10	1.1E-10	1.1E-10
Nickel	5.3E-06	7.0E-06	7.0E-06
TCDD Equivalents, 2,3,7,8-	3.9E-09	4.9E-09	4.9E-09
Total	**1E-05**	**1E-05**	**1E-05**

Summary

Using updated methods and emission inputs, AERA evaluation results changed very minimally and continue to be protective of human health and the environment.

Attachments:

See related Flash drive "AERA files for Emissions True-Up" that contains an electronic copy of:

- AERA updates
    - August Emissions True-Up RASS for Plant Site Cancer
    - August Emissions True-Up RASS Plant Site chronic Noncancer
    - August Emissions True-Up RASS Mine Site Year 8
    - August Emissions True-Up hourly concentrations for Mine Site Year 8
    - August Emissions True-Up annual concentrations for Mine Site Year 8
    - August Emissions True-Up hourly concentration for Plant Site including acute risk estimates paired in space
    - August Emissions True-Up annual concentrations for Plant Site
    - AERMOD bug correction PM4 crystalline silica annual concentrations for Plant Site
    - August Emissions True-Up emissions text files for Mine Site Year 8 and Plant Site
    - 2017 AERA 01 Deliverable checklist_Mine and Plant3
- Effective Fenceline updates
    - Receptor grid for the Plant Site Effective Fenceline
    - Receptor grid for the Mine Site Effective Fenceline