H353004-10000-270-252-0002-0001

DWG. No.

LEGEND

(hexagon)	IMPACTED WATERSHED
(rectangle)	DEVELOPMENT AREAS
(dotted rectangle)	DEVELOPMENT AREAS SUBJECT TO APPROVAL
(rounded rectangle)	STORMWATER PONDS
(solid arrow)	CONTINUOUS OR WATERSHED FLOW
(dashed arrow)	INTERMITTENT FLOW
A/AA 100,000	ANNUAL VOLUME (m³/a)
MAUR	MEAN ANNUAL UNIT RUNOFF (l/s/km²)
MSC	MINE SITE COMPLEX
DA	DRAINAGE AREA (km²)

NOTES:

1. SITE LAYOUT PER DRAWING H353004-00000-220-272-0005-0001.
2. REFER TO PROCESS FLOW DIAGRAM H353004-10000-270-282-0001-0001 FOR MORE DETAILED WATER SUPPLY AND WASTE WATER TREATMENT.
3. RAW WATER SUPPLY FLOW RATE CAMP LAKE IS EQUAL TO OR LESS THAN TYPE A WATER LICENCE 2AM-MRY1325 FLOW RATE LIMIT OF 657.5m³/day (240,000m³/year) TOTAL.
4. USE OF POLISHING WASTE STABILIZATION POND PRIOR TO MARY RIVER DISCHARGE WILL OCCUR ON A CONTINGENCY BASIS ONLY, IN THE EVENT OF OFF-SPEC TREATED SEWAGE EFFLUENT.
5. USE OF POLISHING WASTE STABILIZATION POND AND SHEARDOWN LAKE DISCHARGE WILL OCCUR ON A CONTINGENCY BASIS ONLY, SHOULD CAPACITY BE EXCEEDED THROUGH THE SEWAGE TREATMENT SYSTEM DISCHARGING TO MARY RIVER.
6. BULK FUEL STORAGE AREA RUNOFF DRAINED TO ENVIRONMENT IF QUALITY SATISFIES DISCHARGE REQUIREMENTS; OTHERWISE IS CONVEYED TO MOBILE OIL/WATER SEPARATOR FOR TREATMENT PRIOR TO DISCHARGE.
7. PLANT SITE RECEIVES ONLY PRECIPITATION-RUNOFF AND NO SURFACE WATER RUNOFF FROM SURROUNDING AREAS.
8. REFER ERP SURFACE WATER AND AQUATIC ECOSYSTEM MANAGEMENT FROM H349000-1000-07-126-0005, REV 1.
9. MSC STP MOVED TO PORT.

PERMIT TO PRACTICE
HATCH LTD.
Signature: 2019.04.17 12:22:11 -04'00'
Date
PERMIT NUMBER: P 512
The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

REGISTERED PROFESSIONAL ENGINEER — J.M. WIKSTON — LICENSEE 2019-04-17 — NT/NU

FOR USE

HATCH

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	H VINCENT	NR	24-08-2018
DESIGNER		NR	
CHECKER	P CHERRY		2019-04-16
DESIGN COORD.	R GOOSEN		2019-04-16
RESP. ENG.	J WIKSTON		2019.04.17
LEAD DISC. ENG.	P CHERRY		2019-04-16
AREA LEAD	M HAAKSMA		2019-04-16
ENG. MANAGER	R GOOSEN		2019-04-16
AREA MANAGER	T ATIBA		19-04-17

DRAWING APPROVAL STATUS: Approved for Use

No.	DESCRIPTION	BY	CHK'D	DATE
1	MSC DORMITORIES AND STP MOVED TO PORT	LS	PC	10-04-2019
0	APPROVED FOR USE	HV	PC	12-09-2018

REVISIONS

DRAWING No.	DRAWING TITLE
H349000-4000-10-002-0002	MINE SITE - WATER BALANCE - BLOCK FLOW DIAGRAM

REFERENCE DRAWINGS

REG. PROFESSIONAL

Baffinland

BAFFINLAND IRON MINES LP
MARY RIVER EXPANSION PROJECT

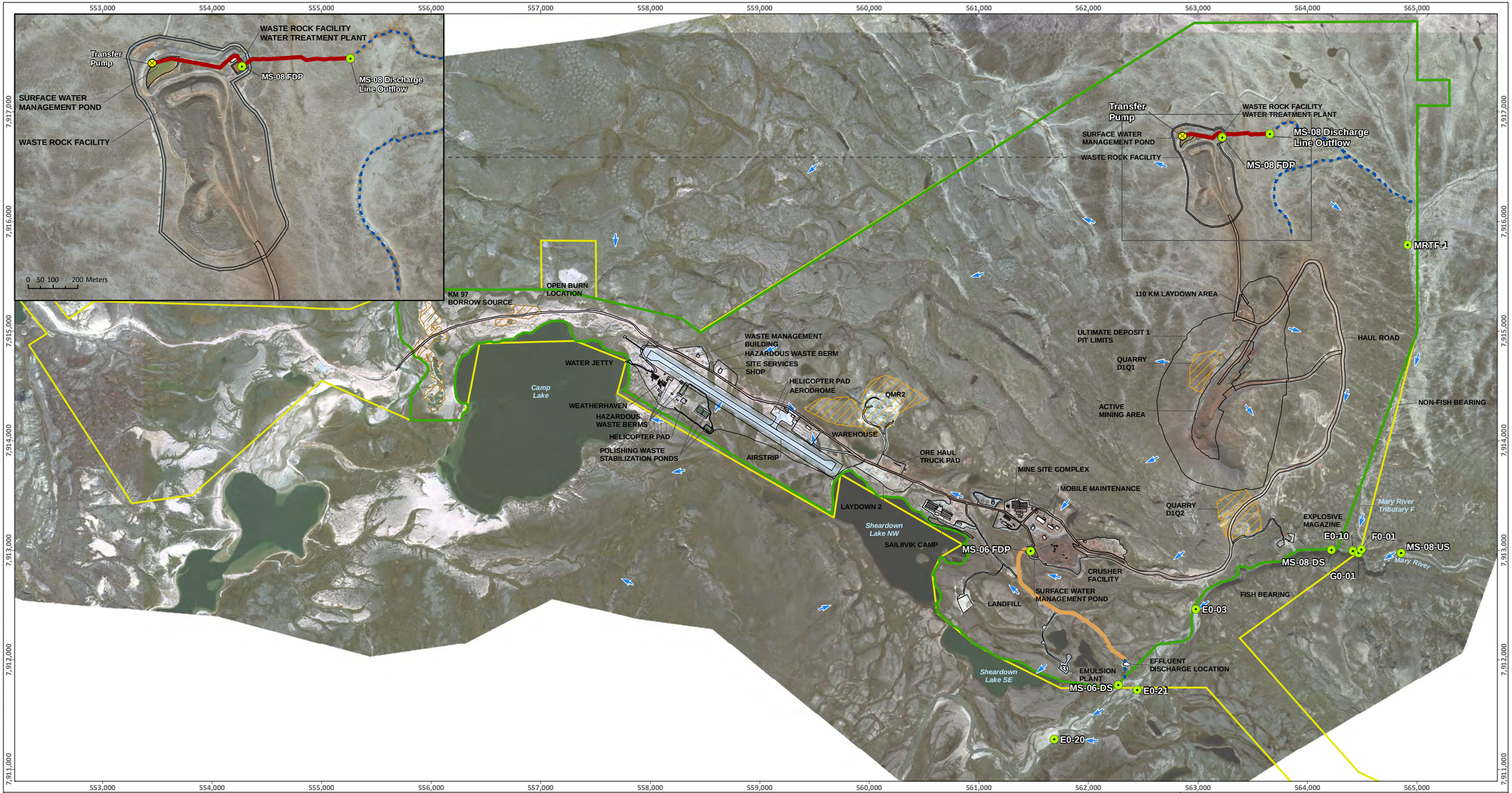
MINE SITE
AREA WATER BALANCE
BLOCK FLOW DIAGRAM

SCALE: NTS OR AS NOTED
DWG. No.: H353004-10000-270-252-0002-0001
REV: 1

SHEET SIZE: D

jdc_pwservice 16-APR-2019 09:24
\\DCPWPDF03\PDFtemp\73967\115106_528\H353004-10000-270-252-0002-0001.dgn

Appendix E
Site Layouts



LEGEND

- Borrow Area
- Quarry Area
- Project Development Area
- Commercial Lease Boundary
- Current Infrastructure
- Lay Flat Hose
- HDPE Pipe
- Overland Surface Water Flow
- Drainage Direction
- Monitoring
- Pump

ᓄᓇᕗᑦ ᐅᕙᖓᓄᐃᑦ MARY RIVER PROJECT

Mine Site Layout and MDMER Water Licence Monitoring Locations

Projection: NAD 1983 UTM ZONE 17N.
Base Map: © 2019 Digital Global, Inc.
Imagery and Infrastructure are representative as of August 2019.

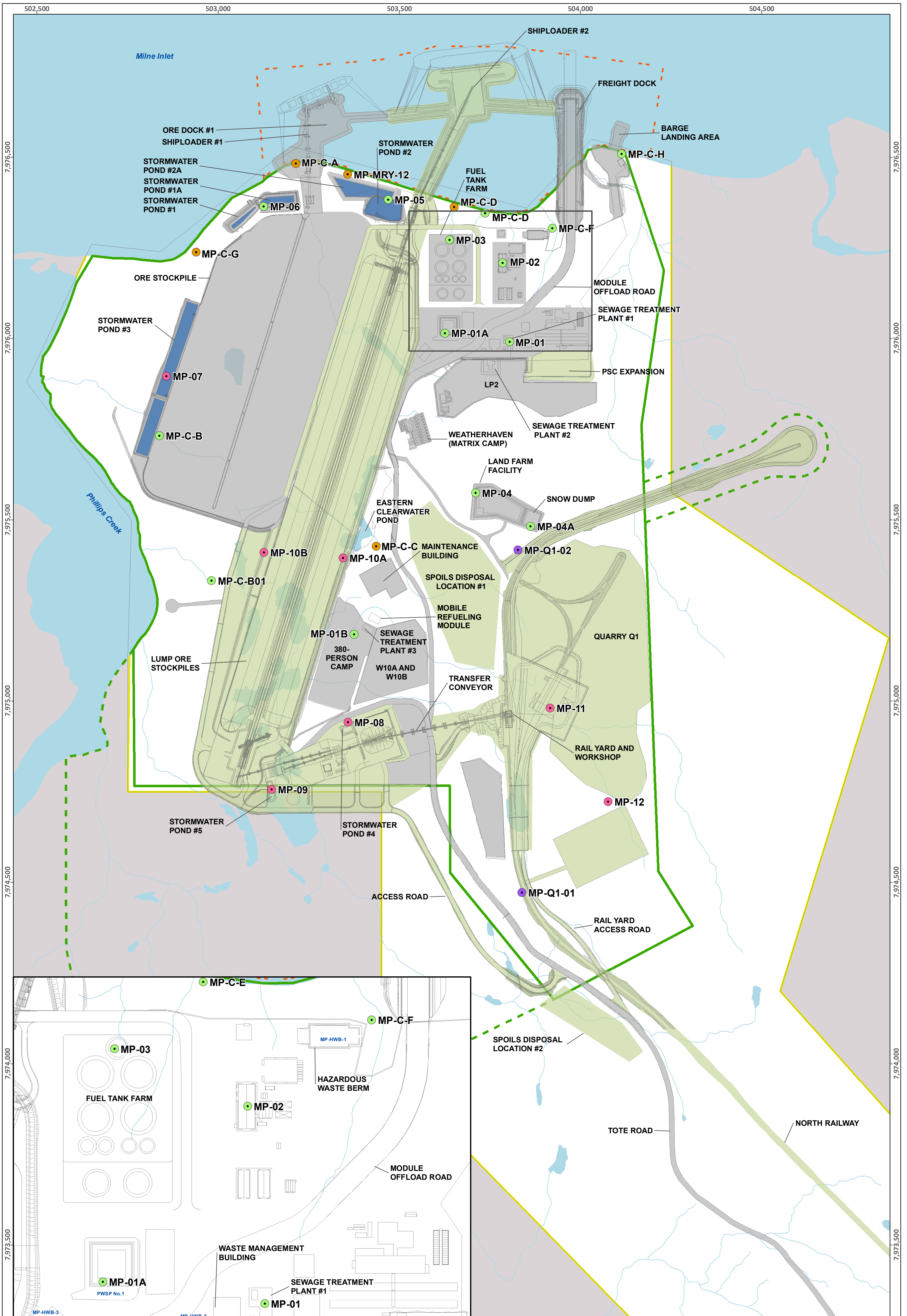
0 115 230 460 690 920 Meters
Scale 1:34,000

N

Baffinland

ᑎᑎᕋᐅᖏᑦ FIGURE 1

SAVED: C:\Users\katie.mcguire\Documents\4 - Maps\Reporting\1_AnnualMDMER\BIM_Fig 1 MineSite MDMER.mxd; 29-Mar-20



LEGEND

- Proposed Phase 2 Surveillance Network Program (SNP) Station
- Water Licence Surveillance Network Program (SNP) Station
- Monitored not officially SNP (Requested to add to SNP in Water Licence Application)
- Inactive
- Foreshore Lease Boundary
- Project Development Area
- Commercial Lease Boundary
- Approved Infrastructure
- Additional Phase 2 Proposal Infrastructure

ᓄᓘᔨᓂ ᐅᔭᕐᓯᐅᕐᑐᑦ MARY RIVER PROJECT

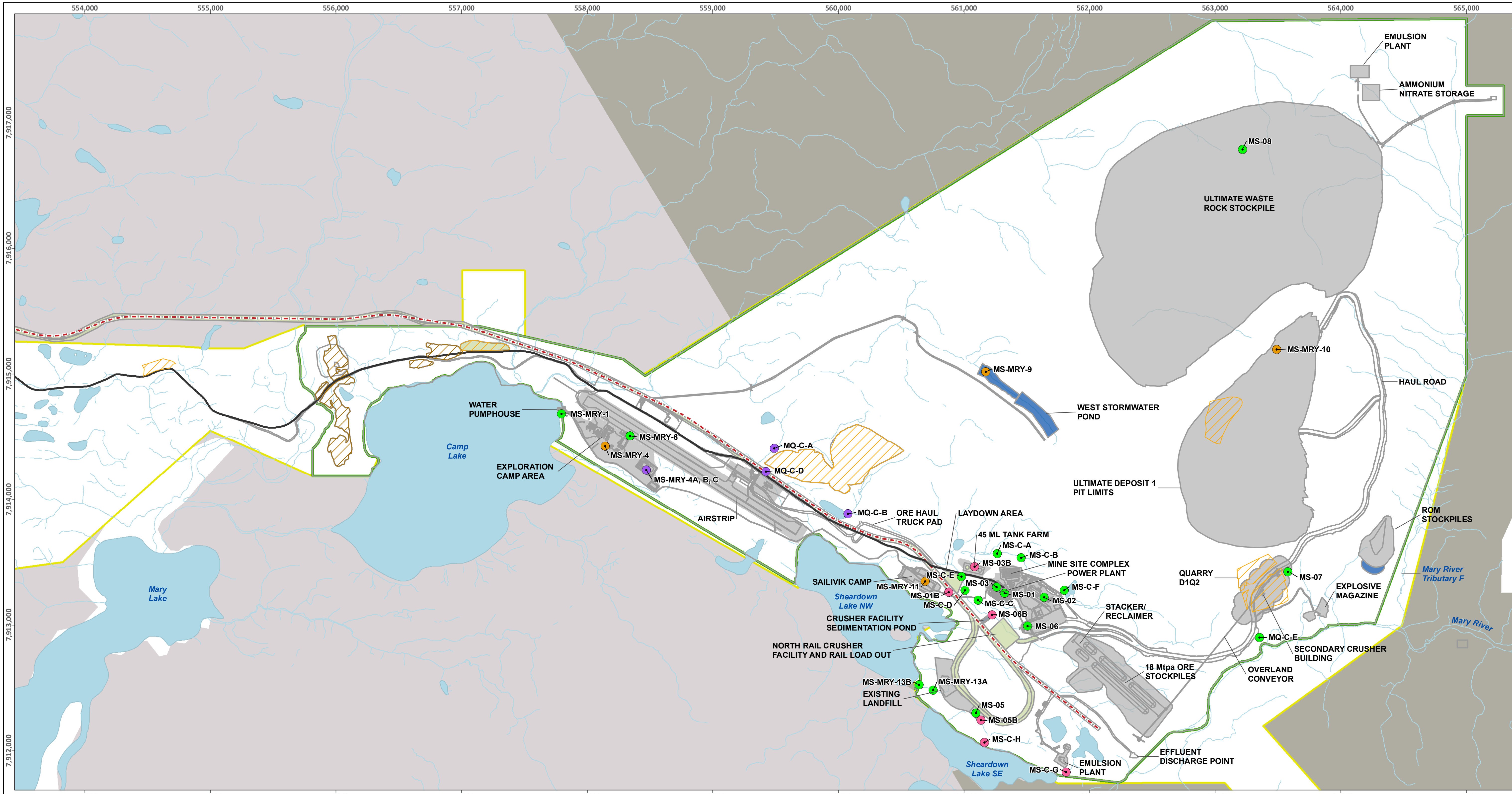
Milne Port Site Layout Phase 2 Proposal

Projection: NAD 1983 UTM ZONE 17N.
Base Map: © Her Majesty the Queen in rights of Canada Department of Natural Resources (2009).

0 30 60 120 180 240 Meters
Scale 1:10,000
N

Baffinland

ᑎᑎᕐᑲᐅᔭᕐᓯᒪᔪᖅ FIGURE 1



SAVED: C:\Users\kale.mcguire\Documents\4 - Maps\External\KPMP\BIM_6_2_MineSite - SNP.mxd; 16-Oct-19

LEGEND

- Proposed Phase 2 Surveillance Network Program (SNP) Station
- Water Licence Surveillance Network Program (SNP) Station
- Monitored not officially SNP (Requested to add to SNP in Water Licence Application)
- Inactive
- Borrow Area
- Quarry Area
- Infrastructure
- Project Development Area
- Commercial Lease Boundary
- Approved Infrastructure
- Additional Phase 2 Proposed Infrastructure

MARY RIVER PROJECT

Mine Site Layout Phase 2 Proposal

Projection: NAD 1983 UTM ZONE 17N.
Base Map: © Her Majesty the Queen in rights of Canada Department of Natural Resources (2009).

0 100 200 400 600 800 Meters
Scale 1:30,000
N

Baffinland

FIGURE 2

Appendix F
Polishing Waste Stabilization Pond Effluent Discharge Plan

Wood Environment & Infrastructure Solutions,
a Division of Wood Canada Limited
900 Maple Grove Road, Unit 10
Cambridge, ON N3H 4R7
Canada
T: 519-650-7100

Technical Memo

To: Connor Devereaux, Baffinland Iron Mines

From: Jack Hinds, P.Eng, Wood E&IS

Reviewer: Jered Munro, P.Eng, Wood E&IS

Project No.: TPC192071

Date: 17 October 2019

Re: PWSP Treatment and Discharge DRAFT

1.0 Background

Baffinland Iron Mines Corporation (Baffinland) has retained Wood Environment and Infrastructure Solutions, a Division of Wood Canada Ltd (Wood E&IS) to prepare this technical memo, outlining treatment, and disposal options for the water stored in the polishing/ waste stabilization ponds (PWSPs) at the Milne Inlet and Mary River sites.

The PWSPs can receive wastewater, sludge, grey water, and offspec effluent from various locations across both sites. These sources include, but are not limited to:

- Offspec effluent from wastewater treatment plants
- Excess sludge generated at wastewater treatment plants
- Raw sewage from spills
- Raw sewage from lift stations as a result of malfunction or emergency
- Greywater from lift stations

This plan updates and amends the previous plan that was completed in March 2012. The intent of this memorandum is to outline options that could be employed to treat the PWSPs to a level that is compliant with the approved Type A Water Licence requirements and be discharged to the environment under those requirements. The proposed treatment options may be used individually, or combined with other treatment options to form a treatment system that is capable of achieving compliant effluent quality. This approach has been selected to provide operators with the ability to address various water quality issues that can occur due to changing conditions in the PWSPs, caused by the various site sources noted above, and the natural environment.

The PWSPs can potentially require treatment for:

- Removal of BOD/COD
- Removal of total suspended solids (TSS)
- Removal of total ammonia
- Removal of total phosphorus
- Removal of oil and grease
- Destruction of faecal coliforms
- Acute Toxicity associated with inorganic or organic compounds
- Control of pH

Wood Environment & Infrastructure Solutions,
a Division of Wood Canada Limited
900 Maple Grove Road, Unit 10
Cambridge, ON N3H 4R7
Canada
T: 519-650-7100

1.1 Onsite Water/Wastewater Treatment Equipment

There are a number of water and wastewater treatment equipment resources available at the Project site that are available for use in treating the PWSPs. The equipment is owned and maintained by Baffinland, and is typically operated by Baffinland, or is operated under contract with an engineering or operations firm. It is expected that Baffinland may be required to purchase additional equipment, or replace existing equipment that is aging or no longer functional.

Baffinland maintains a supply of common treatment chemicals required by the treatment processes. Less common chemicals used for treatment are brought on site on an as-needed basis.

2.0 Treatment of PWSPs

PWSP treatment occurs during the spring and summer discharge seasons, when the water in these ponds is not frozen. Water quality in the PWSPs can be variable, and often changes over the course of the year. These variations in water quality are typically caused by:

- Contributions of impacted water to the PWSPs
- Spring melt, and ice retained within the PWSPs
- Fluctuations in temperature and pH
- Biological activity and consumption of nutrients
- Diurnal effects, exacerbated by long periods of daylight/twilight during the mid-summer months

The treatment methods presented below represent the treatment techniques that may be employed to achieve compliant water quality in the PWSPs, and allow for discharge to the environment. The options presented have been listed discretely but may be combined as required in order to address the influent water quality. As the water quality is variable over the course of a single season, multiple treatment methods or approaches may be required in a single season in order to maintain compliant effluent quality.

2.1 Spring Discharge

During the winter season, the PWSPs will stratify and eventually freeze the entire water column down to the lined bottom of the pond. During spring freshet, warmer temperatures and increased daylight hours cause the top layer of ice to thaw first, creating a pool of clear water on the surface of the PWSPs.

Typically, this initial melt water is compliant for discharge due to settling of solids at the end of the previous season. If the water quality analysis confirms the meltwater is compliant, it may be discharged to the receiving environmentwithout further treatment.

The discharge will be monitored for compliance following the guidelines given in Section 3.0.

2.2 Membrane Bioreactor Treatment

Baffinland owns and operates Membrane Bioreactors (MBRs) for treatment of sewage at both the Mary River and Milne Inlet sites. If there is available capacity in these plants, impacted water from the PWSPs may be treated through the installed MBRs. This may be achieved either through the use of a vac-truck offloading to the equalization tank, or through installation of a temporary or permanent pumped line to the equalization tanks.

Appropriate controls are put in place to ensure the total volume of pond water treated is controlled and recorded, and the equalization tank and MBR treatment system are adequately protected from damage.

An alternate approach that could be considered by Baffinland is to install a package treatment process specifically for the PWSPs. In this case, impacted water from the ponds will be pumped directly into the equalization tank, and treated through the system.

Generally, a package treatment system is comprised of the following processes:

- Equalization tank and pumps
- Coarse filtration system
- Aeration tank, with aeration grid and blowers
- Biological treatment process, including membranes or media, blowers, backwash system, cleaning system etc.
- Sludge pumps and sludge storage
- Sludge handling system, such as a sludge press
- Final effluent holding tank and pumps
- Disinfection system
- Chemical dosing systems

2.2.1 Filter Cake Disposal

Filtered sludge cake generated by the biological treatment process is either incinerated onsite, or backhauled south for disposal at an approved facility. All sludge cake will be handled in accordance with the applicable portions of Baffinland's Fresh Water Supply, Sewage, and Wastewater Management Plan.

2.3 Dissolved Air Flotation

Dissolved Air Flotation (DAF) is a treatment principle typically used to remove solid materials from wastewater, through the use of a recycle stream of air-saturated liquid. Baffinland may employ owned, constructed, or rental DAF units at either site for treatment of the PWSPs. DAF systems typically only remove solid material in the water, making them applicable for removal of BOD, TSS, and total phosphorus.

Wastewater is pumped into the system from the source, through a tube flocculator where coagulation and flocculation chemicals are added prior to entering the main treatment tank through a distribution header. A recycle pump draws a stream of partially-clarified liquid off the side of the tank and pressurizes it in an air saturation tank. At the same time, compressed air is injected into the air saturation tank, creating a recycle stream saturated with dissolved air. This recycle stream is then released back into the main tank, where the saturated air comes out of solution as very fine air bubbles. These bubbles act as nuclei for flocculated/coagulated solids, causing them to rise to the surface. A skimmer transfers floated solids from the surface of the tank to a hopper, where it's pumped to a tote or tank for storage and disposal. Clarified effluent flows over a weir and out of the system.

Generally, a DAF system is comprised of the following processes:

- Influent pump
- Tube flocculator
- Dissolved air floatation tank, with distribution headers
- Compressor
- Air control panel
- Air saturation tank
- Recycle pump
- Float skimmer and hopper
- Float pump
- Effluent weir
- Solids drain
- Effluent break tank or holding tank, and pumps
- Chemical dosing system

For coagulation, a DAF system may use the following chemicals:

Wood Environment & Infrastructure Solutions,
a Division of Wood Canada Limited
900 Maple Grove Road, Unit 10
Cambridge, ON N3H 4R7
Canada
T: 519-650-7100

- Aluminum sulfate (alum)
- Poly-aluminum chloride (PAC)
- Sodium aluminate
- Alum potash
- Ferric/ferrous sulfate
- Ferric chloride
- Lime/soda ash
- Caustic soda

For flocculation, a DAF system may use the following chemicals:

- Vendor-specific, proprietary anionic or cationic polymers

2.3.1 Separated Solids Handling

Solids removed from the water by the flotation system are pumped into totes or other appropriate containers, labelled and manifested appropriately, and backhauled seasonally for disposal.

If possible, the floated solids may also be pressed through a filter press and incinerated, if the composition and water content allow.

2.4 Bulk Pond Treatment

If required, removal of TSS, BOD, total phosphorus, total ammonia, and/or faecal coliforms, may be performed in the ponds themselves. Doing so allows for rapid, bulk treatment of the contents of the PWSPs.

A typical treatment system would require:

- A pond mixing system
- Chemical dosing systems
- Inline mixers, such as a mixing tank, tube flocculator, or static mixer
- Flowmeter for flow measurement and totalization

Jar testing would be completed on the raw contents of the PWSP being treated to determine approximate chemical dosing rates required for treatment. The ponds would be mixed and chemicals would be injected into the mixing streams in accordance with the jar tests. Chemical addition may be completed in multiple steps, to ensure no chemical is dosed beyond what is required for treatment.

Once dosing is complete, the PWSP will continue to be mixed for an appropriate amount of time, to ensure the chemical(s) reacts fully and all contents of the pond have been turned over. Once mixing is complete, the mixing system will be shut off, to allow any coagulated/flocculated solids to settle, or to allow for natural stripping processes to occur. An effluent discharge system will be set up to allow for recirculation of effluent back into the PWSP. When water quality analyses confirm the clarified water is compliant for discharge, discharge may begin.

For in-pond treatment, the following chemicals may be used:

- Aluminum sulfate (alum)
- Poly-aluminum chloride (PAC)
- Sodium aluminate
- Alum potash
- Ferric/ferrous sulfate
- Ferric chloride
- Lime/soda ash
- Caustic soda
- Vendor-specific, proprietary anionic or cationic polymers

- Sulfuric acid
- Citric acid
- Hydrochloric acid
- Phosphoric acid
- Nitric acid
- Sodium hydroxide
- Sodium bicarbonate
- Magnesium hydroxide

2.4.1 Settled Solids Handling

Solids removed as part of this treatment method will naturally settle to the bottom of the ponds. Based on observations made in previous years, the quantities of settled solids are low enough to be considered insignificant in the context of the volume of the pond. Any settled solids typically remain settled and degrade naturally over time. If necessary, Baffinland may elect to drain any one of the ponds and remove and dewater any sludge remaining in the bottom.

2.5 pH Adjustment

pH adjustment may be required as a standalone treatment or may be required as part of a larger treatment system in order to maintain compliance. pH adjustment can be carried out in-pond or adjusted inline prior to discharge, depending on the requirements of the system and the condition of the PWSPs.

A typical pH adjustment system could require:

- A pond mixing system
- Chemical dosing systems
- Temporary chemical storage
- Inline mixers, such as a mixing tank, tube flocculator, or static mixer

Past observations suggest that pH in the PWSPs can be acidic, neutral, or basic, depending on what has been contributed to the pond, and what kind of natural biological activity has occurred. Various other treatment methods listed here may also have an impact on effluent pH, and may require that pH adjustment be added as part of the treatment process to ensure compliant effluent.

The following chemicals may be used to form part of a pH adjustment system:

- Aluminum sulfate (alum)
- Poly-aluminum chloride (PAC)
- Sodium aluminate
- Alum potash
- Ferric/ferrous sulfate
- Ferric chloride
- Lime/soda ash
- Caustic soda
- Sulfuric acid
- Citric acid
- Hydrochloric acid
- Phosphoric acid
- Nitric acid
- Sodium hydroxide
- Sodium bicarbonate
- Magnesium hydroxide

2.6 Filtration

Filtration systems in general provide a physical barrier, allowing for the removal of solid matter from a liquid stream. Doing so may be an effective means of reducing/removing TSS, BOD, and total phosphorus. Filtration may be used as a standalone treatment process or as part of a larger treatment system. Solids removal through filtration can also be used as tertiary treatment when combined with other treatment processes, to protect against carry-over or suspended solids.

A typical solids filtration system may employ one or more of the following technologies:

Wood Environment & Infrastructure Solutions,
a Division of Wood Canada Limited
900 Maple Grove Road, Unit 10
Cambridge, ON N3H 4R7
Canada
T: 519-650-7100

- Basket strainers
- Bag filters
- Disposable cartridge filters
- Backwashing cartridge filters
- Sand filters
- Continuous backwash sand filters
- Multimedia filters
- Rotary drum screens
- Belt filters
- Microfiltration
- Ultrafiltration
- Nanofiltration
- Membrane filtration

Filters used either alone, or in conjunction with other treatment processes, may be stand-alone, skid mounted, packaged, or contained within their own seacan.

2.6.1 Filtered Solids Handling

For most cartridge or bag filtration systems, solids are removed through capture on a fiber media, which cannot be backwashed. The media must be removed and disposed of according to Baffinland's Waste Management Plan.

Backwashing filters may be backwashed back into the PWSPs, or into dedicated storage for further treatment or disposal.

3.0 Sampling and Performance Monitoring

The effluent discharge quality criteria for the PWSPs is defined in the Type A Water Licence 2AM-MRY1325 Amendment No. 1 as issued by the Nunavut Water Board, July 31, 2014. The following table summarizes the discharge criteria:

Parameter	Discharge to Freshwater Max concentration of any grab sample (mg/L)	Discharge to Ocean Max concentration of any grab sample (mg/L
BOD_5	30	100
TSS	35	120
Faecal Coliforms	1000 CFU/100 ml	10,000 CFU/100 ml
Oil and Grease	No visible sheen	No visible sheen
pH	>6.0, <9.5	>6.0, <9.5
Ammonia (NH3-N)	4.0	NR
Total Phosphorus	1.0	NR
Toxicity[1]	Not acutely toxic	Not acutely toxic

1: Acute lethality to rainbow trout (Method EPS/1/RM/13) and daphnia magna (Method EPS/1/RM/14)

Prior to commencing any treatment or discharge, Baffinland or their contractors will be required to develop and submit a discharge plan including details on monitoring and sampling frequency, safeguards, internal limits, etc.