Design Basis - Potable Water Treatment Plant

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The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

REGISTERED PROFESSIONAL ENGINEER
L1247
R. A. HALIM
LICENSEE
SEPT 13, 2011
NWT/NU

2011-07-27	0	Issued for Use Environmental Permit	R. Kapadia	A. Zlatic	J. Cleland	
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1. General

1.1 Introduction

Baffinland Iron Mines Corporation is developing an Iron Ore Mine Site on Baffin Island named the Mary River Project. This design basis will be for several new potable water treatment plants that will support the mine. It is anticipated that there will be a four (4) year construction phase followed by approximately twenty (20) years of operation of the mine. These new systems will therefore be designed to accommodate the expected potable water flow requirements from the various mine camps for both the construction and operation phases.

During the development of the project there will be eight (8) separate sites each housing a varying number of people. Three (3) sites will have construction and permanent camps. These are:

- Milne Port
- Mine Site, and
- Steensby Port

Five sites will be temporary camps. The temporary camps are:

- Mid-Way Camp
- Ravn River Camp
- Mid-Rail Camp
- Cockburn Lake Tunnels Area, and
- Cockburn South Camp

The potable water treatment systems will produce drinking water that meets the Canadian Drinking Water Guidelines 2010. All provinces and territories participate in setting the Guidelines for the Canadian Drinking Water Quality standards under a federal / provincial / territorial committee convened by Health Canada. The guidelines for the Northwest Territories Water Supply System Regulations adopt the Guidelines for Canadian Drinking Water Quality (GCDWQ), making them part of the regulations in the NWT.

Ontario and Québec have comprehensive treatment standards that go above and beyond the Guidelines and for that reason the guidelines of Ontario are also used as a point of comparison.

Minimum system requirements will be based upon the Northwest Territories Water Supply System Regulations, NWT Reg 108-2009, Ontario Design Guidelines for Drinking Water Systems 2008, Ontario Regulation 170/03 - Drinking Water Systems, the Procedure for Disinfection of Drinking Water in Ontario, as well as best management practice.

These guidelines specify that chemically assisted filtration is required for surface water sources. The guidelines also specify the minimum required levels of residual free chlorine in the potable water.

1.2 Description

This design criteria provides the basis for the engineering design of the Potable Water Treatment Plants at each of eight (8) sites, as part of the water treatment requirements for the Mary River Baffinland Iron Ore mine.

Information relating to potable water consumption, plant personnel and feed water composition has been summarized in the subsequent sections.

The new potable water treatment plants shall be able to meet site needs during the construction phase as well the requirements during the operation phase of the mine. The new potable water systems are to be designed to function without using any of the existing equipment or infrastructure.

The potable water plants will be required to treat water for potable consumption only. Other fresh water requirements will be met by a separate fresh water distribution system.

2. References

2.1 Codes and Standards

Unless specifically stated otherwise, the design of the potable water equipment will be in accordance with the latest revision of the following codes, standards and regulations. In addition, the design will comply with any laws or regulations of local authorities and Certificate of Approval.

Table 2-1: Applicable Regulations, Standards and Codes

Number / Acronym	Title
AWWA	*American Water Works Association*
IBC	*International Building Codes*
NSF	*National Sanitation Foundation*
GCWQ	*Guidelines for Canadian Drinking Water Quality*
NWT Reg 108-2009	*Northwest Territories Water Supply System Regulations*
Ontario Reg 170/03	*Safe Drinking Water Act, 2002*
Nunavut Waters and Nunavut Surface Rights Tribunal Act, SC 2002, c 10	
Northwest Territories Water Act	
Northwest Territories Water Regulations (SOR/93-303)	
Ontario Drinking Water Quality Standards	
NSF/ANSI Standard 61	Drinking Water System Components
AWWA Standard B100	Filtering Material
AWWA Standard B604	Granular Activated Carbon
OSHA	*Occupational Safety and Health Administration*

2.2 Other Reference Documents

Additional technical information is provided in the Technical Specification - Potable Water Treatment Plant, Document No. H337697-4000-10-123-0001.

3. Existing Equipment Description

As the project is already in the preliminary stages of development, there is some existing potable water treatment equipment at four of the sites. Descriptions of the existing systems follow. These excerpts are taken from the Baffinland Iron Mines Corporation Mary River Project 2008 Annual Report to the Nunavut Water Board:

3.1 Existing Fresh Water Supplies

Mary River Camp: Potable Water supply for the Mary River Camp was obtained using a diesel pump positioned adjacent to the shoreline of Camp Lake (MRY-1). Water was pumped directly from the lake source to water storage tanks located at the camp.

Milne Inlet Camp: Potable Water supply for the Milne Inlet Camp was obtained using a water truck to deliver water to the camp via the Milne Inlet Tote Road. A small portable pump was used to transfer water to the water truck which subsequently delivered the water to the camp. Once delivered to the camp, the water was transferred to larger holding tanks. Water for Milne Inlet was obtained from km 32 lake (MRY-3) for the entire season.

Steensby Camp: Steensby Inlet Camp potable water came from an unnamed lake approximately 3 km east of the camp. A small portable pump was used to withdraw water from the lake and used to fill small containers on the shore which were then flown back to the camp. Once delivered to the camp, the water was transferred to larger holding tanks. Later in the summer season, a collapsible water line was installed from 3km lake water source to the Steensby Inlet Camp.

Mid-Rail Camp: Mid-Rail Camp potable water came from an unnamed lake adjacent to the camp. A small portable pump was used to withdraw water directly from the lake source to the water storage tanks located at the camp.

3.2 Existing Potable Water Treatment Systems

Fresh water supplied to all four camps was treated with filtration and UV disinfection. Primary and secondary chlorination is not used in any of the existing potable water treatment system as the disinfection method.

3.3 Condition of Existing Treatment Systems

- Milne Port: Operating
- Mine Site: Operating
- Steensby Port: Operating

4. Design Parameters

Given that in no chlorination is used for primary or secondary disinfection, the proposed new potable water systems will replace the existing systems. Existing system components may be considered as a supply of spare parts or for additional redundancy purposes.

Fresh water will be treated in the potable water treatment system an will meet all the project drinking water standards. At a minimum, the potable water treatment will include filtration and chlorination. For technical details of the potable water treatment system configuration, refer to the Technical Specification - Potable Water Treatment Plant, Document No. H337697-4000-10-123-0001.

4.1 Fresh Water Supply (Feed to Potable Water Treatment)

The applicable fresh water supplies for the different Site locations are as follows:

Table 4-1: Fresh Water Sources (Feed to Potable Water Treatment)

Camp / Site	Potable Water Source
Milne Inlet (Port)	Phillips Creek (summer) Km 32 Lake (winter)
Mary River (Mine Site)	Camp Lake
Steensby (Port)	3 Km Lake (construction phase) ST 347 Lake (operation phase)
Mid-way Camp	Nivek Lake (summer) Unnamed lake supplying Ravn Camp (winter)
Ravn River Area	Unnamed lake north of the camp
Mid-Rail Area	Nivek Lake (summer) Unnamed lake supplying Ravn Camp (winter)
Cockburn Lake Tunnels Area	Cockburn Lake
Cockburn South Camp	Cockburn Lake

Notes:

1. A water analysis for Km 32 Lake was not available at the time of issuing this specification. As such, for design purposes the supplier is instructed to use only the Phillips Creek water analysis for the Milne Inlet potable water system. When an analysis for Km 32 Lake becomes available it will be provided to the supplier.
2. The proposed potable water sources were identified in the document: Design Basis for fresh water Distribution system for Mary River, Milne Inlet and Tote road construction (Issued for Feasibility Study) – TDR NO: 165926-6710-131-TDR-0001. As per the Trade-off Study meeting (dated June 28th, 2011) Baffinland Iron Mines Corp. has decided to move the proposed water source for Steensby Port during the operation phase from 3 Km Lake to "new lake" ST 347. At this time no water quality sampling for the new lake has been undertaken and as such the supplier is advised to use only the 3 Km Lake water analysis for the design of the Steensby system. The supplier will be given the water quality for ST 347 when it becomes available.

3. It has been assumed that the unnamed lake north of the Ravn River Area camp will have a water quality similar to that of Ravn River. As such, the supplier is instructed to use the Ravn River water quality for the unnamed lake.
4. The Mid-Way Camp potable water source was not identified. As such it has been assumed that the summer water source will be Nivek Lake given it is located in close proximity to this water source per the Mary River Project Construction Execution Plan, Report No. RP-159952-0000-450-001. The winter source is assumed to be the same as for Mid-Rail Camp, given that the Mid-Rail Camp uses the same summer water source.
5. In the event that the water supply source changes, the supplier will be provided with the updated information.

4.2 Feed Water Composition and Potable Water Quality Criteria

The main water quality parameters of the all raw water sources are supplied in the following tables. Each includes also relevant water quality criteria from the two sources identified in section 1.1:

Table 4-2: Cockburn Area Water Quality

Cockburn Area		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Temp	(°C)	25	0.02	13.48	5.51	13.48	< 15 AO	< 15 AO	< 15 AO
SpC	(mS/cm)	25	0.005	0.015	0.009	0.015			
DO	mg/L	25	10.3	14.9	12.76	14.9			
pH		25	5.88	7.55	6.57	5.88 - 7.55	6.5 - 8.5 AO		6.5 - 8.5 AO
Alkalinity	mg/L CaCO3	25	ND	6	-	6			
Br-	mg/L	25	ND	ND	-	ND			
Cl-	mg/L	25	ND	2	1	2	< 250 AO	< 250 AO	< 250 AO
Conductivity	uS/cm	25	6	17	10	17			
NH3+NH4	mg/L N	25	ND	0.7	-	0.7			
NO2-	mg/L N	25	ND	0.022	-	0.022		1	1
NO3-	mg/L N	25	ND	0.06	-	0.06	45	10	10
NO2+NO3	mg/L N	25	ND	0.06	-	0.06		10	10
Phenols	mg/L	25	ND	ND	-	ND			
SO4-	mg/L	25	ND	2	1	2	< 500 AO	< 500 AO	< 500 AO
TKN	mg/L	18	ND	0.37	-	0.37			
TOC	mg/L	18	ND	4	1.4	4			
DOC	mg/L	18	ND	3.3	-	3.3		< 5 AO	< 5 AO
TSS	mg/L	18	ND	ND	-	ND			
TDS	mg/L	25	ND	49	10	49	< 500 AO	< 500 AO	< 500 AO
Hardness	mg/L CaCO3	25	1	3.9	2.2	3.9			
Phosphorus	mg/L Total	25	ND	0.047	-	0.047			

Cockburn Area		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Turbidity	NTU	25	0	9	1.6	9	0.3 (chem assisted filter), 1 (slow sand filter), 0.1 (membrane filter)		0.3 (chem assisted filter), 1 (slow sand filter), 0.1 (membrane filter)
Aluminium	mg/L Total	25	0.0089	0.204	0.0496	0.204	0.1 (membrane), 0.2 (conventional)		0.1 (membrane), 0.2 (conventional)
Antimony	mg/L Total	15	ND	ND	-	ND	0.006	0.006	0.006
Arsenic	mg/L Total	25	ND	ND	-	ND	0.01	0.025	0.01
Barium	mg/L Total	25	ND	0.003	-	0.003	1	1	1
Beryllium	mg/L Total	15	ND	ND	-	ND			
Bismuth	mg/L Total	15	ND	ND	-	ND			
Boron	mg/L Total	25	ND	0.06	-	0.06	5	5	5
Cadmium	mg/L Total	25	ND	ND	-	ND	0.005	0.005	0.005
Calcium	mg/L Total	25	0.2	0.9	0.526	0.9			
Chromium	mg/L Total	25	ND	ND	-	ND	0.05	0.05	0.05
Cobalt	mg/L Total	25	ND	ND	-	ND			
Copper	mg/L Total	25	ND	0.001	-	0.001	<1 AO	< 1 AO	<1 AO
Iron	mg/L Total	25	ND	0.24	-	0.24	< 0.3 AO	< 0.3 AO	< 0.3 AO
Lead	mg/L Total	25	ND	0.0003	-	0.0003	0.01	0.01	0.01
Lithium	mg/L Total	12	ND	ND	-	ND			
Maganesium	mg/L Total	25	0.1	0.41	0.25	0.41			
Manganese	mg/L Total	25	ND	0.0138	-	0.0138	< 0.05 AO	< 0.05 AO	< 0.05 AO
Mercury	mg/L Total	25	ND	ND	-	ND	0.001	0.001	0.001

Cockburn Area		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Molybdenum	mg/L Total	25	ND	0.005	-	0.005			
Nickel	mg/L Total	25	ND	ND	-	ND			
Potassium	mg/L Total	25	ND	0.37	0	0.37			
Selenium	mg/L Total	25	ND	ND	-	ND	0.01	0.01	0.01
Silicon	mg/L Total	12	0.38	1.46	0.731	1.46			
Silver	mg/L Total	25	ND	ND	-	ND			
Sodium	mg/L Total	25	ND	1.24	0.804	1.24	< 200 AO	< 200 AO	< 200 AO
Strontium	mg/L Total	25	0%	0.0047	0.0031	0.0047			
Thallium	mg/L Total	18	ND	ND	-	ND			
Tin	mg/L Total	25	ND	0.001	-	0.001			
Titanium	mg/L Total	15	ND	0.011	-	0.011			
Uranium	mg/L Total	12	7E-05	0.00023	0.0001	0.000229	0.02	0.02	0.02
Vanadium	mg/L Total	25	ND	ND	-	ND			
Zinc	mg/L Total	25	ND	0.003	-	0.003	< 5 AO	< 5 AO	< 5 AO

Table 4-3: Ravn River Upstream of Angajurjualuk Lake Water Quality

Ravn River - Upstream of Angajurjualuk Lake		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Temp	(°C)	10	0.23	16.06	5.32	16.06	< 15 AO	< 15 AO	< 15 AO
SpC	(mS/cm)	10	0.009	0.038	0.025	0.038			
DO	mg/L	9	9.54	15.21	12.79	15.21			
pH		10	6.43	8.5	7.19	6.43 - 8.5	6.5 - 8.5 AO		6.5 - 8.5 AO
Alkalinity	mg/L CaCO3	10	ND	21	12	21			
Br-	mg/L	10	ND	ND	-	ND			
Cl-	mg/L	10	ND	3	-	3	< 250 AO	< 250 AO	< 250 AO
Conductivity	uS/cm	10	9	40	27	40			
NH3+NH4	mg/L N	10	ND	0.3	-	0.3			
NO2-	mg/L N	10	ND	0.009	-	0.009		1	1
NO3-	mg/L N	8	ND	ND	-	ND	45	10	10
NO2+NO3	mg/L N	8	ND	ND	-	ND		10	10
Phenols	mg/L	8	ND	ND	-	ND			
SO4-	mg/L	10	ND	9	2	9	< 500 AO	< 500 AO	< 500 AO
TKN	mg/L	6	ND	0.4	0.21	0.4			
TOC	mg/L	6	1.6	5.7	3.2	5.7			
DOC	mg/L	6	1.5	4.9	2.8	4.9		< 5 AO	< 5 AO
TSS	mg/L	6	ND	ND	-	ND			
TDS	mg/L	10	6	66	21	66	< 500 AO	< 500 AO	< 500 AO
Hardness	mg/L CaCO3	10	3	18	10.8	18			
Phosphorus	mg/L Total	10	ND	0.01	0	0.01			

Ravn River - Upstream of Angajurjualuk Lake		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Turbidity	NTU	10	1	4	2	4	0.3 (chem assisted filter), 1 (slow sand filter), 0.1 (membrane filter)		0.3 (chem assisted filter), 1 (slow sand filter), 0.1 (membrane filter)
Aluminium	mg/L Total	10	0.014	0.153	0.0662	0.153	0.1 (membrane), 0.2 (conventional)		0.1 (membrane), 0.2 (conventional)
Antimony	mg/L Total	5	ND	ND	-	ND	0.006	0.006	0.006
Arsenic	mg/L Total	10	ND	ND	-	ND	0.01	0.025	0.01
Barium	mg/L Total	10	ND	0.005	-	0.005	1	1	1
Beryllium	mg/L Total	5	ND	ND	-	ND			
Bismuth	mg/L Total	5	ND	ND	-	ND			
Boron	mg/L Total	10	ND	ND	-	ND	5	5	5
Cadmium	mg/L Total	10	ND	ND	-	ND	0.005	0.005	0.005
Calcium	mg/L Total	10	0.5	4	2.271	4			
Chromium	mg/L Total	10	ND	ND	-	ND	0.05	0.05	0.05
Cobalt	mg/L Total	10	ND	ND	-	ND			
Copper	mg/L Total	10	ND	0.00158	-	0.00158	<1 AO	< 1 AO	<1 AO
Iron	mg/L Total	10	0.06	0.21	0.12	0.21	< 0.3 AO	< 0.3 AO	< 0.3 AO
Lead	mg/L Total	10	ND	0.0002	-	0.0002	0.01	0.01	0.01
Lithium	mg/L Total	4	ND	ND	-	ND			
Magnesium	mg/L Total	10	0.37	2	1.27	2			
Manganese	mg/L Total	10	ND	0.02	0.0086	0.02	< 0.05 AO	< 0.05 AO	< 0.05 AO
Mercury	mg/L Total	10	ND	ND	-	ND	0.001	0.001	0.001
Molybdenum	mg/L Total	10	ND	0.0001	-	0.0001			
Nickel	mg/L Total	10	ND	ND	-	ND			

Ravn River - Upstream of Angajurjualuk Lake		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Potassium	mg/L Total	10	ND	0.66	-	0.66			
Selenium	mg/L Total	10	ND	ND	-	ND	0.01	0.01	0.01
Silicon	mg/L Total	4	0.284	1.29	-	1.29			
Silver	mg/L Total	10	ND	ND	-	ND			
Sodium	mg/L Total	10	ND	1.17	-	1.17	< 200 AO	< 200 AO	< 200 AO
Strontium	mg/L Total	10	0%	0.0071	0.0048	0.0071			
Thallium	mg/L Total	6	ND	ND	-	ND			
Tin	mg/L Total	10	ND	ND	-	ND			
Titanium	mg/L Total	5	ND	0.011	-	0.011			
Uranium	mg/L Total	4	9E-05	0.00036	-	0.000363	0.02	0.02	0.02
Vanadium	mg/L Total	10	ND	ND	-	ND			
Zinc	mg/L Total	10	ND	ND	-	ND	< 5 AO	< 5 AO	< 5 AO

Table 4-4: Camp Lake Water Quality

Camp Lake		Feed Water					Canadian Drinking Water Guidelines 2010 (applicable for Nunavut)	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Temperature	oC	26	0.9	8.6	5.677	8.6	< 15 AO	< 15 AO	< 15 AO
Specific Conductance	mS/cm	24	0.092	0.122	0.109	0.122			
Dissolved Oxygen	mg/L	26	4.32	19	12.651	19			
Average Depth	m	3	1	16	6.000	16			
Measured Depth	m	18	1	18	7.500	18			
Total Depth - May Samples	m	6	13	17.4	15.833	17.4			
Ice Thickness - May Samples	m	6	1.8	2.1	1.933	2.1			
Airspace - May Samples	m	6	0.05	0.25	0.150	0.25			
Snow Depth	m	6	0.02	0.25	0.173	0.25			
Water Depth	m	24	10.65	18.9	14.938	18.9			
Turbidity	NTU	21	0	79.8	4.364	79.8	0.3 (chem assisted filter), 1 (slow sand filter), 0.1 (membrane filter)		0.3 (chem assisted filter), 1 (slow sand filter), 0.1 (membrane filter)
Secchi Disk Depth	m	22	5.1	7.8	5.922	7.8			
General Parameters and Nutrients									
pH	-	29	6.8	8.3	7.690	6.8 - 8.3	6.5-8.5 AO		6.5-8.5 AO
Conductivity	µS/cm	29	93	134	112.48	134			
Turbidity	NTU	27	0.1	1.3	0.470	1.3			

Camp Lake		Feed Water					Canadian Drinking Water Guidelines 2010 (applicable for Nunavut)	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Hardness	mg/L as CaCO3	29	50	68.3	56.859	68.3			
Total Dissolved Solids (TDS)	mg/L	3	61	67	65.000	67	< 500 AO	< 500 AO	< 500 AO
TDS (COND - CALC)	mg/L	26	69	87	74.154	87			
Total Suspended Solids (TSS)	mg/L	26	2	2	2.000	2			
Alkalinity	mg/L as CaCO3	29	50	69	57.138	69			
Bromide	mg/L	29	0.05	0.25	0.188	0.25			
Chloride	mg/L	29	1	2	1.069	2	< 250 AO	< 250 AO	< 250 AO
Sulphate	mg/L					0			
		29	1	3	1.517	3	< 500 AO	< 500 AO	< 500 AO
Ammonia (NH3 + NH4)	mg/L N	29	0.02	0.06	0.024	0.06			
Nitrite	mg/L N					0			
		29	0.002	0.012	0.004	0.012			
Nitrate	mg/L N					0		1	1
		29	0.1	0.1	0.100	0.1	45	10	10
NO2+NO3	mg/L N	29	0.1	0.1	0.100	0.1		10	10
Total Phosphorus	mg/L	29	0.003	0.02	0.006	0.02			
Total Organic Carbon (TOC)	mg/L	26	1.7	2.2	1.927	2.2			

Camp Lake		Feed Water					Canadian Drinking Water Guidelines 2010 (applicable for Nunavut)	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Dissolved Organic Carbon	mg/L	26	1.6	2.1	1.865	2.1		< 5 AO	< 5 AO
Total Kjeldhal Nitrogen (TKN)	mg/L	26	0.05	0.35	0.144	0.35			
Phenols	mg/L	29	0.001	0.007	0.001	0.007			
Total Metals and Non-Metals									
Aluminium	mg/L	29	0.001	0.0379	0.010	0.0379	0.1 (membrane), 0.2 (conv)		0.1 (membrane), 0.2 (conv)
Antimony	mg/L	26	0.0001	0.0002	0.000	0.0002	0.006	0.006	0.006
Arsenic	mg/L	29	0.0001	0.001	0.000	0.001	0.01	0.025	0.01
Barium	mg/L	29	0.0044	0.01	0.006	0.01	1	1	1
Beryllium	mg/L	26	0.0005	0.0005	0.001	0.0005			
Bismuth	mg/L	26	0.0005	0.0005	0.001	0.0005			
Boron	mg/L	29	0.01	0.01	0.010	0.01	5	5	5
Cadmium	mg/L	29	1E-05	0.0001	0.000	0.0001	0.005	0.005	0.005
Calcium	mg/L	29	9	13.1	11.297	13.1			
Chromium	mg/L	29	0.0005	0.001	0.001	0.001		0.05	0.05
Cobalt	mg/L	29	0.0001	0.0002	0.000	0.0002			
Copper	mg/L	29	0.0007	0.019	0.002	0.019	< 1 AO	< 1 AO	< 1 AO
Iron	mg/L	29	0.03	0.057	0.032	0.057	< 0.3 AO	< 0.3 AO	< 0.3 AO
Lead	mg/L	29	5E-05	0.001	0.000	0.001	0.01	0.01	0.01
Lithium	mg/L	26	0.005	0.005	0.005	0.005			
Magnesium	mg/L	29	6	8.12	6.893	8.12			
Manganese	mg/L	29	0.0004	0.01	0.002	0.01	< 0.05 AO	< 0.05 AO	< 0.05 AO

Camp Lake		Feed Water					Canadian Drinking Water Guidelines 2010 (applicable for Nunavut)	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Mercury	mg/L	29	1E-05	0.0001	0.000	0.0001	0.001	0.001	0.001
Molybdenum	mg/L	29	0	185	6.380	185			
Nickel	mg/L	29	0.0005	0.005	0.001	0.005			
Phosphorus	mg/L	20	0.3	18	1.185	18			
Potassium	mg/L	29	0.59	2	1.526	2			
Selenium	mg/L	29	0.001	0.001	0.001	0.001	0.01	0.01	0.01
Silicon	mg/L	26	0.389	0.571	0.471	0.571			
Silver	mg/L	28	1E-05	0.0001	0.000	0.0001			
Sodium	mg/L	29	0.47	2	1.535	2	< 200 AO	< 200 AO	< 200 AO
Strontium	mg/L	28	0.0052	0.0076	0.006	0.0076			
Thallium	mg/L	26	0.0001	0.0001	0.000	0.0001			
Tin	mg/L	29	0.0001	0.01	0.002	0.01			
Titanium	mg/L	26	0.01	0.01	0.010	0.01			
Uranium	mg/L	26	0.0003	0.0005	0.000	0.0005	0.02	0.02	0.02
Vanadium	mg/L	29	0.001	0.001	0.001	0.001			
Zinc	mg/L	29	0.001	0.01	0.002	0.01	< 5 AO	< 5 AO	< 5 AO
Dissolved Metals and Non-Metals									
Aluminium	mg/L	29	1E-05	0.017	0.005	0.017			
Antimony	mg/L	26	0	10.8	0.415	10.8			
Arsenic	mg/L	29	0	0.001	0.000	0.001			
Barium	mg/L	29	0	0.01	0.005	0.01			
Beryllium	mg/L	26	0.0005	0.0011	0.001	0.0011			
Bismuth	mg/L	26	0.0005	0.03	0.002	0.03			
Boron	mg/L	29	0	0.01	0.010	0.01			

Camp Lake		Feed Water					Canadian Drinking Water Guidelines 2010 (applicable for Nunavut)	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Cadmium	mg/L	29	1E-05	0.005	0.000	0.005			
Calcium	mg/L	29	6.74	13.6	11.219	13.6			
Chromium	mg/L	29	0.0004	0.001	0.001	0.001			
Cobalt	mg/L	29	0	0.0002	0.000	0.0002			
Copper	mg/L	29	0.0002	0.0023	0.001	0.0023			
Iron	mg/L	29	0.0006	0.03	0.029	0.03			
Lead	mg/L	28	0	0.001	0.000	0.001			
Lithium	mg/L	26	0.005	0.733	0.033	0.733			
Magnesium	mg/L	29	0.001	8.34	6.681	8.34			
Manganese	mg/L	29	0.0004	0.374	0.015	0.374			
Mercury	mg/L	26	0	5E-05	0.000	5E-05			
Molybdenum	mg/L	29	0.0001	1.05	0.037	1.05			
Nickel	mg/L	29	0.0006	0.006	0.001	0.006			
Phosphorus	mg/L	19	0	0.3	0.284	0.3			
Potassium	mg/L	29	0	2	1.499	2			
Selenium	mg/L	29	0.001	0.01	0.001	0.01			
Silicon	mg/L	26	0.0004	0.53	0.439	0.53			
Silver	mg/L	29	0	0.001	0.000	0.001			
Sodium	mg/L	29	0.019	3.46	1.602	3.46			
Strontium	mg/L	29	0.0052	0.0077	0.006	0.0077			
Thallium	mg/L	27	0	0.0001	0.000	0.0001			
Tin	mg/L	29	0	0.01	0.002	0.01			
Titanium	mg/L	26	0.01	0.01	0.010	0.01			
Uranium	mg/L	26	0.0003	0.0005	0.000	0.0005			

Camp Lake		Feed Water					Canadian Drinking Water Guidelines 2010 (applicable for Nunavut)	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Vanadium	mg/L	29	0.001	0.001	0.001	0.001			
Zinc	mg/L	29	0.001	0.0191	0.003	0.0191			

Table 4-5: 3 km Lake Water Quality

3 Km Lake		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Temperature	oC	3	5.41	14.25	8.6	14.25	< 15 AO	< 15 AO	< 15 AO
Specific Conductance	mS/cm	3	0.09	0.13	0.103	0.13			
Dissolved Oxygen	mg/L	3	10.13	11.9	10.94	11.9			
pH	-	3	5.77	6.38	6.11	5.77 - 6.38	6.5-8.5 AO		6.5-8.5 AO
Water Depth	m	3	1	26.4	17.9	26.4			
Turbidity	NTU	3	1	10	5	10	0.3 (chem assisted filter), 1 (slow sand filter), 0.1 (membrane filter)		0.3 (chem assisted filter), 1 (slow sand filter), 0.1 (membrane filter)
Secchi Disk Depth	m	2	5.4	5.4	5.4	5.4			
General Parameters and Nutrients									
pH	-	3	6.74	7.18	7.01	7.18			
Conductivity	µS/cm	3	75	85	79	85			
Turbidity	NTU	3	0.4	2.8	1.3	2.8			
Hardness	mg/L as CaCO3	3	15.8	16.5	16.3	16.5			
TDS (COND - CALC)	mg/L	3	49	55	52	55		< 500 AO	< 500 AO
Total Suspended Solids (TSS)	mg/L	3	2	2	2	2			

3 Km Lake		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Alkalinity	mg/L	3	10	14	12	14			
Bromide	mg/L	1	0.25	0.25	0	0.25			
Chloride	mg/L	3	14	16	15	16	< 250 AO	< 250 AO	< 250 AO
Sulphate	mg/L	3	4	4	4	4	< 500 AO	< 500 AO	< 500 AO
Ammonia (NH3 + NH4)	mg/L as N	3	0.02	0.04	0.03	0.04			
Nitrite	mg/L as N	3	0.005	0.005	0.005	0.005		1	1
Nitrate	mg/L as N	3	0.1	0.18	0.13	0.18	45	10	10
NO2+NO3	mg/L as N	3	0.1	0.18	0.13	0.18		10	10
Total Phosphorus	mg/L	3	0.003	0.011	0.006	0.011			
Total Organic Carbon (TOC)	mg/L	3	2.2	2.5	2.3	2.5			
Dissolved Organic Carbon	mg/L	3	2.1	2.3	2.2	2.3		< 5 AO	< 5 AO
Total Kjeldahl Nitrogen (TKN)	mg/L	3	0.12	0.23	0.17	0.23			
Phenols	mg/L	3	0.001	0.001	0.001	0.001			
Total Metals and Non-Metals									
Aluminium	mg/L	3	0.014	0.101	0.044	0.101	0.1 (membrane), 0.2 (conventional)		0.1 (membrane), 0.2 (conventional)

3 Km Lake		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Antimony	mg/L	3	1E-04	1E-04	0.0001	0.0001	0.006	0.006	0.006
Arsenic	mg/L	3	1E-04	1E-04	0.0001	0.0001	0.01	0.025	0.01
Barium	mg/L	3	0.002	0.003	0.0026	0.00327	1	1	1
Beryllium	mg/L	3	5E-04	5E-04	0.0005	0.0005			
Bismuth	mg/L	3	5E-04	5E-04	0.0005	0.0005			
Boron	mg/L	3	0.01	0.01	0.01	0.01	5	5	5
Cadmium	mg/L	3	1E-05	1E-05	1E-05	0.00001	0.005	0.005	0.005
Calcium	mg/L	3	3.34	3.49	3.43	3.49			
Chromium	mg/L	3	5E-04	5E-04	0.005	0.0005		0.05	
Cobalt	mg/L	3	1E-04	1E-04	0.0001	0.0001			
Copper	mg/L	3	9E-04	0.001	0.001	0.00111	< 1 AO	< 1 AO	< 1 AO
Iron	mg/L	3	0.03	0.109	0.06	0.109	< 0.3 AO	< 0.3 AO	< 0.3 AO
Lead	mg/L	3	5E-05	1E-04	7E-05	0.00011	0.01	0.01	0.01
Lithium	mg/L	3	0.005	0.005	0.005	0.005			
Magnesium	mg/L	3	1.8	1.94	1.9	1.94			
Manganese	mg/L	3	0.001	0.002	0.0016	0.00243			
Mercury	mg/L	3	1E-05	1E-05	1E-05	0.00001	0.001	0.001	0.001
Molybdenum	mg/L	3	7E-05	1E-04	9E-05	0.000099			
Nickel	mg/L	3	5E-04	5E-04	0.0005	0.00053			
Potassium	mg/L	3	0.539	0.626	0.59	0.626			
Selenium	mg/L	3	0.001	0.001	0.001	0.001	0.01	0.01	0.01
Silicon	mg/L	3	0.221	0.386	0.29	0.386			
Silver	mg/L	3	1E-05	1E-05	1E-05	0.00001			
Sodium	mg/L	3	7.39	8.32	7.85	8.32	< 200 AO	< 200 AO	< 200 AO
Strontium	mg/L	3	0.01	0.011	0.01	0.0105			
Thallium	mg/L	3	1E-04	1E-04	0.0001	0.0001			

3 Km Lake		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Tin	mg/L	3	1E-04	1E-04	0.0001	0.0001			
Titanium	mg/L	3	0.01	0.01	0.01	0.01			
Uranium	mg/L	3	6E-05	9E-05	7E-05	0.000093	0.02	0.02	0.02
Vanadium	mg/L	3	0.001	0.001	0.001	0.001			
Zinc	mg/L	3	0.001	0.002	0.002	0.0018	< 5 AO	< 5 AO	< 5 AO
Dissolved Metals and Non-Metals									
Aluminium	mg/L	3	0.007	0.014	0.01	0.0142			
Antimony	mg/L	3	1E-04	1E-04	0.0001	0.0001			
Arsenic	mg/L	3	1E-04	1E-04	0.0001	0.0001			
Barium	mg/L	3	0.002	0.003	0.0024	0.0025			
Beryllium	mg/L	3	5E-04	5E-04	0.0005	0.0005			
Bismuth	mg/L	3	5E-04	5E-04	0.0005	0.0005			
Boron	mg/L	3	0.01	0.01	0.01	0.01			
Cadmium	mg/L	3	1E-05	1E-05	1E-05	0.00001			
Calcium	mg/L	3	3.33	3.48	3.43	3.48			
Chromium	mg/L	3	5E-04	5E-04	0.0005	0.0005			
Cobalt	mg/L	3	1E-04	1E-04	0.0001	0.0001			
Copper	mg/L	3	8E-04	1E-03	0.0009	0.00098			
Iron	mg/L	3	0.03	0.03	0.03	0.03			
Lead	mg/L	3	5E-05	5E-05	5E-05	0.00005			
Lithium	mg/L	3	0.005	0.005	0.005	0.005			
Magnesium	mg/L	3	1.81	1.89	1.9	1.89			
Manganese	mg/L	3	7E-04	1E-03	0.0008	0.000991			
Mercury	mg/L	3	1E-05	1E-05	1E-05	0.00001			

3 Km Lake		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Molybdenum	mg/L	3	6E-05	1E-04	8E-05	0.000115			
Nickel	mg/L	3	5E-04	5E-04	0.0005	0.0005			
Potassium	mg/L	3	0.535	0.578	0.55	0.578			
Selenium	mg/L	3	0.001	0.001	0.001	0.001			
Silicon	mg/L	3	0.173	0.262	0.22	0.262			
Silver	mg/L	3	1E-05	1E-05	1E-05	0.00001			
Sodium	mg/L	3	7.28	8.33	7.76	8.33			
Strontium	mg/L	3	0.01	0.011	0.0101	0.0107			
Thallium	mg/L	3	1E-04	1E-04	0.0001	0.0001			
Tin	mg/L	3	1E-04	1E-04	0.0001	0.0001			
Titanium	mg/L	3	0.01	0.01	0.01	0.01			
Uranium	mg/L	3	5E-05	8E-05	6E-05	0.000079			
Vanadium	mg/L	3	0.001	0.001	0.001	0.001			
Zinc	mg/L	3	0.001	0.002	0.001	0.0016			

Table 4-6: Nivek Lake Water Quality

Nivek Lake		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Temperature	oC	3	3.64	14.5	9.8	14.5	< 15 AO	< 15 AO	< 15 AO
Specific Conductance	mS/cm	3	0.057	0.14	0.085	0.14			
Dissolved Oxygen	mg/L	3	10.17	11.71	10.9	11.71			
pH	-	3	5.57	8.08	6.78	5.57 - 8.08	6.5-8.5 AO		6.5-8.5 AO
Water Depth	m	2	12	12	12	12			
Turbidity	NTU	3	2.8	9	6	9	0.3 (chem assisted filter), 1 (slow sand filter), 0.1 (membrane filter)		0.3 (chem assisted filter), 1 (slow sand filter), 0.1 (membrane filter)
Secchi Disk Depth	m	2	7	7	7	7			
General Parameters and Nutrients									
Chloride	mg/L					< 15	< 250 AO	< 250 AO	< 250 AO
Sulphate	mg/L					< 15	< 500 AO	< 500 AO	< 500 AO
Nitrite	mg/L as N					< 1		1	1
Nitrate	mg/L as N					< 10	45	10	10
NO2+NO3	mg/L as N					< 10		10	10

Nivek Lake		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Total Metals and Non-Metals									
Aluminium	mg/L	3	0.003	0.013	0.007	0.0134	0.1 (membrane), 0.2 (conventional)		0.1 (membrane), 0.2 (conventional)
Antimony	mg/L	3	1E-04	1E-04	0.0001	0.0001	0.006	0.006	0.006
Arsenic	mg/L	3	1E-04	1E-04	0.0001	0.0001	0.01	0.025	0.01
Barium	mg/L	3	0.003	0.003	0.0028	0.0031	1	1	1
Beryllium	mg/L	3	5E-04	5E-04	0.0005	0.0005			
Bismuth	mg/L	3	5E-04	5E-04	0.0005	0.0005			
Boron	mg/L	3	0.01	0.01	0.01	0.01	5	5	5
Cadmium	mg/L	3	1E-05	1E-05	1E-05	1E-05	0.005	0.005	0.005
Calcium	mg/L	3	4.92	5.47	5.22	5.47			
Chromium	mg/L	3	5E-04	5E-04	0.0005	0.0005		0.05	0.05
Cobalt	mg/L	3	1E-04	1E-04	0.0001	0.0001			
Copper	mg/L	3	4E-04	5E-04	0.0004	0.0005	< 1 AO	< 1 AO	< 1 AO
Iron	mg/L	3	0.03	0.053	0.04	0.053	< 0.3 AO	< 0.3 AO	< 0.3 AO
Lead	mg/L	3	5E-05	5E-05	5E-05	5E-05	0.01	0.01	0.01
Lithium	mg/L	3	0.005	0.005	0.005	0.005			
Magnesium	mg/L	3	1.03	1.11	1.1	1.11			
Manganese	mg/L	3	0.002	0.005	0.0031	0.0046			
Mercury	mg/L	3	1E-05	1E-05	1E-05	1E-05	0.001	0.001	0.001
Molybdenum	mg/L	3	5E-05	5E-05	0.0001	5E-05			
Nickel	mg/L	3	5E-04	5E-04	0.0005	0.0005			
Potassium	mg/L	3	0.532	0.643	0.57	0.643			

Nivek Lake		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Selenium	mg/L	3	0.001	0.001	0.001	0.001	0.01	0.01	0.01
Silicon	mg/L	3	0.236	0.246	0.24	0.246			
Silver	mg/L	3	1E-05	1E-05	1E-05	1E-05			
Sodium	mg/L	3	1.49	1.67	1.57	1.67	< 200 AO	< 200 AO	< 200 AO
Strontium	mg/L	3	0.041	0.045	0.043	0.0452			
Thallium	mg/L	3	1E-04	1E-04	0.0001	0.0001			
Tin	mg/L	3	1E-04	1E-04	0.0001	0.0001			
Titanium	mg/L	3	0.01	0.01	0.01	0.01			
Uranium	mg/L	3	1E-05	3E-05	2E-05	3E-05	0.02	0.02	0.02
Vanadium	mg/L	3	0.001	0.001	0.001	0.001			
Zinc	mg/L	3	0.001	0.002	0.001	0.0023	< 5 AO	< 5 AO	< 5 AO
Dissolved Metals and Non-Metals									
Aluminium	mg/L	3	0.001	0.004	0.002	0.0042			
Antimony	mg/L	3	1E-04	1E-04	0.0001	0.0001			
Arsenic	mg/L	3	1E-04	1E-04	0.0001	0.0001			
Barium	mg/L	3	0.003	0.003	0.0027	0.0029			
Beryllium	mg/L	3	5E-04	5E-04	0.0005	0.0005			
Bismuth	mg/L	3	5E-04	5E-04	0.0005	0.0005			
Boron	mg/L	3	0.01	0.01	0.01	0.01			
Cadmium	mg/L	3	1E-05	1E-05	1E-05	1E-05			
Calcium	mg/L	3	5.01	5.5	5.31	5.5			
Chromium	mg/L	3	5E-04	5E-04	0.0005	0.0005			
Cobalt	mg/L	3	1E-04	1E-04	0.0001	0.0001			

Nivek Lake		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Feed Water Quality Value			
Copper	mg/L	3	2E-04	5E-04	0.0003	0.0005			
Iron	mg/L	3	0.03	0.03	0.03	0.03			
Lead	mg/L	3	5E-05	5E-05	5E-05	5E-05			
Lithium	mg/L	3	0.005	0.005	0.005	0.005			
Magnesium	mg/L	3	1.05	1.13	1.1	1.13			
Manganese	mg/L	3	3E-04	0.003	0.0015	0.0032			
Mercury	mg/L	3	0	1E-05	1E-05	1E-05			
Molybdenum	mg/L	3	5E-05	1E-04	0.0001	0.0001			
Nickel	mg/L	3	5E-04	5E-04	0.0005	0.0005			
Potassium	mg/L	3	0.522	0.606	0.55	0.606			
Selenium	mg/L	3	0.001	0.001	0.001	0.001			
Silicon	mg/L	3	0.226	0.245	0.24	0.245			
Silver	mg/L	3	0	1E-05	1E-05	1E-05			
Sodium	mg/L	3	1.51	1.6	1.55	1.6			
Strontium	mg/L	3	0.041	0.044	0.0426	0.044			
Thallium	mg/L	3	1E-04	1E-04	0.0001	0.0001			
Tin	mg/L	3	1E-04	4E-04	0.0002	0.0004			
Titanium	mg/L	3	0.01	0.01	0.01	0.01			
Uranium	mg/L	3	1E-05	2E-05	1E-05	2E-05			
Vanadium	mg/L	3	0.001	0.001	0.001	0.001			
Zinc	mg/L	3	0.001	0.002	0.001	0.0021			

Table 4-7: Phillips Creek Water Quality

Phillips Creek		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Value			
Temp	(°C)	3	0.32	10.4	4.8	10.41	< 15 AO	< 15 AO	< 15 AO
SpC	(mS/cm)	3	0.122	0.16	0.138	0.16			
DO	mg/L	3	11.71	13	12.59	13.03			
pH		3	8.12	8.21	8.17	8.12 - 8.21	6.5 - 8.5 AO		6.5 - 8.5 AO
Alkalinity	mg/L CaCO3	3	67	86	75	86			
Br-	mg/L	3	0.05	0.05	0.05	0.05			
Cl-	mg/L	3	1	1	1	1	< 250 AO		< 250 AO
Conductivity	uS/cm	3	125	166	145	166			
NH3+NH4	mg/L N	3	0.03	0.1	0.07	0.1			
NO2-	mg/L N	3	0.005	0.02	0.009	0.016		1	1
NO3-	mg/L N	3	0.1	0.1	0.1	0.1	45	10	10
NO2+NO3	mg/L N	3	0.1	0.1	0.1	0.1		10	10
Phenols	mg/L	3	0.001	0	0.001	0.001			
Total P		3	0.01	0.03	0.02	0.03			
SO4-	mg/L	3	1	4	2.3	4	< 500 AO	< 500 AO	< 500 AO
TDS	mg/L	3	81	108	94	108	< 500 AO	< 500 AO	< 500 AO
Hardness	mg/L CaCO3	3	65	85	74.3	85			
Phosphorus	Total	3	0.01	0.03	0.02	0.03			
Turbidity	NTU	2	0.6	0.7	0.65	0.7	0.3 (chem assisted filter), 1 (slow sand filter), 0.1 (membrane filter)		0.3 (chem assisted filter), 1 (slow sand filter), 0.1 (membrane filter)

Phillips Creek		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Value			
Aluminium	Total	3	0.006	0.1	0.04	0.101	0.1 (membrane), 0.2 (conventional)		0.1 (membrane), 0.2 (conventional)
Antimony	Total	0				0	0.006	0.006	0.006
Arsenic	Total	3	0.001	0	0.001	0.001	0.01	0.025	0.01
Barium	Total	3	0.01	0.01	0.01	0.01	1	1	1
Boron	Total	3	0.01	0.01	0.01	0.01	5	5	5
Cadmium	Total	3	1E-04	0	0.0001	0.0001	0.005	0.005	0.005
Calcium	Total	3	16	20	17.67	20			
Chromium	Total	3	0.001	0	0.001	0.001	0.05	0.05	0.05
Cobalt	Total	3	2E-04	0	0.0002	0.0002			
Copper	Total	3	0.001	0	0.001	0.001	<1 AO	<1 AO	<1 AO
Iron	Total	3	0.03	0.12	0.06	0.12	< 0.3 AO	< 0.3 AO	< 0.3 AO
Lead	Total	3	0.001	0	0.001	0.001	0.01	0.01	0.01
Maganesium	Total	3	6	8	7	8			
Manganese	Total	3	0.01	0.01	0.01	0.01	< 0.05 AO	< 0.05 AO	< 0.05 AO
Mercury	Total	3	1E-04	0	0.0001	0.0001	0.001	0.001	0.001
Molybdenum	Total	3	0.005	0.01	0.005	0.005			
Nickel	Total	3	0.005	0.01	0.005	0.005			
Potassium	Total	3	0.35	0.51	0.46	0.51			
Selenium	Total	3	0.001	0	0.001	0.001	0.01	0.01	0.01
Silver	Total	3	1E-04	0	0.0001	0.0001			
Sodium	Total	3	0.34	1.15	0.7	1.15	< 200 AO	< 200 AO	< 200 AO
Strontium	Total	3	0.01	0.02	0.0123	0.015			
Tin	Total	3	0.01	0.01	0.01	0.01			
Uranium	Total					< 0.02	0.02	0.02	0.02

Phillips Creek		Feed Water					Canadian Drinking Water Guidelines 2010	Ontario Drinking Water Quality Standards	Design Drinking Water Quality Criteria
		Number of Samples	Min	Max	Mean	Design Value			
Vanadium	Total	3	0.001	0	0.001	0.001			
Zinc	Total	3	0.01	0.01	0.01	0.01	< 5 AO	< 5 AO	< 5 AO

Notes:

1. For some of the parameters listed above minimal sampling was performed. For these parameters, where deemed necessary, we have assumed design values to ensure that the WTP is conservatively designed. Parameters for which water quality drinking standards exist were reviewed in particular.
2. Some water quality parameters, for which water quality drinking standards exist, were not tested for at all. Of these it is expected that only fluoride and colour may be present in significant quantities. It is assumed that fluoride will fall below the guidelines (1.5 mg/L) while colour will be minimal and reduced within the WTP to acceptable limits (< 15 TCU).
3. Other parameters for which water quality drinking standards exist – radiological contaminants and organic pollutants are assumed to be not present in significant quantities. Microbial content is assumed to be present. The WTP effluent requirements for both microbial content, as well as residual chlorine, are given in a subsequent section.
4. It was determined that an as yet unnamed river would be used as the feed source for the Ravn River Camp. Given the lack of specifics we have assumed that water samples from the Ravn River will be representative of this source as provided in Mary River Project Environmental Impact Statement Appendix 7B (December 2010).
5. Water data comes from the Mary River Project Environmental Impact Statement Appendix 7B (December 2010).
6. The term AO refers to Aesthetic Objective. That is a water treatment objective that is desirable but not absolutely required.

Table 4-8: Additional Potable Water Quality Requirements

General Parameters and Nutrients	Units	Canadian Drinking Water Guidelines 2010
E. Coli		0 coliforms per 100 mL
Total Coliforms		0 coliforms per 100 mL
Cyanobacterial toxins	mg / L	0.0015
Residual Free Chlorine	mg / L	0.2 (see notes 1,2,3)

Notes:

1. The residual free chlorine requirement above is based upon the optimum target level identified in Ontario Reg. 170/03 "Procedure for Disinfection of Drinking Water in Ontario". Note that the residual free chlorine requirement applies to the chlorine content of the water at the furthest point of use. For design purposes to determine the chlorine content at the furthest point of use the supplier shall consider the retention time in the effluent tank as well as 5 minutes of water retention in the distribution piping. It is intended that the water in the distribution piping will be constantly flowing as a safeguard against freezing.
2. As per Ontario Reg 170/03, and best management practice, Hatch recommends the use of a *secondary disinfection* system to ensure that the minimum residual chlorine concentration will be maintained at further point-of-use in the potable water distribution system. This is to protect the health of the users, and to ensure a safe drinking water supply.
3. *Primary disinfection* shall be performed with either Chlorination or Ultra Violet methods.

4.3 Potable Water Treatment

The new potable water systems will consist of the following:

- System feed supply pumps.
- Chemically assisted filtration system to remove suspended particulate.
- Disinfection of treated water prior to consumption.

Potable water will be discharged to a product tank (supplied by others). From here water will be drawn by distribution pumps (supplied by others) for distribution to the various areas. The potable water systems will be designed to meet daily potable water requirements while operating 24 hours/day and 365 days/year.

4.4 Potable Water Supply

Potable water will be pumped to the accommodation building for use as drinking water, showers, toilets, sinks and kitchen areas:

At more remote areas, potable water will be trucked from the treatment plant into local potable water storage tanks. Potable water will be supplied for local use from this storage tank for the following facilities:

- Warehouse
- Power plant
- Boiler plant
- Air Ports
- Emulsion Plant
- Mine Truck
- Incinerator Plant
- Emergency Shelter

The water in the distribution piping will be designed to be constantly flowing as a safeguard against freezing.

4.5 Potable Water Demand

The flow requirements of the potable water treatment plants will be based upon the above information as well as the worker populations for the different camps. The resulting flow requirements are presented in the Technical Specification - Potable Water Treatment Plant, Document No. H337697-4000-10-123-0001.

4.5.1 Population

An estimate of worker population during the operations phase and construction phase is shown in the table below:

Table 4-9: Worker Population Distribution

Camp / Site	Worker Population	
	Operation	Construction
Milne Inlet (Port)	40	160
Mary River (Mine Site)	300	1000
Steensby (Port)	200	600
Mid-way Camp	-nil-	49
Ravn River Area	-nil-	200
Mid-Rail Area	-nil-	200
Cockburn Lake Tunnels Area	-nil-	100
Cockburn South Camp	-nil-	400

4.5.2 Average demand flow

Average potable water flow requirements have been estimated based on the number of workers at the site and a per capita consumption rates.

Table 4-10: Potable Water System Average Flow Requirement Design

Parameter	Design Value	Source
Potable Water Requirement per Capita	300 L/person/day	Design Basis for fresh water Distribution system for Mary River, Milne Inlet and Tote road (issued for feasibility study) – Nov. 29, 2010 prepared by AMEC. Doc. No. 165926-6710-131-TDR-0001

4.5.3 *Peak demand flow*

The peak potable water requirements have been estimated using a typical peaking factor. This peaking factor estimates the peak hourly flowrate above the average demand. This factor is an estimate that is based upon the total number of people that are served by the potable water system.

Table 4-11: Potable Water System Peak Demand Flow Design Basis[1,4]

Equivalent Population	Night Minimum Hour Factor	Maximum Day Factor	Peak Hour Factor	Design Peak Hour Factor[2,3]
30	0.1	9.5	14.3	16.4
150	0.1	4.9	7.4	8.5
300	0.2	3.6	5.4	6.2
450	0.3	3	4.5	5.2
500	0.4	2.9	4.3	4.9
1000	0.4	2.75	4.13	4.7

Notes:

1. The source for the peak sewage flow rates design basis is the Ontario Design Guidelines for Drinking Water Systems, 2008.

2. A 15% design allowance was added to the Peak Hour Factor.

3. The design peak hour factor will be used in sizing the equalization tank, upstream of the potable water treatment plant.

4. The potable water treatment plant will be designed to handle the average flowrate.