Memorandum

To: Bill Johnson, Minnesota DNR
From: Greg Williams
Subject: Summary of Existing Conditions Hydrology in the Partridge River and Embarrass River
Date: March 24, 2015
Project: 23-69-0862.00-042-001
c: Jennifer Saran (PolyMet)

This memorandum summarizes the historical hydrology data for the Partridge River and Embarrass River, as related to the development of inputs to the GoldSim probabilistic water quality models of the Mine Site and Plant Site.

Historical gage data used to develop inputs to the probabilistic models is based on the following USGS gage records:

- 04015475 – Partridge River above Colby Lake (September 1978 – November 1988)
- 04016000 – Embarrass River at Embarrass (August 1942 – December 1964)

The Partridge River and Embarrass River flow records listed above are approximately 10-years and 20-years respectively. Note that additional gage data is available in the Partridge River and Embarrass River watersheds, but were omitted as potential sources to inform hydrologic inputs to the probabilistic models due to their relatively short periods of record. Flow statistics with a 10-year return period were estimated for various locations in the Partridge River based on the gage record and extrapolated upstream using XP-SWMM modeling results as described in Section 5.2.4.5 of the Mine Site Water Modeling Data Package (v14) (see Table 1).

Flow statistics with a 10-year return period were estimated for locations on the Embarrass River and selected tributaries based on the historical gage data, watershed area, and estimates of Tailings Basin seepage (see Table 2). This process is described in Section 5.2.1.4 of the Plant Site Water Modeling Data Package (v11). The tributary areas and seepage estimates used to calculate flows at locations in the Embarrass River watershed are listed in Table 2.

Table 1 Estimated existing conditions flows in the Partridge River

River Location	Baseflow[1]	10-Year 7-day Low[2] (cfs)	Average Annual 1-Day Minimum (cfs)	Annual Daily Mean (cfs)	Average Annual 1-day Maximum (cfs)	10-Year 1-day High[2] (cfs)
SW-002	0.4	0.4	0.4	6.1	82	118
SW-003	0.5	0.5	0.5	7.4	93	132
SW-004	0.9	0.7	0.9	14	156	215
SW-004a	2.4	1.7	2.1	38	468	678
SW-004b	3.8	2.8	3.4	58	631	895
PM-4/SW-005	4.9	3.6	4.3	75	737	1,081
SW-006	5.3	3.9	4.7	79	761	1,127

Note: XP-SWMM model results exclude contributions from the Peter Mitchell Pit
[1] Based on average annual 30-day minimum flow.
[2] 10-year values are based on individual model year flow statistics not published in Attachment G of PolyMet 2013i.

Table 2 Estimated existing conditions flows in the Embarrass River and tributaries

Waterbody	Location	Existing Watershed Area (mi[2])	Ground-water Baseflow[1] (cfs)	Total Baseflow[2] (cfs)	10-Year 7-day Low[2] (cfs)	Average Annual 1-Day Min.[2] (cfs)	Annual Daily Mean[2] (cfs)	Average Annual 1-day Max.[2] (cfs)	10-Year 1-day High[2] (cfs)	Tailings Basin Seepage (cfs)
Embarrass River	PM-12	18.97	0.9	0.9	0.4	0.8	14	145	259	0
	PM-12.2	34.19	1.5	1.5	0.7	1.4	25	261	467	0
	PM-12.3	82.98	3.8	8.2	6.2	7.8	65	638	1,139	4.41
	PM-12.4	94.36	4.3	8.7	6.5	8.3	73	724	1,294	4.43
	PM-13	106.64	4.8	10.6	8.1	10.1	84	820	1,463	5.77
Mud Lake Creek	MCL-3	1.40	0.1	0.9	0.9	0.9	1.9	12	20	0.83
	MLC-2	3.57	0.2	1.1	1.0	1.1	3.5	28	50	0.93
Trimble Creek	TC-1	2.18	0.10	3.5	3.4	3.4	4.9	20	33	3.36
	PM-19	3.94	0.18	3.7	3.6	3.6	6.4	34	57	3.48
Unnamed Creek	UC-1a	2.29	0.10	1.2	1.2	1.2	2.8	19	32	1.11
	PM-11	3.37	0.15	1.3	1.2	1.3	3.6	27	47	1.11

[1] Estimated based on average annual 30-day minimum flow from tributary watershed. Excludes seepage from the Tailings Basin.
[2] Flow estimates include Tailings Basin Seepage in addition to contribution from tributary watershed.