APPENDIX D3
Water Resources

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Cumulative Water Resources Effect Assessment

Prepared for Excelsior Energy

Mesaba Energy Project

SEH No. EXENR0502.03

November 2006

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West Range

I. Identification and description of affected watershed: Swan River.

The Swan River Watershed is located in Itasca and St. Louis Counties in Northern Minnesota and is part of the Upper Mississippi River Watershed Basin. Figure 1 shows the Swan River Watershed to a point immediately upstream of the confluence with Trout Creek, the location of Mesaba, and the location of the proposed Minnesota Steel Project.

Human influences related to logging, mining, ditch construction, agricultural activity, dam construction, flow diversion / withdrawal, development of transportation systems, and community development activities have impacted streams in the area, including the Swan River.

The contributing watershed area of the Swan River has been altered primarily through several past mining actions. The land use / cover type was modified significantly through the construction of mining related facilities and, in turn, this alteration has modified the quantity and timing of surficial runoff to the Swan River.

Impacts resulting from the Minnesota Steel Industries ("MSI") project are hydrologically upstream on the Swan River from the Mesaba Energy Project. The Swan River watershed study area was selected at a point sufficiently downstream of the Mesaba's impacts in order to encompass the cumulative impacts within the Swan River Watershed with respect to both the MSI project and Mesaba.

II. Identify existing usage and quality:

Existing Water Appropriation permits from surface waters in the Swan River watershed are shown in **Table 1**.

Table 1 - Existing Water Appropriation Permits for Surface Waters Near the West Range Site within the Swan River Watershed

		Permitted		Reported Pumping (Million Gallons)				
Permittee	**Resource**	**GPM**	**MG/Y**	**2000**	**2001**	**2002**	**2003**	**2004**
MDNR	Hill-Annex Tailing Basin	4500	500	ND	ND	ND	ND	70.3
MDNR	Hill-Annex Mine	7000	3416	ND	ND	621.1	1550.3	1374
Swan Lake Country Club	Oxhide Creek	540	10	4.6	8.5	9.2	8.4	5.8
City of Coleraine	Trout Lake	400	41	37	19.7	19.7	12.1	11.9

Currently, the Swan River is impaired for fecal coliform, dissolved oxygen, and mercury. **Table 18-2** from the **MSI Environmental Assessment Worksheet ("EAW")** includes existing water quality information.

III. Effects from new sources/appropriations

a. Quantity:

i. Mesaba:

The Swan River is affected to the degree that Mesaba One and Mesaba Two will pump water out of the Hill-Annex Mine Pit ("HAMP") complex to the CMP instead of the DNR's current practice of pumping water from the HAMP complex to Upper Panasa Lake, which discharges to Lower Panasa Lake and ultimately the Swan River. The DNR's current NPDES permit allows for annual transfers of water from the HAMP complex at an average pumping rate of 6,500 gpm. However, because of the costs associated with pumping such volumes, seasonal freeze-ups, and pump capacity, the HAMP complex is generally dewatered for 6 months per year at a rate of 6,200 gpm (which is the pump capacity). Therefore, such flows would represent the maximum loss of flow to the Swan River resulting from Mesaba's operations. This maximum would only occur during peak process water demand periods with both Mesaba Phase I and II in operation. Smaller quantities of water are likely to be diverted from the HAMP complex under Phase I if the Canisteo Pit yields more water than estimated and/or if above normal precipitation occurs. Excelsior's regulatory documents (the Joint Application, Environmental Supplement, NPDES Permit Application, and the Water Appropriation Permit Application contain detailed descriptions of Mesaba One and Mesaba Two water uses and the timing of their appropriation. As the Canisteo Pit has no discharge, water appropriated from it will not affect the Swan River or any other streams.

The 9 mile portion of the Swan River between the discharge of the Panasa Lakes and Holman Lake would experience loss of water from the Panasa Lakes discharge point and would not see an increase in flow until the Holman Lake discharge point.

Appropriations from the CMP will be partially offset by discharges of cooling tower blowdown from Mesaba into Holman Lake. Excelsior's NPDES permit application indicates that such discharges to Holman Lake would begin at 800 gpm and decrease to 400 gpm over 30 years. The remainder of cooling tower blowdown would be discharged to the CMP, which does not drain to the Swan River. The exact discharge to each water body will be determined as part of finalizing NPDES permit conditions. See **Table 2** below for a summary of total process water discharges.

Excelsior intends to work within guidelines published by the Minnesota Pollution Control Agency ("MPCA") to establish Total Maximum Daily Load limits to govern discharges of cooling tower blowdown to Holman Lake (*see* "TMDL Work Plan Guidance" issued by MPCA in January 2006 [http://www.pca.state.mn.us/publications/wq-iw1-01.pdf]). This intent will be discussed with the MPCA as part of finalizing NPDES permit conditions for Mesaba One and Mesaba Two. The TMDL process will play a critical role in minimizing cumulative impacts within watersheds affected by the Mesaba Energy Project.

Some withdrawals are possible for Phase I and II from the Lind Mine Pit and the Prairie River (into which the Lind drains). However, MSI will not reduce flows to that watershed and no other projects have been identified to have cumulative impacts to that river, so no further analysis of cumulative impacts on the Prairie River is necessary.

Table 2 – Estimated Process Water Discharge

	Cycles of Concentration	Peak Discharge (GPM)	Average Annual Discharge (GPM)
Phase I	5	1,300	550-900
Phase I and II	3	5,140	2,200-3,500

ii. Minnesota Steel Industries (MSI)

As shown in Table 3, the annual consumptive use of water from the MSI project is 4,063 gpm. This process water would come from surface water runoff to the mine pits and groundwater. The remaining process water would come from surface water sources that currently flow to the Swan River. The amount of process water from surface water runoff and groundwater has not been quantified, but is known to occur; therefore, the total amount of process water taken from the Swan River tributaries would be somewhat less than 4,063 gpm.

Table 3 – Water Consumption by MSI

Location	**Type of Consumption**	**Average annual consumption, gpm**
Crusher, pellet plant and concentrator	Evaporation from thickeners and induration of green balls	416
DRI Plant	Process water and cooling tower losses	1,171
Steel Mill	Cooling tower losses and direct evaporation from hot steel	1,176
Tailings Basin	Losses of water trapped with tailings (voids loss)	1,300
Stream Augmentation*	Replace flow diverted from receiving water bodies	To be determined during permitting *
Total Annual Consumptive Use		4,063*

Source: MSI Environmental Assessment Worksheet, Table 13-2. Note: For assessing cumulative water quantity impacts, stream augmentation is not considered consumptive use.

iii. Nashwauk WWTF

Sanitary wastewater flows to the Nashwauk WWTF from the MSI project could be as high as 21 gpm *(Question 18.b. – MSI EAW)*. The effluent would be slightly less that the influent to the WWTF.

iv. Coleraine-Bovey-Taconite WWTF

Mesaba would connect to the wastewater treatment facility for disposal and treatment of domestic wastewater. The maximum estimated increase in 24 hr-averaged flow to the treatment facility during construction would be 31 gpm during construction and 5 gpm during the operational phase of Mesaba Phase I and II. The effluent from the WWTF would be slightly less than the influent.

Due to inflow and infiltration in the existing collection system, sewage bypasses and excess flows relative to the design limit of the treatment plant sometimes occur during times of heavy precipitation or thaw. Excelsior may seek to rehabilitate the collection system or enlarge the pumps to mitigate this situation.

v. Total: Compare to flow of Swan River.

From the above analysis, the maximum cumulative reduction in flow is approximately 10,300 gpm (9,500-9,900 gpm downstream of Holman Lake's outflow into the Swan River). For non-summer flows (without the loss of water pumped from the HAMP complex), the maximum cumulative reduction would be 4,000 gpm (3,200-3,600 gpm downstream of Holman Lake).

The historic mean flow of the Swan River is 29,000 gpm (USGS gage data for the period 1965-1990). However, significant mining has taken place within the watershed during the period of record, which could cause unnaturally high or low flows to be measured in the river during that time period and would be dependent on dewatering and stream augmentation practices during that period.

b. Quality:

Cooling tower blowdown released by the Mesaba One and Mesaba Two consists of water containing concentrations of minerals and other trace constituents concentrated through evaporation; the chemical species of biggest concern are limited to mercury, nutrients, hardness, and total dissolved solids (TDS).

All of Minnesota Steel's process water, including cooling water, will be treated with a zero liquid discharge (ZLD) system. Therefore, the only identifiable discharges associated with MSI are mine pit dewatering operations and periodic tailings basin discharges, and these discharges will not be concentrated through evaporation. As shown in Table 4, the quality of pit water is similar to that of the Swan River, with modestly higher conductivity (TDS) and hardness. All values are well below those of Mesaba's discharge, which in turn is within applicable discharge standards, so cumulative impacts on water quality from dewatering operations are negligible. Tailings basin discharges are likely to have higher TDS, but specific values were not provided in the EAW.

Table 4 – West Range Water Quality

	Swan River	Pit 1	Pit 5/F	Tailings Basin North	Mesaba discharge
Conductivity (uhmos/cm)	340	410	430	360	2,052 mg/L
Hardness (mg/L)	150	180	190	160	2,070
Phosphorous (mg/L)	<0.1	<0.1	<0.1	<0.1	0.5
Mercury (ug/L)	<0.2	<0.1	<0.1	<0.1	4.2 ng/L

Source: Average values from Table 18.2 of MSI's EAW and Table 1.8-21 from the Environmental Supplement to Mesaba's Joint Application Permit. MSI's Pits 1 and 5/F are adjacent and located approximately two miles northeast of the city of Calumet.

East Range

I. Identification and description of affected watershed: Partridge River.

The Partridge River Watershed is located in St. Louis County in Northern Minnesota. The Partridge River watershed is part of the St. Louis River and Lake Superior Watershed Basin. Figure 2 shows the Partridge River Watershed to a point approximately 5 miles downstream of the confluence with First Creek. The Mesaba Energy Project, Mesabi-Nugget, and PolyMet Projects are located within the watershed study area.

Human influences related to logging, mining, ditch construction, agricultural activity, dam construction, flow diversion / withdrawal, development of transportation systems, and community development activities have impacted streams in the area, including the Partridge River.

The contributing watershed area of the Partridge River has been primarily altered through several past mining actions. The land use / cover type was modified significantly through the construction of mining related facilities and, in turn, this alteration has modified the quantity and timing of surficial runoff to the stream.

Lake levels in Colby Lake are augmented with water from Whitewater Reservoir, which also has impacts on the natural flow regime within the Partridge River.

Impacts resulting from the PolyMet project are hydrologically upstream on the Partridge River from Mesaba. The Mesabi-Nugget project is relatively close to the Mesaba Energy Project and shares some of the same sub watersheds. The Partridge River watershed study area was selected at a point downstream of Mesaba's impacts in order to encompass the cumulative impacts within the Partridge River Watershed with respect to the Mesaba Energy Project, Mesabi-Nugget, and PolyMet.

NOTE: *The Mesaba East Range Site will have Zero Liquid Discharge (ZLD) and would not contribute to any cumulative impact on water quality in the Partridge River resulting from the discharge of wastewater from the project. There is no further discussion of water quality needed.*

II. Identify existing usage: EIS Table 2.5-4

Existing Water Appropriation permits for surface waters in the Partridge River Watershed are shown in **Table 5**.

Table 5 - Existing Water Appropriation Permits for Surface Waters Around East Range Site within the Partridge River Watershed[1]

		Permitted		Reported Pumping (Million Gallons)				
Permittee	**Resource**	**GPM**	**MG/Y**	**2000**	**2001**	**2002**	**2003**	**2004**
MP & Cliffs Erie LLC	Colby Lake	12000	6307	2945.7	69.2	ND	ND	ND
MP	Colby Lake	100500	50000	71.4	60.4	63.4	96.1	117.2

[1] Minnesota DNR. http://files.dnr.state.mn.us/waters/watermgmt_section/appropriations/idxloc.pdf

		Permitted		Reported Pumping (Million Gallons)				
Permittee	**Resource**	**GPM**	**MG/Y**	**2000**	**2001**	**2002**	**2003**	**2004**
MP	Colby Lake	100500	50000	23851.7	24061.7	24261.9	24132.9	22458.9
MP	Colby Lake	100500	50000	21734.0	24133.9	24185.4	24132.9	23541.8
MP	Colby Lake	10500	50000	51.1	4.0	3.4	0.0	21.1
MP	Colby Lake	10500	50000	4.3	41.6	28.8	0.1	0.4
MP	Colby Lake	100500	50000	17.3	0.1	ND	ND	ND
MP	Colby Lake	10500	50000	474.0	516.4	523.6	525.5	525.1
City of Hoyt Lakes	Colby Lake	1050	160	123.1	116.4	120.4	122.8	120.4
City of Hoyt Lakes	Partridge River		4	2.4	1.8	1.7	2.2	1.5
Cliffs Erie LLC		3600	1155	1055.4	ND	ND	ND	ND
Cliffs Erie LLC		3600	1155	ND	ND	ND	ND	ND
Cliffs Erie LLC		3600	1155	ND	ND	ND	ND	ND
Cliffs Erie LLC		1500	551	ND	ND	ND	ND	ND
Cliffs Erie LLC		20000	10512	ND	ND	ND	ND	ND
Cliffs Erie LLC		20000	10512	ND	ND	ND	ND	ND
Cliffs Erie LLC		20000	10512	1860.2	ND	ND	ND	ND
Cliffs Erie LLC		20000	10512	ND	ND	ND	ND	ND
City of Aurora		1020	160	73.7	74.7	81.8	106.5	93.4
Cliffs Erie LLC		5000	788	ND	ND	ND	ND	ND
Cliffs Erie LLC		12000	3049	316.9	ND	ND	ND	ND
Cliffs Erie LLC		12000	3049	ND	ND	ND	ND	ND
Cliffs Erie LLC		12000	3049	ND	ND	ND	ND	ND
Cliffs Erie LLC		3000	1050	ND	ND	ND	ND	ND
Cliffs Erie LLC		3000	1050	1807.2	ND	ND	ND	ND

III. Effects from new sources/appropriations

a. Quantity:

i. Mesaba:

Pits 3, 5N, and 5S discharge water to small streams, which flow to the Upper Partridge River, and the Stephens and Knox pits discharge water to small streams that flow to the Lower Partridge River. The Upper Partridge River is defined as the portion of the river upstream of Colby Lake and the Lower Partridge River is the stream reach downstream of the lake.

Pits 3, 5N, and 5S currently contribute an estimated mean flow to the Upper Partridge River of 500 gpm, which would potentially be eliminated if the water is used by Mesaba.

The Stephens and Knox pits contribute an estimated mean flow of 435 gpm to the Lower Partridge River, which would potentially be eliminated if the water is used by Mesaba.
The water sources that would be used for Mesaba are shown in **Table 6**.

Table 6 - Water Source Supply Capability

Water Source (Pits)	**Est. Range of Flow (gpm)**	**Currently Discharging (yes/no)**	**Assumed Sustainable Flow for Water Balance Modeling (gpm)**
2E	ND	N	112
2W	ND	N	898
2WX	ND	N	673
6	ND	N	1,795
Source: MDNR East Range Hydrology Report	Sub-Total		**3,478**
3	150–450	Y	300
5N	30–100	Y	60
5S	90–270	Y	140
9 / Donora	130–380	N	260
9S	90–270	N	180
Stephens	190–590	Y	390
Knox	20–70	Y	45
Source: Surface Water Modeling[1]	Sub-Total		**1,375**
Mesabi Nugget Discharge	1000	N	**1,000**
Source: MPCA NPDES Discharge Permit			

[1]Excelsior estimated the range of flow based only on the surface drainage area to the pit and average yearly rates of runoff. This represents a first order in approximation and the actual flow rates are likely much more dependent on groundwater components. The groundwater inflow/outflow component in this area can be highly variable as a result of fractures in the bedrock and/or highly pervious tailings dikes. Due to the complexity associated with the groundwater component, groundwater inflow/outflow has not been evaluated.

ii. PolyMet

PolyMet will not appropriate water directly from the Partridge River, but it may appropriate water from Colby Lake. Since PolyMet would not directly appropriate water from the Partridge River,

there would be no direct impacts on stream flow in the river. PolyMet may have some indirect impacts on the stream flow in the Partridge River by cutting off a portion of the runoff to the river and dewatering of the mine pit which could cause a localized drop in the groundwater levels. This impact has not been quantified.

According to the MDNR, PolyMet may need to appropriate as much as 3000 gpm from Colby Lake, but this is a moving target at this time.

The PolyMet project would appropriate water from Colby Lake through an existing water appropriation permit held jointly by Cliffs-Erie and Minnesota Power.

PolyMet may be able to satisfy some or all of their make-up water need from Colby Lake, by amending and/or transferring part of the authority under this permit. A condition under this permit requires that the permit holder pump water from the Whitewater Reservoir into Colby Lake to offset their appropriation when the water level of Colby Lake is below a determined threshold. The control structure between the Whitewater Reservoir and Colby Lake was owned by Cliffs Erie, but is now owned by Minnesota Power. There is an agreement between Cliff's Erie and Minnesota Power whereby the conditions of the permit would be met. Any assignment of an appropriation permit from one party to another would require the consensus of all parties and the DNR's review and approval. The review would take into consideration effects on Colby Lake and Whitewater Reservoir water levels and outflow from Colby Lake.

PolyMet will reportedly employ a Zero Liquid Discharge system, so it would not contribute any new discharges of water to the system.

iii. Mesabi-Nugget

A water appropriation permit has been issued to Mesabi-Nugget. The permit from the MDNR allows Mesabi-Nugget to pump up to 5,000 gpm from Pit 1 and Pit 2WX would be used as a standby source with a permitted appropriation of 5,000 gpm. Pit 1 does not currently discharge to a surface water.

iv. Hoyt Lakes POTW

At this time, there are no reasonably foreseeable expansions to the Hoyt Lakes POTW. However, Mesaba would connect to the Hoyt Lake wastewater collection and treatment system. The current system discharges to Colby Lake, and additional effluent from the treatment facility would have negligible effects on the Partridge River flows.

The maximum estimated increase in flow to the treatment facility during construction would be 31 gpm during construction and 5 gpm during the operational phase of Mesaba Phase I and II. The effluent would be slightly less than the influent.

v. Total: Compare to low-flow of Partridge River.

Low, average, and high flow estimates for the Upper Partridge River are shown in Table 17-1 of the PolyMet EAW. Low flows are estimated to be in the range of 320-835gpm, average flow is estimated at 17,500gpm, and high flows are estimated at 156,000-161,000gpm. *The low flow*

estimated is the 7Q10 flow, which is a 7-day average low flow with a 10-year reoccurrence interval. The total maximum flow that Mesaba could remove from the Upper Partridge River could be 500 gpm.

The total maximum flow that Mesaba could remove from the Lower Partridge River could be as much as 450 gpm. This is not cumulative with removals from the Upper Partridge River during low flow conditions, because the water level (and hence outflow) of Colby Lake, which separates the two rivers, is controlled according to existing permits. Currently, a number of different entities appropriate water from Colby Lake. Minnesota Power is required to augment lake levels in Colby Lake and a minimum allowable lake level has been established. When the lake level is at its minimum, flow out of the lake to Lower Partridge River is also at its minimum, which is approximately 13 cfs. This means that flows on the Lower Partridge River should never fall below 13 cfs or 5,835 gpm.

The maximum total estimated amount of water that PolyMet could appropriate from Partridge River (Colby Lake) would be determined by Minnesota Power and the MDNR. The Colby Lake water levels would still be expected to be augmented.

References

Minnesota Department of Natural Resources. "Water Appropriation Permit Index." 2001-2005. Available: http://files.dnr.state.mn.us/waters/watermgmt_section/appropriations/idxloc.pdf.

Attachments

Figure 1: Swan River Watershed
Figure 2: Partridge River Watershed

Table 1: Minnesota Steel Industries, Environmental Assessment Worksheet, Table 18-2
Table 2: Minnesota Steel Industries, Environmental Assessment Worksheet, Table 13-2
Table 3: PolyMet, Environmental Assessment Worksheet, Table 17-1

Table 18-2. Baseline Water Quality Data
Collected by MIS.

PARAMETER / ANALYTE	UNITS	MDL	METHOD	LPA Larue Pit Access	LPA Larue Pit Access	LPA Larue Pit Access	LPA Larue Pit Access	LPA Larue Pit Access	LS Little Sucker	LS Little Sucker	LS Little Sucker	LS Little Sucker	LS Little Sucker	OBCH O'Brien Creek Head	OBCH O'Brien Creek Head	OBCH O'Brien Creek Head	OBCH O'Brien Creek Head	OBCH O'Brien Creek Head	OBCH O'Brien Creek Head	OE Oxhide Extension	OE Oxhide Extension	OE Oxhide Extension	OE Oxhide Extension	OE Oxhide Extension
SAMPLING ROUND				3	5	6	7	8	3	5	6	7	8	3	5	6	7	8	8	2	3	5	6	7
SAMPLED DATE				06/01/99	09/13/99	11/29/99	05/01/00	07/18/00	06/01/99	09/13/99	11/29/99	05/01/00	07/17/00	06/01/99	09/14/99	11/29/99	05/01/00	07/17/00	07/17/00	03/15/99	06/01/99	09/13/99	11/29/99	05/01/00
TIME (MILITARY)							930	915		1445		1005	1535		1530		1156		1447	1130				1127
EASTING (1927 State Plane Feet)				1986318	1986318	1986318	1986318	1986318	1963207	1963207	1963207	1963207	1963207	1985913	1985913	1985913	1985913		1985913	1971955	1971955	1971955	1971955	1971955
NORTHING (1927 State Plane Feet)				323566	323566	323566	323566	323566	320739	320739	320739	320739	320739	297552	297552	297552	297552		297552	304644	304644	304644	304644	304644
ELEVATION (feet, from 1997 mapping)				1413.1	1413.1	1413.1	1413.1	1413.1	1389.5	1389.5	1389.5	1389.5	1389.5	1343	1343	1343	1343		1343	1347.5	1347.5	1347.5	1347.5	1347.5
AIR TEMP	° F			47	56	24	55		48	56	26	55		51	59	24	59				51	56	24	58
WATER TEMP	° F			62	65	40		70	58	60	24		72	60	57	34			72		61	65	35	
Conductivity	uhmos/cm	1	EPA 120.1	282	299	324	351	349	261	239	327	224	223	315	308	293	319	315	280	434	440	384	390	449
Hardness, Total	mg/L	1	EPA 130.2	157	73.3	157	164	146	146	65.8	141	97	94	141	122	148	144	141	128	204	198	88.8	190	195
Color	PCU	5	EPA 110.2	5					50					30				30			10			
pH	SU	0.1	EPA 150.1	8.04	8.44	8.11	8.28	8.65	6.97	7.29	7.58	8.02	8.75	8.11	8.24	8.17	8.12	8.11	9.24	8.05	8.16	8.05	7.73	8.19
Alkalinity, Carb	mg/L	1	EPA 310.1	<1.0					<1.0					<1.0				<1.0		<1.0	<1.0			
Alkalinity, Total	mg/L	1	EPA 310.1	149	140				121	86				129	134			129		182	161	138		
Ammonia as N	mg/L	0.1	EPA 350.1	<0.10					<0.10					<0.10				<0.10		<0.10	0.12			
Kjeldahl Nitrogen, Total as N	mg/L	0.1	EPA 351.1	0.1	<0.1	0.4	0.66	0.36	2.7	0.4	1	1.01	1.18	0.4	0.3	0.7	1.2	0.4	0.76		0.2	<0.1	0.2	1.14
Nitrate+Nitrite as N	mg/L	0.1	EPA 353.2	<0.01					<0.01					<0.01				<0.01			<0.01			
Nitrate as N	mg/L	0.1	(NO3+N02)-NO2																	<0.10				
Nitrite as N	mg/L	0.01	EPA 354.1																	<0.01				
Nitrogren: N, Total	mg/L	0.2	TKN+NO2+NO2																					
Phosphorus, Total as P	mg/L	0.01	EPA 365.2	0.01	0.01	<0.1	<0.1	<0.01	0.06	0.03	<0.1	<0.1	0.01	0.02	0.03	<0.1	0.01	0.02	<0.01	<0.01	0.01	0.01	<0.1	0.01
Bromide	mg/L	0.1	EPA 320.1																					
Calcium	mg/L	1	EPA 200.7	31.7	29.3	34.2	35.2	32.4	32.5	26.3	33.6	24.8	22.7	30.3	26.8	33.7	33.1	30.3	26.4	39.6	39.3	35.5	42.1	43.4
Chloride	mg/L	0.5	EPA 325.3	1.7					1.5					5.2				5.2		7.1	5.8			
Fluoride	mg/L	0.1	EPA 340.1	0.44	0.24	0.012	<0.1	0.24	0.44	0.24	0.18	0.19	0.24	0.28	0.2	0.12	0.19	0.28	0.45		0.2	0.24	0.14	0.19
Iron	mg/L	0.03	EPA 236.1	0.06	0.05	0.04	<0.03	0.7	0.43	0.24	0.28	0.07	0.37	0.18	0.2	0.36	0.48	0.18	0.41	<0.03	0.03	6.59	0.2	0.23
Magnesium	mg/L	0.5	EPA 200.7	19.0	17	17.5	18.6	17	15.7	11.7	13.8	8.6	8.57	15.6	13.5	15.5	14.8	15.8	14	23.4	24.3	20.1	20.6	21.1
Manganese	mg/L	0.01	EPA 243.1	0.01	<0.01	0.04	<0.01	0.01	0.26	0.05	0.09	0.04	0.06	0.09	0.06	0.09	0.19	0.09	0.11	0.26	0.03	0.02	0.06	0.07
Potassium	mg/L	0.5	EPA 200.7	2.7	2.5				1.4	1.5				1.7	1.8			1.7		2.6	2.4	2.3		
Strontium	mg/L	4	EPA 200.7	73.2	68	75	78.4	72.3	79	70.1	78.7	57.4	53.8	75.7	73.1	80	79.2	75.7	66		115	98.1	113	119
Sulfide, Total	mg/L	2	EPA 376.1															<2						
Sulfite	mg/L	0.025	EPA 425.1	<2					<2					<2				<0.025			<2			
Sulfate	mg/L	1	EPA 375.4	8.92	<1	8.69	8.3	6.8	23.4	<1	32.8	16.6	11.7	8.92	4.19	10.7	8.3	8.92	6.3	45.6	36	17.1	43.2	26.7
Sodium	mg/L	0.5	EPA 200.7	4.1	3.8				4.6	3.2				5.9	5			5.9		8.1	7.7	6.6		
Aluminum	µg/L	10	EPA 202.2	0.05	34.6	18.5	22	42.8	0.02	26.4	<10	13.9	57.4	0.04	100	48.8	319	0.04	152		0.01	27.3	12.4	<10
Antimony	ug/L	3	EPA 204.2	<3.0					<3.0					<3.0				<3.0			<3.0			
Arsenic	µg/L	2	EPA 206.2	<2.0	<2	<2	<2	<2	<2.0	<2	<2	<2	<2	<2.0	<2	<2	<2	<2	<2		<2.0	<2	<2	<2
Barium	µg/L	10	EPA 200.7	0.01					0.03					0.02				0.02			0.02			
Beryllium	µg/L	0.2	EPA 210.2	<0.2					<0.2					<0.2				<0.2			<0.2			
Boron	µg/L	35	EPA 200.7	<35					44					41				41			52			
Cadmium	µg/L	0.2	EPA 213.2	<0.2					<0.2					<0.2				<0.2			<0.2			
Chromium	µg/L	4	EPA 218.2																					
Cobalt	µg/L	1	EPA 219.2	<1.0					<1.0					<1.0				<1.0			<1.0			
Copper	µg/L	1	EPA 220.2	<1.0					<1.0					<1.0				<1.0			<1.0			
Lead	µg/L	1	EPA 239.2	<1.0					<1.0					<1.0				<1.0			<1.0			
Lithium	µg/L	1	EPA 200.7	5.2					3.8					3.8				3.8			9.3			
Mercury--NTS	µg/L	0.2	EPA 245.1	<0.1					<0.1					<0.1				<0.1			<0.1			
Molybdenum	µg/L	5	EPA 246.2	<5.0	<5	<5	<5	<5	<5.0	<5	<5	<5	<5	<5.0	<5	<5	<5	<5	<5	<5.0	<5.0	<5	<5	<5
Nickel	µg/L	2	EPA 249.2	<2.0					<2.0					<2.0				<2.0			<2.0			
Selenium	µg/L	3	EPA 270.2	<3.0					<3.0					<3.0				<3.0			<3.0			
Silica	µg/L	1	EPA 200.7	5480	6220				1620	8410				1300	5170			1300		2380	5430	5690		
Silver	µg/L	1	EPA 200.7																					
Thallium	µg/L	4	EPA 279.2	<4.0	<4	<4	<2	<2	<4.0	<4	<4	<2	<2	<4.0	<4	<4	<2	<2	<2		<4.0	<4	<4	<2
Tin	µg/L	10	EPA 282.2	<10.0					<10.0					<10.0				<10.0			<10.0			
Titanium	µg/L	10	EPA 283.2	<10.0					<10					<10.0							<10.0			
Vanadium	µg/L	4	EPA 200.7	<4.0					<4.0					<4.0				<10			<4.0			
Zinc	µg/L	10	EPA 200.7	10					<10					<10.0				<0.06			12			
BOD	mg/L	1	Std Meth 5210	<2					<2					<2				<2			<2			
Chemical Oxygen Demand	mg/L	1	HACH 8000	5.6	<1	3.7	15	3.7	28.9	22.2	38.4	35.3	18.7	11.3	11.3	22.2	18.7	11.3	18.7		3.7	<1	7.5	18.7
Organic Carbon, Total	mg/L	1	EPA 415.1	3.0	2.9	2.2	5.2	2.3	11.4	14.6	11.7	11.2	8.2	8.5	7.2	7.2	8.2	8.5	6.6		3	3.4	2.5	4.5
Oil and Grease	mg/L	1	EPA 413.1	<0.5					<0.5					<0.5				<0.5		<0.5	<0.5			
Solids, Total Suspended	mg/L	1.0	EPA 160.2	4.0					4.0					3.0				3.0		<1.0	5.0			
Solids, Total Dissolved	mg/L	1	EPA 160.1	120	144	128	143	155	128	180	146	98	116.0	142.0	166	128	144	142	154	219	171.0	122	184	209
Corrosivity Index (Langlier)			Std Meth																	-0.13				
DRO-WATER	mg/L	0.1	WI Modified DRO	<0.10	<0.06	<01	<0.1	<0.1	<0.10	<0.06	<0.1	<0.1	<0.1	<0.10	<0.06	<0.1	<0.1	<0.1	<0.1			<0.06	<0.1	<0.1
GRO-WATER	mg/L	0.1	WI Modified GRO	<0.06	<0.10	<0.1	<0.06	<0.06	<0.06	<0.10	<0.1	<0.06	<0.06	<0.06	<0.10	<0.1	<0.06	<0.06	<0.06		<0.06	<0.10	<0.1	<0.06
Surfactants	mg/L	0.025	EPA 425.1	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	1	<0.025	<0.025	<0.025	<0.025
Fecal Coliform	colonies	1	Std Meth 9222																					
Residual Chlorine	mg/L		Std Meth 4500-Cl																					
Free Chlorine			HACH																	<0.2				
Chlorine (field)			HACH		0.03	0.07	0.07	0.01		0.04	0.04	0.09	0.14		0.04	0.02	0.08		0.07			0.03	0.09	0.1
Chlorine (field, second try)			HACH																					

Table 18-2. Baseline Water Quality Data
Collected by MIS.

PARAMETER / ANALYTE	UNITS	MDL	OE	P1	P1	P1	P1	P1	P1	P1	P1-5C	P5	P5	P5	P5-D	P5	P5-D	P5	P5-D	P5	P5-D	P5-D	SBL	SBL	SBL	SBL
			Oxhide Extension	Pit 1	Pit 1	Pit 1	Pit 1	Pit 1	Pit 1	Pit 1	Pit 1/5 Channel	Pit 5	Pit 5	Pit 5	Pit F	Pit 5	Pit F	Pit 5	Pit F	Pit 5	Pit F	Pit F	Snowball Lake	Snowball Lake	Snowball Lake	Snowball Lake
SAMPLING ROUND			8	1	3	5	6	7	8	8	2	1	3	5	5	6	6	7	7	8	8	8	3	5	6	7
SAMPLED DATE			07/17/00	03/05/97	06/02/99	09/14/99	11/30/99	05/01/00	07/17/00	07/17/00	03/15/99	03/05/97	06/02/99	09/14/99	09/14/99	11/30/99	11/30/99	05/01/00	05/01/00	07/17/00	07/17/00	07/17/00	06/01/99	09/13/99	11/29/99	05/01/00
TIME (MILITARY)			1400		1030	1430		1304		1305	1000		1000	1400	1400			1318	1322	1340		1335		1430		1116
EASTING (1927 State Plane Feet)			1971955		1971544	1971544	1971544	1971544		1971544			1970468	1970468	1970468	1970468	1970468	1970468	1970468	1970468		1970468	1966716	1966716	1966716	1966716
NORTHING (1927 State Plane Feet)			304644		313782	313782	313782	313782		313782			312869	312869	312869	312869	312869	312869	312869	312869		312869	303787	303787	303787	303787
ELEVATION (feet, from 1997 mapping)			1347.5	1360.1	1360.1	1360.1	1360.1	1360.1		1360.1		1354.5	1354.5	1354.5	1354.5	1354.5	1354.5	1354.5	1354.5	1354.5		1354.5	1357.1	1357.1	1357.1	1357.1
AIR TEMP	° F				58	58	42	59					58	61	59			58	58				51	56	24	55
WATER TEMP	° F		74		61	62	41			70			59	59	61	41	41			69		69	60	62	39	
Conductivity	uhmos/cm	1	419		408	371	381	431	440	428	415		424	381	385	437	418	448	450	453	424	415	285	240	260	269
Hardness, Total	mg/L	1	172		188	161	187	189	198	174	188		201	178	158	204	212	193	196	182	201	184	122	59.3	113	111
Color	PCU	5		<5	5				10			<5	5								5		20			
pH	SU	0.1	8.32	7.82	8.13	8.29	8.2	7.99	8.16	8.53	7.9	7.92	8.13	8.32	8.28	8.23	8.28	8.15	7.92	7.41	8.13	8.4	8.29	8.12	8.19	8.14
Alkalinity, Carb	mg/L	1			<1.0				<1.0		<1.0		<1.0								<1.0		<1.0			
Alkalinity, Total	mg/L	1			146	134			161		164		160	141	142						160		99.0	86		
Ammonia as N	mg/L	0.1		<0.10	0.11				0.12		<0.10	<0.10	0.11								0.11		<0.10			
Kjeldahl Nitrogen, Total as N	mg/L	0.1	0.34	<0.2	0.2	0.2	0.2	0.64	0.2	0.31		<0.2	0.1	<0.1	<0.1	0.2	0.2	0.7	0.47	0.32	0.1	0.27	0.4	0.3	0.5	1.38
Nitrate+Nitrite as N	mg/L	0.1			<0.01				<0.01				0.02								0.02		<0.01			
Nitrate as N	mg/L	0.1		<0.10							<0.10	<0.10														
Nitrite as N	mg/L	0.01									<0.01															
Nitrogren: N, Total	mg/L	0.2		<0.2								<0.2														
Phosphorus, Total as P	mg/L	0.01	<0.01	<0.01	0.01	<0.01	<0.1	<0.1	0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.1	<0.1	0.04	<0.1	<0.01	0.01	<0.01	0.02	0.01	<0.1	<0.1
Bromide	mg/L	0.1		<0.1								<0.1														
Calcium	mg/L	1	33.8		40.6	36.2	43.8	43.9	39.3	41	40.3		42.1	38.5	34	43.9	45.2	43.2	43.9	40.4	42.1	14.9	29.6	23.7	29	29
Chloride	mg/L	0.5			7.3				5.8		8.0		6.2								6.2		8.0			
Fluoride	mg/L	0.1	0.27	0.25	0.3	0.36	0.14	0.14	0.2	0.18		0.25	0.3	0.88	0.24	0.12	0.18	0.14	0.14	0.24	0.3	0.18	0.2	0.2	0.12	0.19
Iron	mg/L	0.03	0.17	0.07	<0.03	0.05	0.05	0.07	0.03	0.28	<0.03	0.26	<0.03	0.07	0.03	<0.03	<0.03	<0.03	<0.03	0.12	<0.03	0.18	0.07	0.11	0.07	0.08
Magnesium	mg/L	0.5	20.8	19.6	19.9	17.2	18.9	19.3	24.3	17.4	19.4	25.2	23.4	19.8	17.8	23	24.2	20.8	21	20	23.4	20	11.6	9.4	9.9	9.3
Manganese	mg/L	0.01	0.03	0.02	0.02	0.05	0.01	0.06	0.03	0.07	0.03	0.03	0.02	0.01	<0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.04	0.09	0.06	0.06	0.08
Potassium	mg/L	0.5			2.3	2.2			2.4		2.5		2.5	2.4	2.1						2.5		1.4	1.2		
Strontium	mg/L	4	97.3		95.7	84.3	101	102	115	90.2			111	92.3	91.8	115	119	112	111	97.2	111	97.6	81.5	68.7	78.5	78.1
Sulfide, Total	mg/L	2		<0.5					<2			<0.5									<2					
Sulfite	mg/L	0.025		<2	<2				<0.025			<2	<2								<0.025		<2			
Sulfate	mg/L	1	33.6	36	31.5	39.1	36.9	38.6	36.0	31.5	46.0	42	34.2	41.9	40.6	38.8	39.2	37.8	32	32.7	34.2	33.3	20.0	<1	16.8	17.4
Sodium	mg/L	0.5			6.4	6			7.7		6.8		7.0	6.4	5.8						7.0		7.0	5.6		
Aluminum	µg/L	10	30.2	0.01	0.03	12.4	<10	26.7	0.01	18.9		<0.01	0.01	14.4	16.6	<10	<10	10.8	12.3	14.4	0.01	38	0.02	17.1	<10	19
Antimony	ug/L	3		<4	<3.0				<3.0			<4	<3.0								<3.0		<3.0			
Arsenic	µg/L	2	<2	<1.0	<2.0	<2	<2	<2	<2	<2		<1.0	<2.0	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2.0	<2	<2	<2
Barium	µg/L	10		0.01	0.01				0.02			0.02	0.01								0.01		0.03			
Berylllium	µg/L	0.2		<0.2	<0.2				<0.2			<0.2	<0.2								<.02		<0.2			
Boron	µg/L	35		45.6	<35				52			63	38								38		<35			
Cadmium	µg/L	0.2		<0.2	<0.2				<0.2			<0.2	<0.2								<0.2		<0.2			
Chromium	µg/L	4		<4.0								<4.0														
Cobalt	µg/L	1		<1.0	<1.0				<1.0			<1.0	<1.0								<1.0		<1.0			
Copper	µg/L	1		<1.0	<1.0				<1.0			<1.0	<1.0								<1.0		<1.0			
Lead	µg/L	1		<1.0	<1.0				<1.0			<1.0	<1.0								<1.0		<1.0			
Lithium	µg/L	1			9.8				9.3				10								10		4			
Mercury--NTS	µg/L	0.2		<0.2	<0.1				<0.1			<0.2	<0.1								<0.1		<0.1			
Molybdenum	µg/L	5	<5	<5.0	<5.0	<5	<5	<5	<5	<5	<5.0	<5.0	<5.0	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5.0	<5	<5	<5
Nickel	µg/L	2		<1.0	<2.0				<2.0			<1.0	<2.0								<2.0		<2.0			
Selenium	µg/L	3		<1.0	<3.0				<3.0			<1.0	<3.0								<3.0		<3.0			
Silica	µg/L	1			8990	7620			5430		2110		7870	6500	7080						7870		1220	2480		
Silver	µg/L	1		<1.0								<1.0														
Thallium	µg/L	4	<2	<4	<4.0	<4	<4	<2	<2	<2		<1.0	<4.0	<4	<4	<4	<4	<2	<2	<2	<2	<2	<4.0	<4	<4	<2
Tin	µg/L	10		<4.0	<10.0				<10.0			<4.0	<10.0										<10.0			
Titanium	µg/L	10		<5.0	<10.0							<5.0	<10.0										<10.0			
Vanadium	µg/L	4			<4.0				12				<4.0								<10.0		<4.0			
Zinc	µg/L	10		<10	12				<0.06			<10	12								<0.06		12			
BOD	mg/L	1		<1.0	<2				<2			<1.0	<2										<2			
Chemical Oxygen Demand	mg/L	1	53	<2.0	3.7	3.7	<1	7.5	3.7	44.4		<2.0	3.7	<1	3.7	<1	<1	<1	7.5	76.2	3.7	28.9	15.0	15	18.7	28.9
Organic Carbon, Total	mg/L	1	2.2	1.8	1.9	1.5	1.9	3.3	3.0	1.2		1.4	1.7	1.3	1.3	1.7	1.6	3	2.6	<1	1.7	<1	6.6	6.8	6.7	8.3
Oil and Grease	mg/L	1		<1.0	<0.5				<0.5		2.1	<1.0	<0.5								<0.5		<0.5			
Solids, Total Suspended	mg/L	1.0		<1.0	1.0				5.0		20.0	1.2	3.0								3.0		3.0			
Solids, Total Dissolved	mg/L	1	190		181.0	178	178	196	171	213	219		185.0	232	210	1?	182	200	213	203	185	133	127	102	120	126
Corrosivity Index (Langlier)											-0.32															
DRO-WATER	mg/L	0.1	<0.1		<0.10	<0.06	<0.1	<0.1	<0.1	<0.1			<0.10	<0.06	<0.06	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.06	<0.1	<0.1
GRO-WATER	mg/L	0.1	<0.06		<0.06	<0.10	<0.06	<0.06	<0.06	<0.06			<0.06	<0.10	<0.10	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.10	<0.1	<0.06
Surfactants	mg/L	0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	2	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Fecal Coliform	colonies	1		<1								<1														
Residual Chlorine	mg/L			<0.01								<0.01														
Free Chlorine																										
Chlorine (field)			0		0.06	0.07	0.05	0.08		0.05			0.03	0.03	0.03	0.06	0.06	0.08	0.07	0.06		0.06		0.12	0.06	0.11
Chlorine (field, second try)			0											0.13	0.13									0.2		

Table 18-2. Baseline Water Quality Data
Collected by MIS.

PARAMETER / ANALYTE	UNITS	MDL	SBL Snowball Lake	SBL Snowball Lake	SL1 Swan 1	SL1 Swan 1	SL1 Swan 1	SL1 Swan 1	SL2 Swan 3	SL2 Swan 3	SL3 Swan 3B	SL3 Swan 3	SL3 Swan 6	SL6 Swan 6	SL6 Swan 6B	SL6 Swan 6	TBN (Tailings Basin North)	TBN (Tailings Basin North)	TBN (Tailings Basin North)	TBN (Tailings Basin North)	TBN (Tailings Basin North)	TBN (Tailings Basin North)	UOD Upper Oxhide Diversion	UOD Upper Oxhide Diversion	UOD Upper Oxhide Diversion
SAMPLING ROUND			8	8	4	7	8	8	4	8	6	7	8	4	6	7	2	3	5	6	7	8	3	5	6
SAMPLED DATE			07/17/00	07/17/00	08/25/99	05/02/00	07/17/00	07/18/00	08/25/99	07/18/00	11/30/99	05/02/00	07/18/00	08/25/99	11/30/99	05/02/00	03/15/99	06/01/99	09/14/99	11/29/99	05/01/00	07/17/00	06/02/99	09/14/99	11/30/99
TIME (MILITARY)				1355		1000		1015		1000		1030	1025			1100	1100		1600		1422	1510	1100	1500	
EASTING (1927 State Plane Feet)				1966716	1979911	1979911		1979911	1978326	1978326	1978326	1978326	1977758	1977758	1977758	1977758	1990309	1990309	1990309	1990309	1990309	1990309	1977634	1977634	1977634
NORTHING (1927 State Plane Feet)				303787	293970	293970		293970	301561	301561	301561	301561	288741	288741	288741	288741	319809	319809	319809	319809	319809	319809	319515	319515	319515
ELEVATION (feet, from 1997 mapping)				1357.1	1335.5	1335.5		1335.5	1335.5	1335.5	1335.5	1335.5	1335.5	1335.5	1335.5	1335.5	1372.7	1372.7	1372.7	1372.7	1372.7	1372.7	1503	1503	1503
AIR TEMP	° F				82				78					82					59	26	58		58	62	35
WATER TEMP	° F			68	76			68	76	67	34		67	76	33			58	62	36		72	68	59	33
Conductivity	uhmos/cm	1	408	263	308	362	115	370	311	372	326	366	371	307	317	364	349	355	320	353	385	382	115	109	126
Hardness, Total	mg/L	1	183	110	135	159	48	146	140	154	167	159	152	135	150	160	162	165	143	170	166	174	48	42	54
Color	PCU	5	5		<20		40		<30					<20				20					40		
pH	SU	0.1	8.13	8.8	8.7	8.39	7.35	8.72	8.79	8.65	8.5	8.37	8.73	8.81	8.63	8.36	7.68	7.88	8.25	8.01	7.78	7.29	7.35	7.62	7.67
Alkalinity, Carb	mg/L	1	<1.0		7.5		<1.0		7.5					5			<1.0	<1.0					<1.0		
Alkalinity, Total	mg/L	1	146		125		40.0		123					135			148	148	134				40	42	
Ammonia as N	mg/L	0.1	0.11		<0.1		<0.10		<0.1					<0.1			<0.10	<0.10					<0.10		
Kjeldahl Nitrogen, Total as N	mg/L	0.1	0.2	0.64	0.7	0.98	1	0.55	0.6	0.47	1.3	0.96	0.58	0.6	0.5	0.89		0.3	0.5	0.8	1.39	0.49	1	0.7	0.6
Nitrate+Nitrite as N	mg/L	0.1	<0.01		<0.1		<0.01		<0.1					<0.1				<0.01					<0.01		
Nitrate as N	mg/L	0.1															<0.10								
Nitrite as N	mg/L	0.01															<0.01								
Nitrogren: N, Total	mg/L	0.2																							
Phosphorus, Total as P	mg/L	0.01	0.01	<0.01	<0.01	<0.1	0.03	<0.01	0.02	<0.01	0.1	<0.1	<0.01	0.02	<0.1	<0.1	<0.01	0.02	0.01	<0.1	0.02	<0.01	0.03	<0.01	<0.1
Bromide	mg/L	0.1																							
Calcium	mg/L	1	40.6	26	27.7	32.4	10.4	30	28	30.7	34.5	32.6	30	26.6	30.8	32.3	34.5	36.9	32.6	40.2	39.8	36.4	10.4	9.9	13.1
Chloride	mg/L	0.5	7.3		7.2		5.0		7.4					7.2			7.4	6.6					5		
Fluoride	mg/L	0.1	0.3	0.27	0.28	0.19	0.3	0.32	0.28	0.32	0.22	0.21	0.32	0.24	0.24	0.17		0.24	0.36	0.14	0.19	0.32	0.3	0.36	0.1
Iron	mg/L	0.03	<0.03	0.31	0.03	<0.03	0.9	0.29	0.04	0.25	1.13	<0.03	0.32	0.04	0.09	<0.03	0.04	0.12	0.06	0.34	0.11	0.09	0.9	1.62	2.64
Magnesium	mg/L	0.5	19.9	9.43	18.1	19	5.4	17.5	18.3	17.8	19.6	19	17.8	17.2	17.7	19.2	16.4	17.6	15	16.8	16.3	15.5	5.4	4.1	5.2
Manganese	mg/L	0.01	0.02	0.14	<0.01	0.03	0.29	0.02	<0.01	0.03	0.88	0.04	0.02	0.04	0.09	0.04	0.26	0.1	0.05	0.46	0.31	0.06	0.29	0.17	0.28
Potassium	mg/L	0.5	2.3		2.4		1.2		2.4					2.3			2.3	2.2	2				1.2	1.2	
Strontium	mg/L	4	95.7	69.6	78.3	83.8	39.8	74.5	77.8	78.1	87.2	83.8	78.5	77.5	79	83.8		89.2	77.8	94.1	92.4	84.7	39.8	36.1	41.2
Sulfide, Total	mg/L	2	<2				<2																		
Sulfite	mg/L	0.025	<0.025		<2		<0.025		<2					<2				<2					<2		
Sulfate	mg/L	1	31.5	14	24.3	21.4	<1.0	18.6	23.2	18.9	23	22.4	18	21.1	22.6	22.8	<1.0	13.7	<1	16.8	16.8	11	<1.0	2	9.76
Sodium	mg/L	0.5	6.4		7.3		3.6		7.3					7.2			7.1	7.1	6				3.6	3	
Aluminum	µg/L	10	0.03	94.4	10.1	<10	0.07	<10	13.1	<10	229	<10	18.3	12.2	<10	<10		0.03	21.4	55.1	12.9	12	0.07	52.4	99.2
Antimony	ug/L	3	<3.0		<3		<3.0		<3					<3				<3.0					<3.0		
Arsenic	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2		2	<2	<2	<2	<2	2.5	<2	<2
Barium	µg/L	10	0.01		19.8		0.01		20.1					19.7				0.03					0.01		
Berylllium	µg/L	0.2	<0.2		<0.2		<0.2		<0.2					<0.2				<0.2					<0.2		
Boron	µg/L	35	<35		<35		<35		<35					<35				39					<35		
Cadmium	µg/L	0.2	<0.2		<0.2		<0.2		<0.2					<0.2				<0.2					<0.2		
Chromium	µg/L	4																							
Cobalt	µg/L	1	<1.0		<1		<1.0		<1					<1				<1.0					<1.0		
Copper	µg/L	1	<1.0		1.1		<1.0		<1					1.5				<1.0					<1.0		
Lead	µg/L	1	<1.0		<1		<1.0		<1					<1				<1.0					<1.0		
Lithium	µg/L	1	9.8		5.3		2.1		5.3					5.1				4.9					2.1		
Mercury--NTS	µg/L	0.2	<0.1		<0.2		<0.1		<0.2					<0.2				<0.1					<0.1		
Molybdenum	µg/L	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5.0	<5.0	<5	<5	<5	<5	<5.0	<5	<5
Nickel	µg/L	2	<2.0		<2		<2.0		<2					<2				<2.0					<2.0		
Selenium	µg/L	3	<3.0		<3		<3.0		<3					<3				<3.0					<3.0		
Silica	µg/L	1	8990		3.25		2540		3.2					3.45			2080	6070	7050				2540	6450	
Silver	µg/L	1																							
Thallium	µg/L	4	<2	<2	<4	<2	<2	<2	<4	<2	<4	<2	<2	<4	<4	<2		<4.0	<4	<4	<2	<2	<4.0	<4	<4
Tin	µg/L	10	<10.0		<10		<10.0		<10					<10				<10.0					<10.0		
Titanium	µg/L	10			<10				<10					<10				<10.0					<10.0		
Vanadium	µg/L	4	12		<4.0		12		<4.0					<4				<4.0					<4.0		
Zinc	µg/L	10	<0.06		10		<0.06		<10					<10				12					12		
BOD	mg/L	1	<2		2.4		<2		2.4					2.2				<2					<2		
Chemical Oxygen Demand	mg/L	1	3.7	7.5	25.6	25.6	3.7	68.8	32.1	7.5	25.6	22.2	18.7	28.9	15	22.2		11.3	11.3	22.2	30.5	22.2	3.7	18.7	25.6
Organic Carbon, Total	mg/L	1	1.9	5.8	7.9	8.6	12.7	5.2	8.2	5.2	8.8	8.5	5.2	7.5	7.9	8.5		14.5	6.7	7.9	7.2	4.6	12.7	10.2	11.8
Oil and Grease	mg/L	1	<0.5		6.2		<0.5		7.9					4.3			<0.5	<0.5					<0.5		
Solids, Total Suspended	mg/L	1.0	1.0		5.0		4.0		4.0					6.0			1.0	2.0					4.0		
Solids, Total Dissolved	mg/L	1	181	126	173	175	56.0	164	178	190.0	144	180	185	184	140	187	181	146.0	204	152	170	200	56.0	70	62
Corrosivity Index (Langlier)																	-0.67								
DRO-WATER	mg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.10	<0.06	<0.1	<0.1	<0.1	<0.10	<0.06	<0.1
GRO-WATER	mg/L	0.1	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06		<0.06	<0.10	<0.1	<0.06	<0.06	<0.06	<0.10	<0.06
Surfactants	mg/L	0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	2	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Fecal Coliform	colonies	1																							
Residual Chlorine	mg/L																								
Free Chlorine																	<0.2								
Chlorine (field)				0.12	0.13	0.08		0.11	0.04	0.01		0.06		0.06	0.08	0.09				0.06	0.08	0.11	0.07	0.21	0.05
Chlorine (field, second try)																									

Table 13-2. Water Consumption

Location	Type of consumption	Average annual consumption[1], gpm
Crusher, pellet plant and concentrator	Evaporation from thickeners and induration of green balls	416
DRI plant	Process water and cooling tower losses	1,171
Steel mill	Cooling tower losses and direct evaporation from hot steel	1,176
Tailings basin	Losses of water trapped with tailings (voids loss)	1,300
Stream Augmentation	Replace flow diverted from receiving water bodies[2]	To be determined during permitting.
Total consumptive use		4,063+

[1] Average annual figures account for annual shutdowns and downtime. They are slightly lower than the corresponding averages during operation.

[2] Not including possible augmentation of Little Sucker Lake, McCarthy Lake, or Snowball Lake.

Table 17-1 (of PolyMet EAW) – Calculated Low, High, and Average Flow Statistics for Ungauged Portions of the Partridge River

Location	Drainage Area (mi^2)	Low Flow – 7Q10 (cfs)		High Flow – Q2 (cfs)		Average Flow
		Brooks and White	Siegel and Ericson	Siegel and Ericson	This study	Siegel and Ericson
PU-1 without Pit B Area	10.8	0.23	0.05	90	57	6
PU-1 with Pit B Area	14.4	0.33	0.08	114	78	9
PU-2 without Pit B Area	20	0.49	0.13	149	111	13
PU-2 with Pit B Area	23.6	0.61	0.17	171	132	15
PU-3 without Pit B Area	54.4	1.71	0.65	340	325	37
PU-3 with Pit B Area	58	1.86	0.72	358	348	39