Water Management Plan
Doris North Project, Nunavut

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1.0 PURPOSE AND SCOPE OF THE WATER MANAGEMENT PLAN

The Water Management Plan provides information on how water will be handled in a safe and environmentally sound manner at the Miramar Hope Bay Ltd. (MHBL) Doris North Project (Doris North) in Nunavut. This plan outlines the management strategy and procedures to be used to manage:

- All storm water that comes in contact with the mine facilities and thus can become contaminated; and
- All water to be released from the Tail Lake tailings containment system.

The purpose of this document is to provide a consolidated summary of information on the operation of the water management facilities at the Doris North Project during the operational phase of the project. These procedures are an integral component of the overall Environmental Protection Plan (EPP) for the proposed Doris North Project and will be periodically reviewed and updated as the Doris North mine moves through construction, operations, and final closure and reclamation. This Plan is a “living document” and will be reviewed and updated periodically during the mine life to ensure that site experience with water management procedures are captured and shared amongst all operating staff (adaptive management).

This Management Plan is a component of the Doris North Environmental Management System and will be updated after the water license has been issued to incorporate any new commitments made by MHBL during the license process and to incorporate any conditions contained within the water license relating to the handling and management of water at the Doris North Project. This Management Plan is to be reviewed annually during the first quarter of each calendar year by the mine’s environmental staff and updated as needed to reflect changes in operating procedures. The revised Water Management Plan will be made available to the appropriate mine operating staff with appropriate refresher training and sent to the Nunavut Water Board (NWB) for inclusion in the public registry.

The Water Management Plan is intended to provide the mine’s operating staff with a summary of the operating and management procedures for the handling, management and disposal of water that comes is used by or comes into contact with the Doris North mine facilities that were developed through the environmental assessment and project design process. It similarly provides a summary of the same to the regulatory agencies and to the land owner who have regulatory interest over the mine facilities.

This Plan is not intended to be a design document for the water management facilities. The reader is referred to the following sources for design information:

- Design of the Surface Infrastructure Components Doris North Project, Hope Bay, Nunavut, Canada, prepared for MHBL by SRK Consulting (Canada) Inc., dated March 2007. (Supporting Document S2 to the Revised Water License Application Support Document, April 2007)

    - Section 2.4 (Climate); Section 2.5 (Permafrost), Section 2.6 (Hydrology), Section 2.7 (Hydrogeology);
    - Design Information in: Section 4.4 (Culverts), Section 4.5 (Bridge and Bridge Abutments), Section 4.9 (Fuel Transfer Station), Section 4.10 (Fuel Tank Farm), Section 4.14 (Pollution Control Pond), Section 4.15 (Sedimentation Pond), Section 4.16 (Landfill), and Section 4.17 (Landfarm); and
    - Operation and Maintenance Procedure in: Section 5.4 (Culverts), Section 5.5 (Camp, Mill, Beach Laydown Area, Explosives Storage Facility, Pump House Pad and Temporary Waste Rock Pile Pad), Section 5.6 (Fuel Transfer Station and Fuel Tank Farm), Section 5.9 (Pollution Control and Sedimentation Ponds), Section 5.10 (Landfill), and Section 5.11 (Landfarm).

- Design of the Tailings Containment Area, Doris North Project, Hope Bay, Nunavut, Canada, prepared for MHBL by SRK Consulting (Canada) Inc., dated March 2007. (Supporting Document S1 to the Revised Water License Application Support Document, April 2007)
    - Section 6 (Water Balance); Section 7 (Design of the Water Management Facilities, Section 9 (TCA Operation), Section 11.4 (TCA Monitoring – Water Quality) and Section 12 (TCA Closure Methodology);
    - Appendix C SRK Technical Memorandum re: Water Cover Design for Tail Lake;
    - Appendix E SRK Technical Memorandum re: Wave Run-up Calculations; and
    - Appendix F SRK Technical Memorandum re: Water Balance Calculation.

- Engineering Drawings for Tailings Containment Area and Surface Infrastructure Components, Doris North Project, Nunavut, Canada, prepared for MHBL by SRK Consulting (Canada) Inc., dated March 2007. (Supporting Document S4 to the Revised Water License Application Support Document, April 2007)
    - Drawing G-02 General Arrangement;
    - Drawings S-01 and S-02 Beach Laydown Area and Fuel Transfer Station;
    - Drawings S-05 and S-06 Fuel Tank Farm;
    - Drawings S-07 and S-08 Camp and Mill Pad;
    - Drawing S-11 Culvert and Road Turnout Plan, Sections and Detail;
    - Drawing S-12 Bridge Crossing Plan and Typical Sections;
    - Drawings S-13 and S-14 Landfill and Landfarm; and
    - Drawings T-01 thru T-14 Tailings Containment System Design Drawings.

- Technical Specifications for Tailings Containment Area and Surface Infrastructure Components, Doris North Project, Hope Bay, Nunavut, Canada, prepared for MHBL by SRK Consulting (Canada) Inc., dated March 2007. (Supporting Document S3 to the Revised Water License Application Support Document, April 2007)
    - Section 10.2.5 Fuel Transfer Station;
    - Section 10.2.9 Fuel Tank Farm;
    - Section 10.2.16 Temporary Waste Rock Pile Pollution Control Pond;
    - Section 10.2.17 Camp/Mill Pad Sedimentation Pond;
    - Section 10.2.18 Other Surface Runoff Management Facilities;
    - Section 10.2.21 Culvert Installations;

  - Section 10.2.22 Landfill;
  - Section 10.2.23 Landfarm; and
  - Section 11 Tailings Containment Area Components (Section 11.4 Spillway Construction, Section 11.5 Pipeline Installations, Section 11.6 Emergency Dump Catch Basins and Section 11.7 Implement Shoreline Erosion Protection Works.

The reader is referred to the following documents for additional information on the water quality model developed for the tailings containment area and for further information on the water management and discharge strategy:

- Tail Lake Water Quality Model, Doris North Project, Hope Bay, Nunavut, Canada, prepared for MHBL by SRK Consulting (Canada) Inc., dated October 2005. (Supporting Document A2 to the Technical Support Document to the Final Environmental Impact Statement submitted to the Nunavut Impact Review Board, October 2005)
  - All sections.

- Water Quality Model, Doris North Project, Hope Bay, Nunavut, Canada, prepared for MHBL by SRK Consulting (Canada) Inc., dated March 2007. (Supporting Document S6 to the Revised Water License Application Support Document, April 2007)
  - All sections.

2.0 HYDROLOGICAL SETTING

2.1 Climate

Baseline climate data for the project was collected at the Boston and Windy camps during exploration (August 1993 thru 2003, with some interruptions). This site specific data combined with data from three longer-term regional weather stations operated by Environment Canada (Lupin, Cambridge Bay, and Kugluktuk) were used to develop annual climate profiles for the Doris North site.

The Doris North site has a low arctic ecoclimate with a mean annual temperature of -12.1°C with winter (October to May) and summer (June to September) mean daily temperature ranges of -5 0°C to +11°C and -14°C to +30°C, respectively; and mean precipitation ranges from 94 mm to 207 mm, with only about 40% falling as rain. Annual lake evaporation (typically occurring between June and September) is about 220 mm.
Wind speed data reported for the Boston area (Rescan 2001)[1] indicates predominant wind directions ranging from northwest to northeast, with wind speed in the order of 5 to 7.5 m/s. Calm conditions (wind speed below 1 m/s) occur about 6 to 9% of the time.

2.2 Permafrost

The Doris North site is underlain by continuous permafrost that has been estimated to extend to depths in the order of 550 m (SRK 2005a)[2]. This permafrost depth is based on a 200 m deep drill hole (SRK-50) where the mean surface temperature is about -6.3 °C and the geothermal gradient is 11.4 °C km^{-1}. The geothermal gradient in the upper 100 m appears to be isothermal or slightly negative. For comparison, the deep ground temperature profile measured at the Boston Camp, 60 km south of the site, also suggested a similar permafrost depth, about 560 m (EBA 1996[3]; Golder 2001[4]). The mean annual surface temperature is however colder at –10 °C and the geothermal gradient is higher at 18 °C km^{-1}. The difference in the ground temperature profiles at these two sites can be attributed to different surface conditions and the thermal conductivity of the ground at depth. The geothermal gradient measured at the Doris North site is probably representative of the conditions at Tail Lake.
Temperature data collected around Tail Lake indicates that the active layer in the marine clay/silt soils appears to be about 0.5 m, while the sand deposit has an active zone no greater than 2 m. The depth of zero annual amplitude varies between 11 and 17 m. The ground temperatures at the depth of zero annual amplitude are generally in the range of -9 to -7 °C.

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[1] Rescan. 2001. Supplemental Environmental Baseline Data Report, *Hope Bay Belt Project*. Report submitted to Hope Bay Joint Venture

[2] SRK Consulting Inc. 2005b. *Groundwater Study, Doris North Project, Hope Bay, Nunavut, Canada*. Report submitted to Miramar Hope Bay Limited, October 2005.

[3] EBA Engineering Consultants Ltd. 1996. Boston Gold Project. Surficial Geology and Permafrost Features. Report submitted to Rescan Environmental Services Ltd.

[4] Golder 2001. Report on Thermistor Data Review – Hope Bay Project. Letter-report submitted to Miramar Mining Corporation.

2.3 Hydrology

The Doris North Project is located primarily in the Doris Lake outflow drainage basin. Tail Lake basin, part of the Doris basin, is the Project's TCA. The major catchment areas are shown in Figure 2.1. Patch Lake drains to the north through Ogama Lake into Doris Lake which in turn drains to Little Roberts Lake and into Roberts Bay. Windy Lake drains through Glen Lake into Roberts Bay. Pelvic Lake drains north through Roberts Lake into Roberts Bay.

Peak flows typically occur in June during snowmelt. A second smaller peak may occur from rainfall in late August or early September. The streams in the study area are usually frozen with negligible flow from November until May. The mean flow from June to October for Tail, Doris and Little Roberts Lake outflows are about 0.03, 0.85, and 1.73 m^3/s, respectively (AMEC 2003[5]).

The general watershed divisions at the Doris North Project site and the general directions of flow are shown in Figure 2.2. The site can drainage can generally be broken into five separate drainage basins:

- Drainage Basin 1: This area drains to the north ultimately towards Roberts Bay. Infrastructure to be constructed within this area includes the beach laydown area and fuel transfer station, Quarry #1, the airstrip and most of the northern part of the Roberts Bay access road;
- Drainage Basin 2: This area drains into Roberts Bay through Doris Creek and Little Roberts Lake. Infrastructure to be constructed within this watershed division is the Tail Lake discharge pipeline and access road;
- Drainage Basin 3: This area drains into Doris Lake. Doris Lake drains through Doris Creek into Little Roberts Bay. Infrastructure to be constructed within this watershed division includes the non-hazardous landfill and landfarm, Quarry 2, the mill and camp site pad, the underground mine portal, the tank farm, Doris Lake freshwater pump house, float plane dock and access road, the southern half of the Roberts Bay access road and the access road to the TCA and the first two emergency dump catch basins for the tailings and reclaim water lines.
- Drainage Basin 4: this is the Tail Lake watershed which drains into the TCA which will then be allowed to discharge in a controlled fashion into the Doris Creek. Infrastructure to be constructed in this watershed division include the tailings dams and the tailings access roads, and the third, fourth, fifth and sixth emergency dump catch basins for the tailings and reclaim water lines;

[5] AMEC 2003. *Meteorology and Hydrology Baseline, Doris North Project, Nunavut, Canada*. Report submitted to Miramar Hope Bay Limited, August 2003.

- Drainage Basin 5: this is the drainage basin to the west of basins 1 and 3 and drains to the west into Glen Lake which then drains north to Roberts Bay. The infrastructure to be constructed in this watershed division includes the permanent explosives storage facility and approximately 1 km of the south end of the Roberts Bay access road (approximately between the 23+00 and 13+00 set out points for this road) that runs between watershed divisions 1 and 3.

2.4 Hydrogeology

The permafrost underlying the Project site is generally impervious to groundwater movements. Groundwater movement will only occur in the shallow active layer (0.5 m to 2.0 m) during its seasonal thaw period. There is no hydraulic connection between the taliks beneath Tail and Doris Lakes, as has been demonstrated though a series of deep drill holes[6].

[6] SRK Consulting Inc. 2005b. Groundwater Study, Doris North Project, Hope Bay, Nunavut, Canada. Report submitted to Miramar Hope Bay Limited, October 2005.

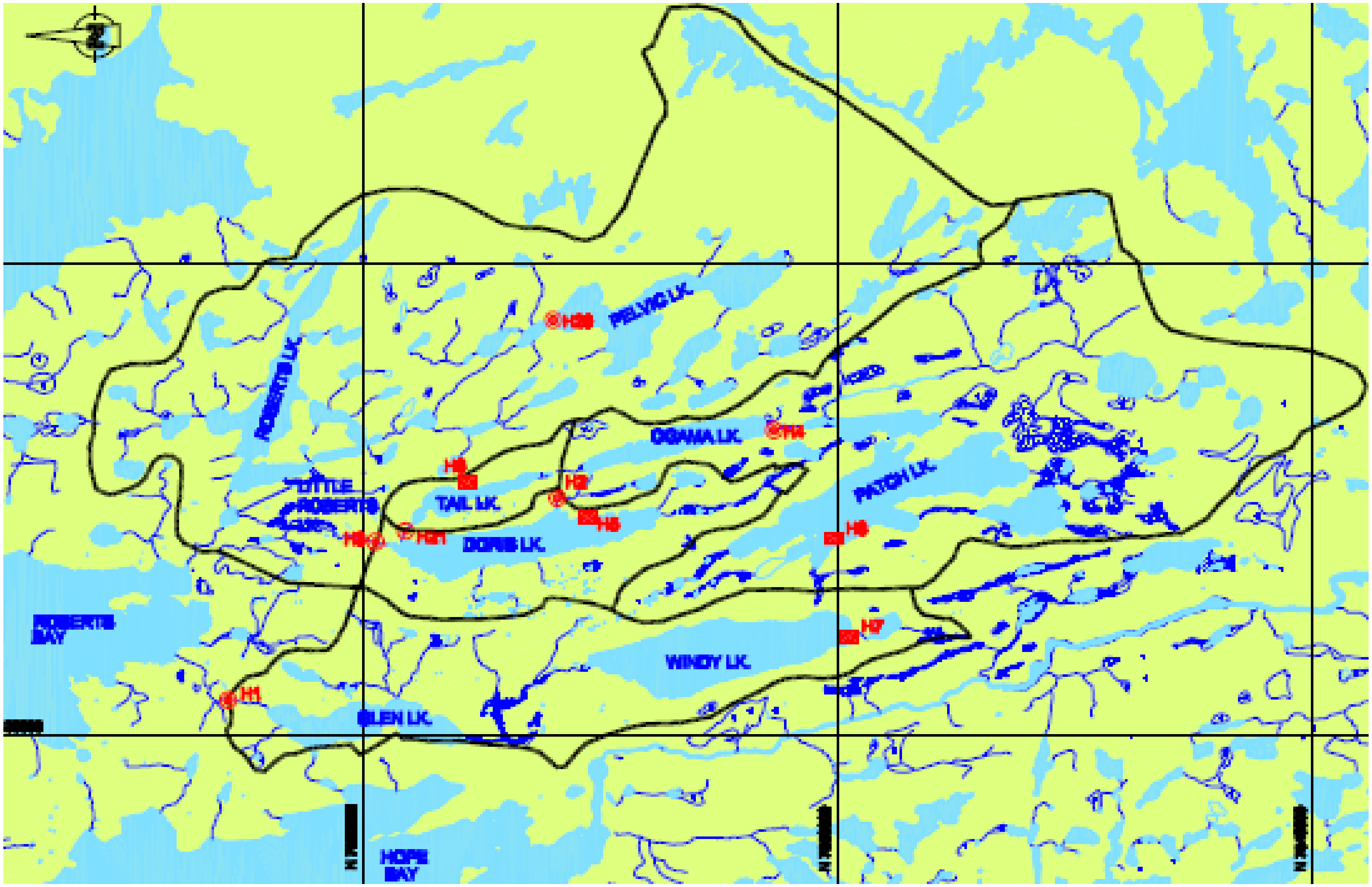

Figure 2.1: General Catchment Areas at the North End of the Hope Bay Greenstone Belt

Scale: 1:100,000

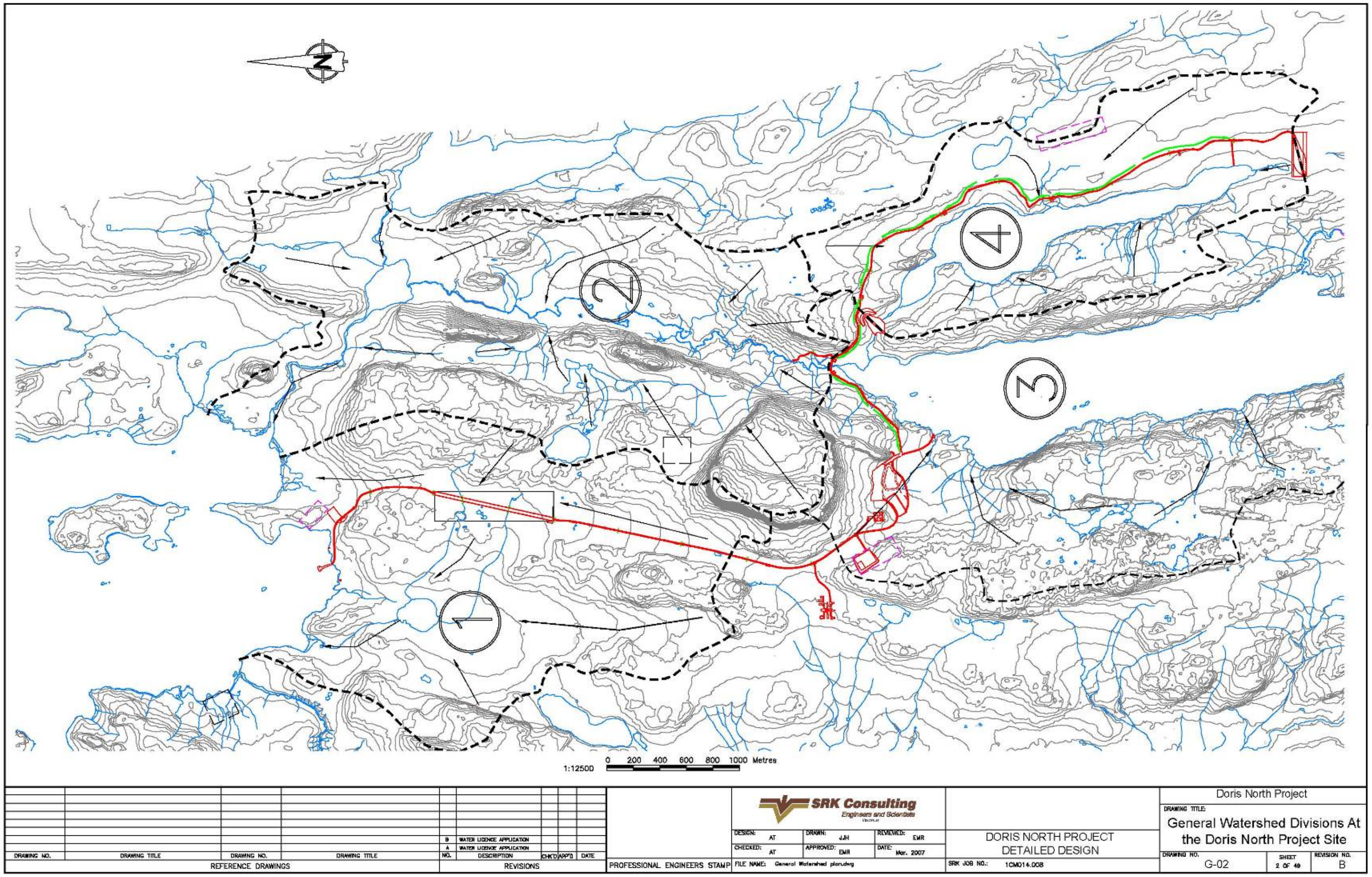

Figure 2.2: General Watershed Divisions at the Doris North Project Site

3.0 FRESHWATER USE

The Doris North Project will obtain its fresh water from Doris Lake from a pump house to be constructed at the north end of Doris Lake adjacent to the proposed float plane dock. Water will be drawn into the pump house wet well through a 4" diameter HDPE pipe laid on the bottom of Doris Lake.

3.1 Potable Water

During the construction phase potable water for the construction camp will be obtained from Doris Lake using the same pumping facilities that will be in place for the operational phase. Potable water will be chlorinated and stored within the camp.

For the operational phase of the project, potable water, fire suppression water and up to 50% of the mill water will be drawn from Doris Lake (the remaining 50% of the water required for the mill will come from Tail Lake). The recycle of water from Tail Lake will be maximized where practical to reduce freshwater use in the milling process and is targeted to approach 100% in the second year of operation. Two separate 100 mm diameter insulated and heat traced HDPE lines will pump water from the lake to storage tanks at the mill and camp sites. Potable water will be treated in a packaged plant installed in a 12.2 m x 2.4 m container and will consist of sand filtration followed by ultra violet light and/or chlorination treatment.

The Project's projected potable water consumption is 30,000 m^3 per year (daily average potable water consumption of 68.6 m^3 per day plus a contingency of 17%) The daily consumption estimates is based on a 175 person camp with a per person consumption of 0.04 m^3 (40 liters) per person per day.

3.2 Fresh Water Consumption for Mining and Milling

Mill process water requirements are projected to average 970 m^3/day with a maximum mill process water requirement of 1,183 m^3/ day. This maximum value has been used in the water quality model to ensure that the model reflects the most conservative assumptions with respect to the volume of water reporting to the tailings containment area with the mill tailings streams.

Water use underground is expected to be minimal. A brine solution will be mixed in the mill and piped underground for use in drilling and dust suppression. This brine solution will be recirculated through an underground sump. Development and production drilling will use this brine solution to stop drills from freezing in the permafrost. Total requirements are estimated at approximately 0.1 m^3/h. As mining is expected to be within the permafrost zones, groundwater is anticipated to be minimal. Any water encountered will be pumped from underground and discharged into the tailings line to Tail Lake.

Consequently the maximum projected freshwater use for non-potable water uses (process water) at the Doris North Project is estimated at 450,000 cubic meters per year (estimated daily average consumption of 1,183 m^3/ day plus a 16% contingency allowance). This assumes no recycle of water from Tail Lake.

4.0 RECLAIM AND RECYCLE WATER USE IN THE MILLING PROCESS

MHBL plans to reclaim water from Tail Lake for use in the milling process and to recycle water within the milling process to minimize the Project's use of freshwater from Tail Lake to the greatest practical extent and to minimize the volume of water that subsequently has to be discharged from the tailings containment area (TCA) to the receiving environment.

4.1 Use of Reclaim Water from the Tailings Containment Area (Tail Lake)

It is MHBL's intent to maximize to the greatest practical extent the use of recycle water from the tailings containment area. However, there is a possibility that the water may not be able to clarify sufficiently during the winter period when lake ice reduces the volume in Tail Lake (especially during the first winter). During summer months (June through September), process water will be taken from Tail Lake by a pump mounted on a floating pump house barge located near the north end of the lake. Make up freshwater for use in the mill will be drawn from the freshwater holding tank only in case of a shortage from Tail Lake.

The projected volume of water recycled from Tail Lake as mill process water is 145,000 m^3 per year (based on 1,183 m^3/ day for four months). MHBL will attempt to increase the volume of water recycled from Tail Lake as this will improve its overall Tail Lake water management strategy.

4.2 Recycle of Water within the Milling Process

There will be three internal recycle water streams within the milling flowsheet (see Figure 4.1):

- Overflow from the regrind circuit thickener where the reground flotation concentrate will be thickened ahead of the leach circuit with the thickener overflow recycled back to the mill process water tank;

- Leach residue from the carbon-in-leach (CIL) circuit will be thickened ahead of the cyanide destruction circuit with the thickener overflow solution recycled to the head end of the CIL circuit; and

- The discharge slurry from the cyanide destruction circuit will be thickened and then filtered on a belt filter to produce a relatively dry residue that will be trucked underground as backfill. Approximately 70% of the thickener overflow and filtrate from the belt filter will be recycled to the head end of the cyanide destruction circuit (79 m^3/day). The remaining 30% (31.4 m^3/day) will be bled off and co-disposed with the flotation tailing in the Tail Lake TCA.

The volume of these three internal recycle water streams has been accounted for in the mill process water consumption totals presented in the preceding sections.

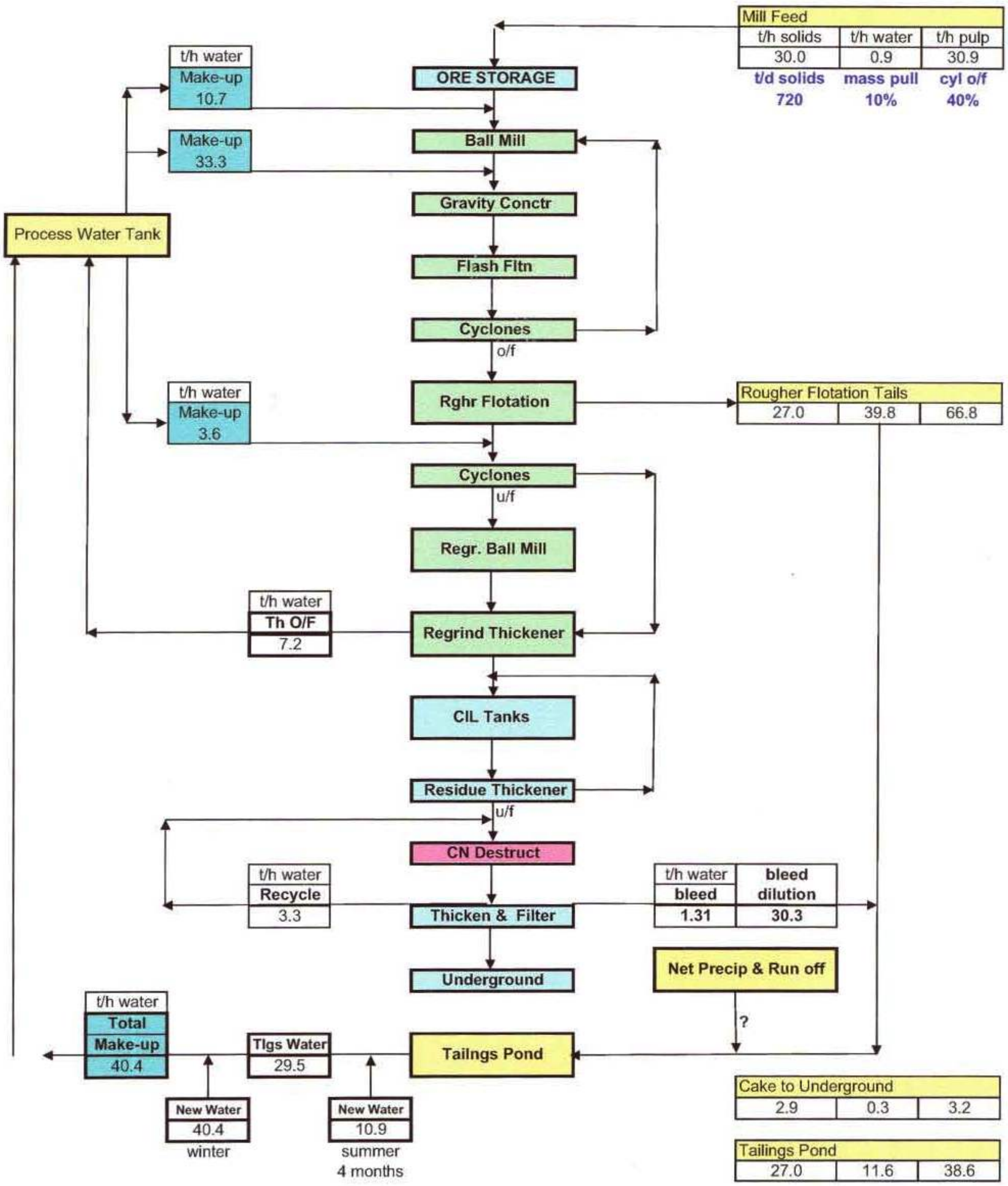

Figure 4.1: Simplified Mill Process Flowsheet

5.0 SOURCES OF CONTAMINATED WATER TO BE MANAGED

The potential “sources” of contaminated water[7] that will require management at the Doris North mine site include:

a) Quarried rock used as road base, turn-out areas, the airstrip, mill and camp site pad area fill, the jetty fill and other infrastructure construction fill;

b) Mine waste rock stored on surface for the duration of mining (after which it will be backfilled to the underground workings);

c) Ore stockpiled during milling operations;

d) Wall rocks and waste rock backfill in the underground workings during mining operations, contributing to the loadings in water recovered from the underground workings;

e) Saline drilling fluids, contributing to the loadings in water recovered from the underground workings;

f) Blasting residues (from explosives) present in quarried construction rock, waste rock in storage, and in ore;

g) Treated sewage effluent discharged to Tail Lake;

h) Precipitation runoff and snowmelt collected within the sump box at the lined fuel transfer station at the Roberts Bay beach laydown area;

i) Precipitation runoff and snowmelt collected within the sump box at the lined Fuel Tank Farm;

j) Precipitation runoff and snowmelt collected within the pollution control sump at the lined Landfarm facility;

k) Precipitation runoff and snowmelt collected within the pollution control sump at the non-hazardous landfill within Quarry 2;

l) Mill tailings discharged to Tail Lake comprising flotation tailings and treated cyanide leach circuit bleed stream;

m) Solute and suspended matter released to Tail Lake from shoreline erosion and re-suspension by wave action; and

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[7] The reader is referred to the Water Quality Model, Supporting Document S6 to the Revised Water License Application Support Document, April 2007, for information on how these contaminated water streams were incorporated into the water quality model developed for the TCA. Specific information on the source loads and concentrations used within the model for each of these potentially contaminated water streams is presented in Section 3.3 along with a discussion on the assumptions that were made in determining these source loads. The overall mass balance for Tail Lake is presented in Section 3.4.

n) Salinity released to Tail Lake due to thawing where permafrost is present, along the shores of Tail Lake.

The majority of these potential contaminant sources will be managed by intercepting, collecting and transferring the potentially contaminated water to the Tail Lake tailings containment area. Specifically, from the above list the following potential sources of contaminated water will be intercepted, collected and transferred to the TCA:

i) All runoff from the quarried rock used to construct the mill and camp pad area;
ii) All precipitation runoff and snowmelt from the mill and camp pad area;
iii) All runoff and drainage from the temporary waste rock stockpile (waste from the underground mine);
iv) All runoff and drainage from the ore stockpile;
v) All water collected within the underground mine sumps (including all brine solution used in drilling and for dust suppression and any drainage from the placement of the filtered cyanide leach residue as backfill);
vi) All treated sewage and grey water;
vii) Mill tailings; and
viii) Drainage from the access roads and shoreline constructed within the Tail Lake watershed.

The method of transfer for each of these streams is covered in further detail in Section 6.

As part of the storm water management strategy, the runoff from the mill site including runoff from the fill, waste rock in storage and the ore stockpile, will be collected and pumped with the tailings to Tail Lake. Thus, contaminants released from these sources will report directly to Tail Lake. Contaminants released from road base materials and fill used for infrastructure development will report directly to either Doris Lake or Tail Lake, depending on its catchment.

Losses in saline drilling fluids that will be used during mining will report to the mine water recovered during the dewatering of the underground workings, as will any contaminants released from the mine wall rocks and waste rock and filtered cyanide leach residue backfilled to the underground workings during operations. The mine water will be pumped to the mill tailings pump box form where it will be transferred to Tail Lake. It should be noted that since the mine is not expected to require any dewatering, this is conservative.

Blast residues will be present in all quarried rock, waste rock and ore produced at the site, and will contribute loadings to Doris Lake and Tail Lake as described above. As well, blast residues and spilled explosives will contribute nutrients to the mine water.

Treated sewage, together with the mill tailings will be pumped to Tail Lake. As the water level rises, permafrost in the banks of Tail Lake will thaw. The pore water (which is saline) from the thawed banks will be released to Tail Lake only once a hydraulic gradient develops to displace the pore water. This will occur once the water level in Tail Lake is lowered.

A schematic representation of the potentially contaminated water streams that will be intercepted, collected and transferred to Tail Lake is presented in Figure 5.1.

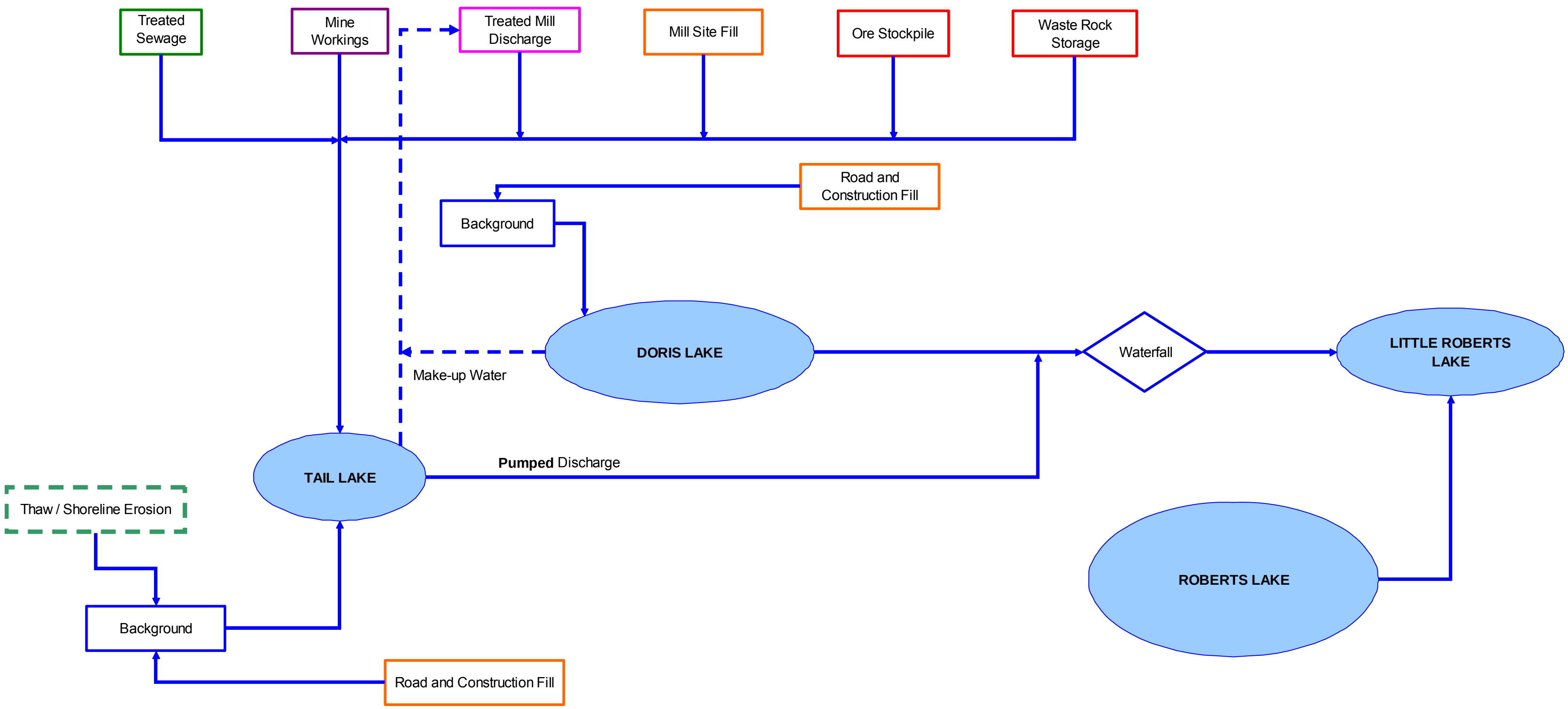

Figure 5.1: Simplified Schematic Water and Load Flow Diagram for the Tail Lake Tailings Containment Area

The potential sources of contaminated water that will not be transferred to the TCA are as follows:

- Precipitation runoff and snowmelt that comes into contact with the quarried rockfill used as road base (excluding the roads outside the Tail Lake watershed), turn-out areas, the airstrip, the jetty, the tank farm, and the explosives storage area.
- Precipitation runoff and snowmelt collected within the sump box at the lined fuel transfer station at the Roberts Bay beach laydown area;
- Precipitation runoff and snowmelt collected within the sump box at the lined Fuel Tank Farm;
- Precipitation runoff and snowmelt collected within the pollution control sump at the lined Landfarm facility; and
- Precipitation runoff and snowmelt collected within the pollution control sump at the non-hazardous landfill within Quarry 2.

The precipitation runoff and snowmelt collected in the sumps at the fuel transfer station, the fuel tank farm and within the landfarm facility will be treated through an oil adsorption system designed to remove particulates and hydrocarbons and then land applied onto the adjacent tundra. This process is described in more detail in Section 6.0.

The quarried rockfill materials to be used in construction as road base, turn-out areas, the airstrip, the jetty, and the infrastructure rockfill pads were subjected to a program of geochemical characterization conducted on samples obtained from a drilling program carried out at the four quarry sites in the winter of 2006. The results of this study[8] concluded that:

- Quarry rock is not potentially acid generating and uniform geology was intersected at each location and geochemical parameters showed no obvious vertical patterns;
- Most of the neutralization potential measured in standard acid-base account testing is in the form of calcite and dolomite (calcium and magnesium carbonates);
- Electron microprobe analysis of carbonate grains supported the findings that calcite and dolomite were the host minerals for all inorganic carbon in the samples tested. Calcite was found to contain trace to no iron, manganese or magnesium. Dolomite was found to contain up to 0.22 mole fraction iron and manganese, with calcium and magnesium making up the balance;
- The mineralogy and carbonate speciation data show that most analytically-determined NP is hosted by calcium and magnesium carbonates. These minerals are sufficiently abundant and reactive to neutralize any acid that forms during the weathering of sulphide minerals from the proposed quarry rock fill; and

[8] Geochemical Characterization of Quarry Materials, Supporting Document S7 to the Revised Water License Application Support Document, April 2007.

- The risk of metal leaching from quarry rock and subsequent impacts on receiving waters is very low as indicated by shake flask extractions, major and trace element determinations, and previous static and kinetic testwork.

Consequently this source of rockfill is non acid generating and will not be a significant source of contaminant release when in contact with precipitation runoff and snowmelt.

6.0 STORM WATER MANAGEMENT

Storm water includes precipitation runoff and snowmelt. MHBL will intercept, collect and manage storm water from those areas of the mine site where the risk of contaminant release is significant, specifically from:

- The camp and mill pad area where most of the surface mine related activities will occur;
- The lined fuel transfer station, the fuel tank farm and the landfarm facility; and,
- The non-hazardous landfill facility.

The methods to be used to manage this storm water are covered in the following sub-sections:

6.1 Camp and Mill Pad Area, Temporary Waste Rock and Ore Stockpiles

Pads are required to house the ore stockpile, mill building, crusher building, mill reagent storage, power plant, light vehicle refueling station, workshop, camp, kitchen, offices, dry, sewage treatment plant, potable water treatment plant, environmental laboratory and first aid station. The mill and crusher buildings cannot withstand any differential settlement, and as a result a precision blasted pad will be cut into bedrock to facilitate construction of these facilities. A nominal layer of surfacing material will be placed on the bedrock surface to provide a smooth and graded surface for civil construction. Based on surface topography, the final mill pad size (about 75 m x 250 m), will allow room over and above the mill and crusher, for the ore stockpile (about 10,000 tonnes, or 15 days of mill feed), the mill reagent storage area and the power plant.

The camp and mill pads will house all the processing and accommodation facilities for the Project. From a water management aspect the following operational procedures apply:

- The mill, crusher and workshop will be in individually enclosed buildings and will have self contained sumps to contain any spills. Emptying of these sumps will depend on the nature of the spill, and may be returned to the mill or pumped to Tail Lake;

- The temporary waste rock pile is considered to be “dirty” water areas, and all runoff from these locations will be directed to the pollution control pond. Water in this pond will be pumped to Tail Lake; and

- The remaining surface areas of the camp and mill pads are generally considered “clean” surfaces; however, all runoff and melt water from these pads will be collected in the sedimentation pond. Once suspended matter has settled, and if the water quality in the pond is deemed acceptable (meets the proposed discharge standards as set out in Table 6.1), this water will be pumped out onto the tundra. If the water quality is not deemed to be of acceptable quality it will either be used as mill make-up water or pumped to Tail Lake.

During the Spring melt, the water collected in this sedimentation pond will be sampled by the on-site environmental personnel and analyzed for pH, TSS, Total Ammonia, Nitrate, Nitrite, Total Sulphate, Total CN, Total Oil and Grease, Alkalinity, Chloride, Al, As, Cu, Fe, Pb, Ni, and Zn.

Water will be pumped from the sedimentation pond onto the tundra and be land applied, as long as it meets the proposed discharge standards as set out in Table 6.1. The water will be discharged to the area immediately to the south of the pond where it will have a ~500 m cross country flow path before reaching Doris Lake. Pumping from the sedimentation pond will only start once water in the pond has been verified as meeting the proposed discharge standards.

Table 6.1: Proposed Discharge Standards for the Camp and Mill Pad Sedimentation Pond

Parameter Being Monitored	Proposed Discharge Standard (mg/L)[1]
pH	**5.0 to 9.0**
TSS	**15.0**
Total Ammonia	**2.00**
Total CN	**1.00**
Total Oil and Grease	**5.0 and no visible sheen on pond**
Al	**1.0**
As	**0.05**
Cu	**0.02**
Fe	**0.30**
Pb	**0.01**
Ni	**0.05**
Zn	**0.01**

[1] Based on a review of discharge limits used at other mine sites in the NWT for small volume discharges into freshwater

2. MHBL proposes that average allowable concentration be calculated as a monthly average of all samples taken during the reporting month.

Once pumping starts the discharge from the pond will be sampled daily for each day of pump operation with the sample analyzed for pH, TSS, Total Ammonia, Total Sulphate, Total CN, Total Oil and Grease, Al, As, Cu, Fe, Pb, Ni, and Zn.

MHBL looked at discharge limits established in other water licenses for relatively new mine sites in the North to determine what discharge standards were being used to protect the freshwater aquatic environment for small volume discharges from surface runoff ponds and fuel containment facilities. Only limited information could be found. The results of the MHBL review are presented in Table 6.2. At Doris North the water released from the mill and camp pad sedimentation pond will be land applied onto the tundra at a site approximately 500 m upstream of Doris Lake. The tundra will play a significant role in attenuating contaminants contained in this release. The large dilution available in Doris Lake will further attenuate these contaminants. The proposed discharge limits for the release of water from this sedimentation pond (Table 6.1) were drawn from the data in Table 6.2. These levels have been selected by the regulatory agencies managing water in the N.W.T. as being protective of water quality in the receiving environment in similar settings.

Table 6.2: Comparison of Water License Discharge Standards at Other Mining Operation in the North

Mine Site	**Ekati - Sable, Beartooth, and Pigeon Pits**		**Diavik Diamond Mines**		**Snap Lake**		**Boston**		**MMER**	
Water License #	**MV2001L2-0008**		**N7L2-1645 amended May 2004**		**MV2001L2-0002 Apr 15 2004**		**NWB1BOS0106 Oct 5 2001**			
Type of Discharge Limit	**Discharge from Waste Rock piles, Sedimentation Ponds, Surface Runoff**		**All Discharges to Lac de Gras from WTP - last point of control**		**All Discharges to Snap Lake**		**All Minewater discharged from minewater pond**			
	Maximum Average Concentration	**Maximum Concentration of Any Grab Sample**	**Maximum Average Concentration**	**Maximum Concentration of Any Grab Sample**	**Maximum Average Concentration**	**Maximum Concentration of Any Grab Sample**	**Maximum Average Concentration**	**Maximum Concentration of Any Grab Sample**	**Maximum Authorized Monthly Mean Concentration**	**Maximum Authorized Concentration in any Grab Sample**
Total Ammonia mg/L	2.0	4.0	N/A	20.0	N/A	20.0				
Total Aluminum mg/L	1.0	2.0	1.5	3.0	1.0	2.0				
Total Arsenic mg/L	0.050	0.1	0.05	0.10	0.02	0.04	0.50	1.00	0.50	1.00
Total Copper mg/L	0.02	0.04	0.02	0.04	0.01	0.02	0.30	0.60	0.30	0.60
Total Cadmium mg/L	0.0015	0.003	0.0015	0.003	0.001	0.002				
Total Chromium mg/L	0.02	0.04	0.02	0.04	0.02	0.04				
Total Lead mg/L	0.01	0.02	0.01	0.02	0.005	0.009	0.20	0.40	0.20	0.40
Total Zinc mg/L	0.01	0.02	0.01	0.02	0.01	0.02	0.50	1.00		
Total Nickel mg/L	0.05	0.1	0.05	0.10	0.05	0.1	0.50	1.00	0.50	1.00
Nitrate mg/L					28	56			0.50	1.00
Nitrite mg/L	1.0	2.0	1.0	2.0	1.0	2.0				
Total Suspended Solids mg/L	15	25	15.0	25.0	7	14	25	50	15.00	30.00
Total Cyanide mg/L									1.00	2.00
Turbidity NTU	10	15	10	15						
Oil and Grease mg/L							No Visible Sheen			
Extractable Petroleum Hydrocarbons - F1					4.6					
Extractable Petroleum Hydrocarbons - F2					2.1					
Total Phosphorous mg/L	0.2	0.4								
pH - all discharges to environment	6.0 to 9.0		6.0 to 8.4		6.0 to 9.0		6.0 to 9.5			
pH - surface runoff	5.0 to 9.0		5.0 to 8.4		5.0 to 9.0					
Sewage Treatment Plant Discharge										
Oil and Grease mg/L *	3.0		3.0	5.0	5.0		No Visible Sheen			
Total Suspended Solids mg/L			10.0	20.0	35.0		100			
BOD mg/L			15.0	25.0	30		80			
Faecal Coliforms CFU/100ml			10	20	1000		10000			
Surface Runoff During Cnstruction										
Total Suspended Solids mg/L	50	100	50	100	50	100				

* At Colomac Oily Water Separator is discharged to sewage lagoon. MV2000L2-0001 limits oil and grease in lagoon discharge to 5.0 mg/L

All facilities (other than the crusher building and mill) will be erected on a 2 m thick rock fill pad measuring about 60 m x 150 m. Both pads will be graded such that all surface water runoff and melt water will drain into the sedimentation pond located immediately downstream of the camp pad. The mill and crusher buildings will be covered and will have self contained sumps in the event of spills. The ore stockpile area will be graded to drain towards the pollution control pond immediately downstream of the temporary waste rock pile.

Temporary storage for about 137,000 tonnes of waste rock is required. Some of the waste rock is potentially acid generating, and as a result MHBL will return it all as underground backfill. However, until the waste rock is used as backfill, a temporary waste rock pile will be constructed on a 1 m thick pad of clean run of quarry rock immediately downstream of the mill pad. This will allow for easy dumping and reloading of any waste rock without a risk of damage to the underlying permafrost. Immediately downstream of the pad, a pollution control pond will be constructed to ensure complete containment of all surface runoff and melt water from the temporary waste rock pile and the ore stockpile. Berms strategically located along the edges of the pad will ensure complete containment.

The Temporary Waste Rock Pile Pollution Control Pond is designed to contain all surface runoff and melt water from the temporary waste rock pile. The pond is designed for full containment of the 1:100 year storm event of 24-hour duration, plus an additional freeboard of 0.3 m. Containment is provided, at least to the full supply level of 35.7 m by an HDPE liner sandwiched between two geotextiles. A protective cover layer is placed over the liner. No emergency spillway is provided, since it is intended that pumping out of this facility be initiated whenever there is at least one hour of pumping capacity in the pond. The pond pumps are designed to completely empty the pond within six hours.

The water that accumulates within the Temporary Waste Rock Pile Pollution Control Pond is to be pumped to the tailings pump box within the mill so that it can be transferred to the tailings containment area. No water is to be discharged onto the surrounding tundra without the authorization of the Nunavut Water Board. The water that accumulates within the Temporary Waste Rock Pile Pollution Control Pond is to be sampled monthly during periods of open water and sent for analysis (pH, TSS, Total Ammonia, Total Sulphate, Total CN, Total Oil and Grease, Al, As, Cu, Fe, Pb, Ni, and Zn). The results are to be reported to the Nunavut Water Board under the Surveillance Network Program (SNP) contained within the water license.

The sedimentation pond is designed to retain all surface water runoff and melt water from the remaining areas of the mill and the entire camp pad. The hydraulic design criteria are identical to that for the pollution control pond. The sedimentation pond is not lined. An emergency overflow is provided for the pond in the form of an outflow culvert located at the pond full supply level of 35.7 m.

The water flow path ways for the Camp and Mill Pad Area are shown on Figure 6.1. The blue arrows represent uncontaminated runoff directed by berms away from the pad area. This water will be directed around the pad. The green arrows represent the runoff flow from the “clean” areas of the pad which will be directed to the Sedimentation Pond. The red arrows represent the runoff flow from the “dirty” areas of the pad which will be directed to the pollution control pond for transfer to the TCA.

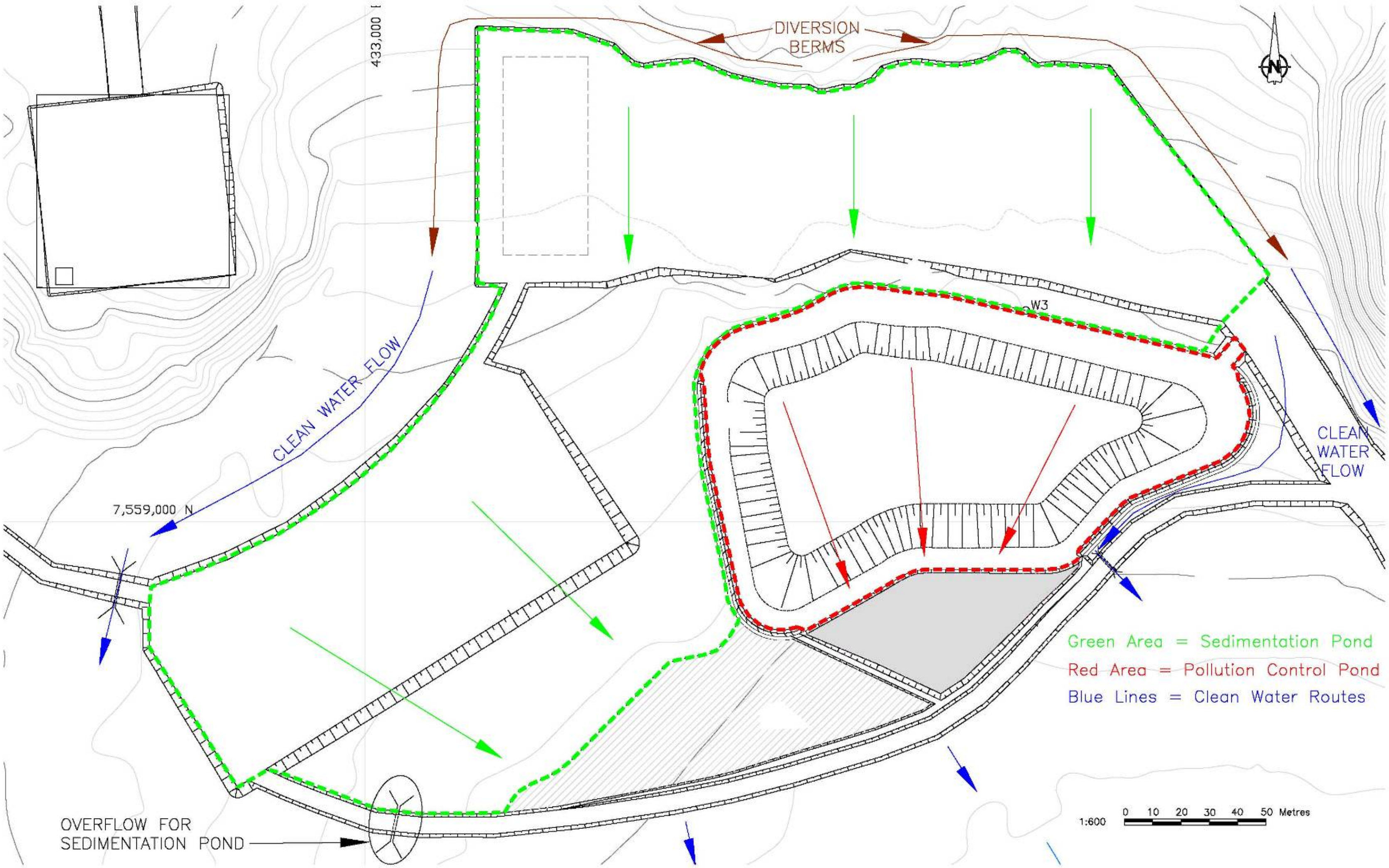

Figure 6.1: Water Flow Patterns at the Camp and Mill Pad Area (Including the Temporary Waste Rock and Ore Stockpiles)

6.2 Fuel Transfer Station, Fuel Tank Farm and Landfarm Facility

The precipitation runoff and snowmelt collected in the sumps at the fuel transfer station, the fuel tank farm and within the landfarm facility will be treated by passing this water through an F1 "Flow and Plug" Oil Adsorption System (Model F11-C-180-TM-Cx2 as supplied by Terry Ruddy Sales of Edmonton Alberta)[9] . This is a portable unit set up on standard pallets so that they can be moved to the fuel transfer station, the fuel tank farm and the landfarm facility as and when needed. The system consists of a self priming electric positive displacement pump, a particulate filter, a drum containing TM-100 oil adsorbing media and two activated carbon media containers connected in series. The unit operates at 5 to 7 gpm. The unit is designed so that the TM-100 oil adsorbing media will blind off when it reaches its absorbent capacity. The unit will be moved into location soon after the spring snowmelt so that the sumps in the fuel transfer station, the fuel tank farm and the landfarm can be drained of precipitation runoff and snowmelt water collected inside the lined facility sump. The unit will then be moved back into the transfer station, the fuel tank farm and the landfarm whenever the sump fills (such as in the late summer or fall when precipitation falling as rain normally increases.

No allowance has been made to remove uncontaminated snow from each of these facilities (the fuel transfer station, the fuel tank farm and the landfarm) before the spring melt. It has been assumed that all snow collected in these three lined facilities will melt and have to be treated through the oil-water adsorption system. In reality MHBL will attempt to remove uncontaminated snow from these facilities, specifically in areas of drift in the late winter ahead of the spring thaw. A combination of hand shovelling and a small bobcat front end loader will be used to clear this snow where practical. This activity will be directed by the on-site environmental coordinator to ensure that the liner integrity is protected.

All precipitation runoff and snowmelt from these three facilities will be treated through the Oil Adsorption System with the treated water then directed onto the nearby tundra to be land applied in a method that prevents erosion at the point of application. The discharge from the Oil Adsorption System will be sampled and analyzed on a once per day basis whenever the system is in operation.

Samples of the water collected within the landfarm facility liner will be conducted early each summer following the spring melt to determine water quality prior to the start up of the oil adsorption treatment system. The samples will be analyzed for pH, Total Suspended Solids, Total Oil and Grease, Benzene, Toluene, Ethyl benzene and Total Ammonia (Total Ammonia only at the landfarm as it is not expected to be present at the other two facilities).

The discharge from the Oil Adsorption system will be sampled and analyzed on a once per day basis whenever the system is in operation. The sample will be taken from the discharge of the oil adsorption system prior to this water being land applied onto the tundra. The samples will be analyzed for: pH, Total Suspended Solids, Total Oil and Grease and Total Ammonia (Total Ammonia only at the landfarm as it is not expected to be present at the other two facilities).

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[8] Appendix B, Landfarm Management Plan, Supporting Document S10h to the Revised Water License Application Support Document, April 2007.

MHBL recommends that the standard that must be achieved for discharge be set as set out in Table 6.3:

Table 6.3: Proposed Discharge Standard for Water Discharged from the lined Fuel Transfer Station, Fuel Tank Farm and Landfarm Facilities

Parameter Being Monitored	Proposed Discharge Standard (mg/L)[1]
pH	**5.0 to 9.0**
TSS	**15.0**
Total Oil and Grease	**5.0**
Total Ammonia[2]	**2.0**

[1] Based on a review of discharge limits used at other mine sites in the NWT for small volume discharges into freshwater

[2] Total Ammonia standard is only for the landfarm facility where nitrogen based nutrients are added to aid soil remediation

3. MHBL proposes that average allowable concentration be calculated as a monthly average of all samples taken during the reporting month.

MHBL looked at discharge limits established in other water licenses for relatively new mine sites in the North to determine what discharge standards were being used to protect the freshwater aquatic environment for small volume discharges from surface runoff ponds and fuel containment facilities. Only limited information could be found. The results of the MHBL review are presented in Table 6.2. At Doris North the treated water released from the fuel transfer station, the fuel tank farm and landfarm will be land applied onto the tundra. The tundra will play a significant role in attenuating contaminants contained in this release. The large dilution available in Doris Lake and Roberts Bay will further attenuate these contaminants. The proposed discharge limits for the release of treated water from these facilities (Table 6.3) were drawn from the data in Table 6.2. These levels have been selected by the regulatory agencies managing water in the N.W.T. as being protective of water quality in the receiving environment in similar settings.

6.3 Non-Hazardous Landfill Facility

Non-combustible and non-hazardous waste will be disposed of in a landfill that will be constructed in a portion of the rock quarry immediately west of the camp (Quarry 2). A surface area of at least 100 m x 100 m will be dedicated to the landfill. The landfill will be isolated from the surrounding watershed via a set of containment and barrier berms. The landfill surface will be graded towards a single sump to allow pump out of clean water directly onto the tundra, or contaminated water to a tanker and then on to Tail Lake. The landfill will be fenced and access will be via a lockable vehicle gate.

Uncontaminated precipitation runoff will be directed away from the landfill area by small rockfill berms located along the upslope edge of the quarry excavation. Similar rockfill berms constructed along the down slope edge of the quarry excavation will retain precipitation runoff and snowmelt within the landfill footprint. The floor of the quarry is founded on bedrock and will be sloped gently to drain into an excavated sump located at the south-east corner of the landfill area.

During the Spring melt, the water collected in this sump will be sampled by the on-site environmental personnel and analyzed for pH, TSS, Total Ammonia, Total Sulphate, Total CN, Total Oil and Grease, Al, As, Cu, Fe, Pb, Ni, and Zn.

Water will be pumped from the sump onto the tundra and be land applied, as long as it meets the proposed discharge standards as set out in Table 6.1 (the same discharge standard as proposed for the mill and camp pad sedimentation pond). Pumping from the landfill pollution control sump will only start once water in the sump has been verified as meeting the proposed discharge standards.

Once pumping starts the discharge from the sump will be sampled daily for each day of pump operation with the sample analyzed for pH, TSS, Total Ammonia, Total Sulphate, Total CN, Total Oil and Grease, Al, As, Cu, Fe, Pb, Ni, and Zn.

The water will be discharged to an area immediately to the east of Quarry 2 where it will have a long cross country flow path before reaching Doris Lake.

If water quality does not meet the proposed discharge standards then the water contained in the landfill pollution control sump will be pumped into a truck mounted tank and transferred to the tailings containment facility at Tail Lake. This transfer of water will continue until sampling verifies that the landfill pollution control sump water complies with the proposed discharge standards. The volume of water collected in the sump is expected to peak in the spring freshet then remain relatively dry throughout the summer months, increasing during the final 30 days leading up to winter.

7.0 SEWAGE TREATMENT AND DISPOSAL

In the past sewage from mining sites was often not treated and either released separately to the receiving environment or co-disposed in an untreated condition with the mill tailings. More recently, sewage from human activities is typically treated at northern mine sites using sewage lagoons or packaged sewage treatment plants that harness biological activity to digest the sewage so that it does not adversely impact the receiving environment.

Sewage sludges typically consume oxygen from the water column if they are placed into areas where they ultimately end up on the bottom of a lake. In northern lakes this can have adverse effects in that typically these lakes are shallow and are covered by a relatively thick ice cover over an extended winter period. In these lakes dissolved oxygen within the water column naturally decrease over the winter months as oxygen is consumed by biological activity within the remaining unfrozen portion of the water column. This leaves a decreasing oxygen presence to sustain life including fish within the lake, but generally sufficient oxygen remains to sustain aquatic life. Any additional oxygen consumer (such as untreated sewage sludge) can however exacerbate this problem and result cause depletion of oxygen in the water column under ice cover, leading to the death of the over wintering fish populations within these lakes.

The release of sewage water and sludge into water bodies also adds nutrients to the receiving lakes which under certain conditions can lead to increase rates of algal growth. The decay of the additional algal mass may increase the consumption of oxygen and again reduce the available oxygen in the water column to sustain life.

Consequently the release of untreated sewage wastewater and sludge into receiving water bodies can affect the ability of these water bodies to sustain life by increasing the consumption of oxygen from the water column.

For the Doris North Project, MHBL is proposing to install and operate a packaged sewage treatment plant to treat all sewage and grey waters produced on site. The treated wastewater and sludge from this sewage treatment plant will then be co-disposed with the mill tailings slurry through the tailings storage facility. In this way the sewage sludge will be fully encapsulated within tailings solids and will not be available to consume oxygen in the overlying water column. The treated sewage sludge will represent less that 0.1% of the total weight of mill tailings discharged into the tailings storage facility. The treated sewage wastewater will be similarly managed by mixing it with the tailings. After mixing with the tailings, the residual oxygen demand of the treated waste water will very small and will not represent a concern. Water from the tailings containment area will be released to the environment (Doris Creek) in a controlled fashion only during open water season to be discharged at a point upstream of a waterfall where the water will be re-oxygenated through passing over the waterfall. Thus, after mixing the Doris Creek water, the oxygen demand will be further reduced and the sewage wastewater management proposed for the Doris North Project will prevent adverse effects typically associated with uncontrolled release of sewage wastewater into northern lakes and streams.

Sewage will be treated in a modular packaged biological treatment plant that will be brought to site fully assembled within two skid mounted 12.2 m x 2.4 m containers (61 m^2). The treatment plant will have a treatment capacity of 68.6 m^3/day, which is sufficient capacity for a fully manned 175-person camp. The camp wastewater will be collected in a grinder pump lift station and discharged to the solids settling tank within the skid-mounted container. Clarified raw sewage overflows to the equalizing tanks that feed the extended aeration bioreactors.

Each bioreactor consists of an aerated primary side and a clarifier cone. Wastewater will enter the primary aerated side and will be mixed with the existing water by means of an extremely efficient fine bubble aeration system. The clarification cone separates developed solids from the treated wastewater, allowing solids to settle back into the aerated side of the tank. This action reduces the amount of total solids and improves treatment.

The ROTORDISK® sewage treatment plant is a high-efficiency packaged plant using the process of rotating biological contactors (RBCs) to remove pollutants from wastewater. ROTORDISK® employs disks made from 3/8" grid extruded medium density polyethylene material with U.V. light inhibitors. The grid pattern promotes oxygen transfer into the wastewater and particularly into the core of the media. The assembly is specially designed to prevent anaerobic conditions from developing.

ROTORDISK® is a multi-staged, fixed steel baffle RBC that has been proven to be more efficient for the removal of carbonaceous biological oxygen demand (BOD) and nitrification than a rotating baffle and plug flow media system. This process utilizes a fixed growth bacteria process whereby bacteria are grown on a media surface that is rotated into and out of the wastewater. The treated wastewater flows through four zones, each with a progressively higher standard of treatment. Unlike most suspended growth bioreactors, the ROTORDISK® is not prone to upsets and can be operated with very low flows during early years of project development (construction phase). The system can be operated from zero influent to above design capacity.

Treated effluent will be collected in a discharge/recycle tank for delivery into the tailings line. Final discharge is into the tailings containment area via the mill tailings pump box. Sludge will be similarly pumped via the mill tailings box into the tailings containment area.

The sewage treatment plant outflow and sludge will be pumped to the tailings impoundment as part of the tailings feed stream. This volume of sludge is dependant of the size of the camp. For the 175-person camp, the total sewage treatment plant, the load has been estimated at ~ 68.6 m^3/day.

Sewage from the construction camp will be collected and treated in the same modular sewage treatment plant set. During the construction phase of the Project, the treated wastewater from the sewage treatment plant will be pumped overland and discharged approximately 200 m to 500 m to the northwest of the camp in a direction away from Doris Lake. The discharge technique would be similar to that used at the Windy exploration camp over the past several years where the treated wastewater is pumped into a small depression on the tundra in an area where the flow is not directed through an existing drainage swale directly into a lake or watercourse. In this manner the treated wastewater can be distributed across the tundra avoiding direct impact on the local lakes. During the short construction phase it may not be necessary to remove sludge from the plant however in the event that sludge levels rise to the point where sludge must be removed to maintain performance of the RBC treatment, then the sludge will be pumped into drums, sealed and held on site until the mill and TCA are operational. At that time the sludge will be transferred into the TCA.

Water quality performance estimates were obtained from a manufacturer of package sewage treatment plants (information provided by PJ Equipment Sales Corp). Expected average solute concentrations and annual loadings for a 175 person camp are summarised in Table 7.1. It was assumed that these loadings would report to Tail Lake continuously throughout the mill operational period, and for one year thereafter.

This wastewater stream has been incorporated into the water quality model prepared for the TCA[10].

[10] For additional information on how this waste water stream was incorporated in the modelling, the reader is referred to Section 3.3.6 and Section 3.5 presents a discussion on nutrient degradation reactions considered within the Tail Lake water quality model, Water Quality Model, Supporting Document S6 to the Revised Water License Application Support Document, April 2007.

Table 7.1: Summary of estimated treated sewage water quality and loadings

Parameter	Average Concentration (mg/L)	Average Loading (kg/year)
Total Ammonia	10	250
Nitrate	1.0	25
Nitrite	30	751
Aluminium	0.052	1.3
Arsenic	0.0002	0.004
Cadmium	0.0001	0.0013
Chromium	0.0025	0.063
Copper	0.0020	0.050
Iron	0.025	0.63
Lead	0.0001	0.0013
Molybdenum	0.0001	0.0013
Nickel	0.0005	0.013
Phosphorus	1.0	25
Uranium	0.0002	0.005
Zinc	0.002	0.05

8.0 PROCESS TAILINGS

Mineral processing of the gold bearing ore will comprise free gold recovery by gravity separation, followed by concentration of the sulphide minerals by conventional flotation technology. The flotation concentrate will then be cyanide leached for gold recovery.

The cyanide leached tailings will be detoxified to reduce total and free cyanide concentrations. In the cyanide destruction circuit cyanide and its metal complexes are oxidized to cyanate (CNO^-). The detoxified cyanide leach residue will be thickened and filtered with the "dry" residue" (~8.5% moisture) will be trucked underground and placed as backfill within mined stopes. Approximately 70% of the detoxified cyanide solution will be recycled within the mill while the remaining 30% of this solution will be "bled" from the circuit and co-disposed with the flotation tailings in the TCA[11].

Subsequent to deposition, the tailings will at all times be covered by a water depth in excess of 4 m. The water cover will prevent any oxygen entry to the tailings and therefore, the sulphide minerals contained in the tailings will be prevented from oxidizing. Consequently no additional solute release from the tailings will occur after the tailings have been deposited in Tail Lake. It should further be noted that since the tailings will be fully submerged and water will be decanted from the surface of the lake, no hydraulic gradients will develop that could cause the pore water to be displaced from the tailings. It is therefore expected that the tailings pore water will be 'locked' interstitially in the tailings indefinitely.

The water and load balance calculations consequently do not consider any additional solute release from the tailings once they have been deposited in Tail Lake.

[11] The assessment of contaminant release from these tailings is described in the Water Quality Model, Supporting Document S6 to the Revised Water License Application Support Document, April 2007.

9.0 TAIL LAKE WATER MANAGEMENT

A water management strategy for the Tail Lake tailings containment system was developed by SRK Consulting (Canada) Inc. (SRK) for MHBL and is a component of the Water Quality Model[12]. The following management plan is drawn from this source.

9.1 Objectives

The primary objective of the Tail Lake water management strategy is to meet CCME guidelines (Canadian Water Quality Guidelines) for parameters of concern (see Table 9.1)[13] to protect freshwater aquatic life in Doris Creek, downstream of the waterfall. These guidelines were established by the Canadian Council of the Ministers of Environment and represent a vigorous determination of levels for each parameter that are protective of aquatic life within fresh waters in Canada. These are guidelines not regulated limits and incorporate a highly conservative approach in determining from scientific research world wide at what level of each parameter are harmful effects noted on aquatic life. Consequently they provide guidance as to levels of each parameter in receiving waters below which there is assurance of "low to no" risk of adverse effect on aquatic life. It should be noted that quite often natural levels of parameters within Canadian freshwaters may already exceed the CCME Guideline values. Consequently by meeting the CCME Guidelines in the receiving water, MHBL is striving to ensure that there will be no adverse effect on aquatic life downstream of its discharge point.

Table 9.1: Discharge Limits under MMER

Parameter	Units	Maximum Monthly Mean	Maximum in a Composite	Maximum Grab Sample
Arsenic (As)	ug/L	500	750	1000
Copper (Cu)	ug/L	300	450	600
Lead (Pb)	ug/L	200	300	400
Nickel (Ni)	ug/L	500	750	1000
Zinc (Zn)	ug/L	500	750	1000
Total Suspended Solids	mg/L	15	22.5	30
Total CN	mg/L	1.0	1.5	2.0
Radium 226	Bq/L	0.37	0.74	1.11

MHBL chose to meet these CCME Guideline values at a point downstream of a 4.3 m waterfall in the Doris Creek as this is the closest point at which Arctic Char can come into

[12] Sections 5.2 and 6.0, Water Quality Model, Supporting Document S6 to the Revised Water License Application Support Document, April 2007.

[13] MHBL expects to meet all CCME Guideline values for the parameters of concern listed in Table 4.1 at the monitoring point down stream of the waterfall within Doris Creek with the possible exception of nitrite. The predicted levels of nitrite are only marginally above CCME Guideline values (see Table 4.2 in Water Quality Model Report, Supporting Document S6 to the Revised Water License Application Document, April 2007) and will only occur for a very short duration as nitrite will quickly convert to nitrate in the receiving waters.

contact with the water released from the TCA. This waterfall acts as natural barrier to the migration of Arctic Char and other downstream fish species up into Doris Lake.

Technology does not exist that would allow MHBL to treat the water to be released from Tail Lake to meet these CCME Guideline values, consequently MHBL acknowledges that it cannot achieve the CCME Guidelines at the end of the discharge pipe from Tail Lake. MHBL's discharge strategy relies on metering the amount of water released from Tail Lake so that the combined water meets the CCME Guideline values below the waterfall. The location of the discharge pipe was placed immediately upstream of this waterfall to protect aquatic life upstream of the discharge point within Doris Lake and the upper reaches of the Doris Creek. In other words the proposed end of pipe discharge point was selected to minimize to the greatest extent possible the amount of Doris Creek that could be exposed to the end of pipe discharge before it mixes completely with the receiving water as it goes over the waterfall.

The Federal Government acknowledges that CCME Guidelines are to be used for guidance purposes only and are thus not incorporated into regulated discharge standards. The Federal discharge standards that apply to the Canadian mining industry are set out in Schedule 4 of the Metal Mining Regulation under the Fisheries Act. These are based on best-practical-available-technology for water treatment and not necessarily meant to be protective of aquatic life. In most regulatory jurisdictions these end of pipe discharge standards are assessed on a case by case basis to determine acceptable levels of impact once the discharge has been mixed in the receiving waters. In other words, setting of discharge criteria typically relies upon a natural mixing zone within the receiving waters. Under the MMER regulation, by law the end-of-pipe discharge from Tail Lake must meet the MMER discharge limits and pass the LC_{50} fish toxicity test.

However, MHBL recognizes that indiscriminate discharge of water from Tail Lake at these limits would not necessarily result in water quality meeting CCME guidelines in the Doris Creek. Consequently MHBL devised a discharge strategy that allows for the load (kg per time period) of contaminants discharged from Tail Lake to be varied in proportion to the background flow and load in the Doris Creek so that concentrations are consistently at or below CCME guideline values in Doris Creek below the point of mixing. To be successful this approach departs from the traditional fixed end of pipe discharge limit and maximum flow rate normally contained in water licenses and replaces it with a fixed allowable concentration in the receiving water.

The active management strategy means that Tail Lake can be operated successfully at several lower than optimum discharge rates. In the event that maximum allowable discharge flow rates are lower than estimated within the water quality model, the proposed control system will automatically adjust to the lower flow rates.

In the event that contaminant of concern concentrations in water sample upstream of the discharge location meet CCME guideline values, and concentrations in water as sampled immediately downstream of the waterfall do not meet the CCME Guideline values, MHBL personnel are to take the following actions:

- Immediately discontinue the discharge of water from Tail Lake by turning off the discharge pump;
- Obtain new analytical data from the monitoring points within Tail Lake and within Doris Creek upstream of the discharge point and re-calculate the allowable discharge rate using the process set out below in Section 9.3;

- Adjust the allowable discharge rate in the PLC controller and re-start the Tail Lake discharge pump; and

- Re-sample the water in Doris Creek at the monitoring point downstream of the waterfall and have it analyzed to verify that CCME Guideline values are being met for the parameters of concern.

Tail Lake can be operated successfully at several lower than optimum discharge rates. In the event that maximum allowable discharge flow rates are lower than estimated within the water quality model, the proposed control system will automatically adjust to the lower flow rates.

In the unlikely event that, for those contaminants of concern with concentrations below their CCME guideline values in the background (upstream of the discharge), CCME Guideline values cannot be met downstream of the waterfall the discharge system would be shut down and no water discharged until the reason can be assessed by MHBL's environmental team[14].

In the unlikely event that no discharge is possible at, or after commencement of operations, water balance modelling has shown that Tail Lake has sufficient capacity to store water for several years after operations would cease. During this time it will be possible to monitor changes in water quality in Tail Lake and, either commence active discharge if suitable conditions develop, or, project water quality into the future to the time that the FSL will be reached. The effects of natural discharge would be re-assessed for that time and if acceptable for natural discharge, Tail Lake would be allowed to fill to its FSL and then allowed to overflow naturally until solute concentrations approach CCME guidelines to enable discharge of excess water contained in Tail Lake and allow breaching of the North Dam. This represents the first contingency strategy.

A second contingency is available for the management of the water contained in Tail Lake. The water quality monitoring undertaken in the early stages of the 'holding' period will identify the solutes that may be of concern at the time the FSL is reached. This will provide ample time to identify water treatment requirements, if any, that may be required to enable discharge of excess water when the FSL is reached. Construction and commissioning of a water treatment plant would represent a second level contingency; however it is unlikely that this contingency would ever have to be developed.

[14] The contingency management strategies in such an event are presented in Section 5.3, Water Quality Model, Supporting Document S6 to the Revised Water License Application Support Document, April 2007.

9.2 Doris Creek Flow Monitoring

A pressure transducer will be installed at a suitable location within Doris Creek to facilitate real time monitoring of flow. The pressure transducer will be connected to a programmable logic controller (PLC) that would record flows in Doris Creek and be used to control the discharge flow rate. If initial monitoring suggests that greater accuracy is required, a flow monitoring weir may be constructed in Doris Creek at a location approximately 50 to 100 m upstream of the waterfall, as dictated by site conditions.

During periods of active discharge, the flow level in Doris Creek will be monitored visually on a daily basis and checked against the real time monitoring results. For this purpose, a staff gauge will be installed at the location where the pressure transducer is located. The area will also be inspected on a daily basis for ice and any debris, and cleared as required to ensure accurate monitoring of flows.

9.3 Determination of the Discharge Rate

The discharge rate would be determined once it has been established that discharge may proceed. The following steps would be undertaken.

First, prior to discharge Tail Lake water would be assessed to determine if it meets MMER criteria as listed in Table 9.1.

It is also a requirement of the MMER criteria that the water not be acutely toxic. If these criteria are exceeded, water would not be discharged from the TCA. For example, if the copper concentration is at or above 300 ug/L, water would not be discharged.

The baseline water quality monitoring results have indicated that occasionally some parameters may naturally exceed the CCME guidelines. While the intent is to not exceed CCME guidelines in Doris Creek, discharge from the TCA should be constrained only if the discharge water would further increase the concentrations of those parameters that exceed CCME guidelines. If, for example, selenium is the only solute in Doris Creek that exceeds its guideline (say at a concentration of 1.5 ug/L), and, the selenium concentration in the TCA is below that (say 1.2 ug/L) then any amount of discharge would in fact cause a decrease in the selenium concentration downstream of the discharge point. The volume of discharge would then be determined subject to meeting CCME guidelines for all remaining parameters and selenium would be excluded as a constraint.

Therefore, the next step in determining the allowable discharge volume would be as follows. Solute concentrations in Doris Creek would be compared to the CCME guidelines for the protection of freshwater aquatic life as listed in Table 9.2, and those that exceed these values would be identified.

Table 9.2: Summary of CCME Water Quality Guidelines

Parameter	Units	CCME WQG
Aluminium (Al)	ug/L	100[15]
Arsenic (As)	ug/L	5
Cadmium (Cd)	ug/L	0.017
Chromium (Cr)	ug/L	1[16]
Copper (Cu)	ug/L	2
Iron (Fe)	ug/L	300
Lead (Pb)	ug/L	1
Mercury (Hg)	ng/L	26
Molybdenum (Mo)	ug/L	73
Nickel (Ni)	ug/L	25
Selenium (Se)	ug/L	1
Silver (Ag)	ug/L	0.1
Thallium (Tl)	ug/L	0.8
Zinc (Zn)	ug/L	30
Ammonia-N	mg/L	1.27
Nitrate-N	mg/L	2.94
Nitrite-N	mg/L	0.060[17]
pH	pH	6.5-9.0
Free CN	mg/L	0.005

[15] Where CCME Guideline is dependent on other water quality values, the mean values of these parameters were used to calculate the guideline for the Doris North Project. Al is dependent on pH and hardness and thus this guideline value is a calculated value

[16] The guideline for chromium is for Cr(VI+) and not total chromium; ammonia, nitrate and nitrite are in units of nitrogen equivalency

[17] The CCME Guideline for Nitrite was updated in December 2006 (Update 6.0.1) to reflect Nitrite measured Nitrite-nitrogen which is equivalent to 0.197 mg/L Total Nitrite.

For each parameter identified to exceed its CCME guideline in Doris Creek, its concentration in Doris Creek would be compared to its concentration in Tail Lake, and if the concentration in Tail Lake is above that in Doris Creek, water would not be discharged.

If the concentrations in Tail Lake of these parameters are below their corresponding concentrations in Doris Creek, these parameters would be excluded from further consideration in determining the allowable volume of discharge.

The Allowable Discharge Volume Ratio (ADVR) would be calculated as follows:

$$ADVR(Cu) = (CCME_{Cu} – [Cu]_{DC}) / ([Cu]_{TL}-CCME_{Cu})$$

Where $[Cu]_{DC}$ = copper concentration in Doris Creek (mg/L),

$[Cu]_{TL}$ = copper concentration in Tail Lake (mg/L), and

$CCME_{Cu}$ = CCME Freshwater Aquatic Guideline for copper (mg/L).

The ADVR for other key parameters would then be calculated on the same basis. The lowest ADVR ($ADVR_{MIN}$) would then be selected as the controlling ADVR. Note that nitrite is expected to oxidize rapidly within Doris Creek and field monitoring would be undertaken to assess actual oxidation rates and determine allowances for calculation of the ADVR.) For example, if the ADVR for chromium is 0.23 and that for copper is 0.35, then the ADVR for chromium would be selected for further evaluation.

The key parameters (parameters of concern) that will be measured for effluent characterization and water quality monitoring are listed in Table 9.3.[18]

[18] Section 5.2.3 and Table 5.1, Water Quality Model, Supporting Document S6 to the Revised Water License Application Support Document, April 2007.

Table 9.3: Parameters to be measured for effluent characterization and water quality monitoring

Deleterious substances and pH[1,2]	Required Effluent Characterization and Water Quality Monitoring Parameters[2,3]:	Required Additional Water Quality Monitoring Parameters	Site-Specific Parameters[6]
Arsenic	Aluminium	Dissolved oxygen[5]	Chromium
Copper	Cadmium	Temperature[5]	Manganese
Lead	Iron		Selenium
Nickel	Mercury[4]		Total phosphorus
Zinc	Molybdenum		Nitrite[7]
Radium 226	Ammonia		Conductivity
Total cyanide	Nitrate		Calcium
Total suspended solids	Alkalinity		Chloride
pH	Total hardness		Magnesium
			Potassium
			Sodium
			Sulphate
			Dissolved organic carbon[5] Total organic carbon [5]

Notes:

1. List of parameters regulated (deleterious substances and pH) as per Schedule 3 of the MMER; concentration limits specified in the regulation (Schedule 4).
2. All concentrations are total values; dissolved concentrations may also be reported; effluent loading (Section 20 of MMER) will also be calculated and reported.
3. List of parameters required for effluent characterization and water quality monitoring as per Schedule 5 of the MMER
4. Analysis of mercury may be discontinued if the concentration of total mercury in effluent is less than 0.10 µg/L in 12 consecutive samples of effluent.
5. In situ measured parameters only for water quality monitoring (in receiving waters).
6. These other parameters are potential contaminants or supporting parameters; analysis is optional and may be added based on site specific historical monitoring data or geochemistry data.
7. Nitrite will not be considered as a controlling parameter for the calculation of the ADVR and TDR unless actual concentrations significantly exceed the predicted values

In the next step, the target discharge rate (TDR) is calculated as follows:

$$TDR = Q_{DC} * 0.8 * ADVR_{MIN}$$

Where TDR = target discharge rate (m^3/s), and
$ADVR_{MIN}$ = lowest allowable discharge ratio.

The factor 0.8 is a factor of safety that will ensure that the discharge flow remains at or below 80 percent of the maximum flow rate at which concentrations would be equal to CCME guidelines in Doris Creek. This conservatism is applied to allow for potential upset conditions in flows or analytical results.

Furthermore, the control simulation modelling[19] indicated that, initially when the solute concentrations are low in Tail Lake, there may be no constraints on the discharge rate. For this reason two additional constraints have been placed on the discharge rate as follows:

- First, the discharge rate cannot exceed 10 % of the flow in Doris Creek; and
- Second, the water in Tail Lake will not be drawn down below the current elevation of 28.3 m ASL to ensure that an adequate water cover is maintained to prevent re-suspension of the tailings.

The overall decision process is illustrated in Figure 9.1.

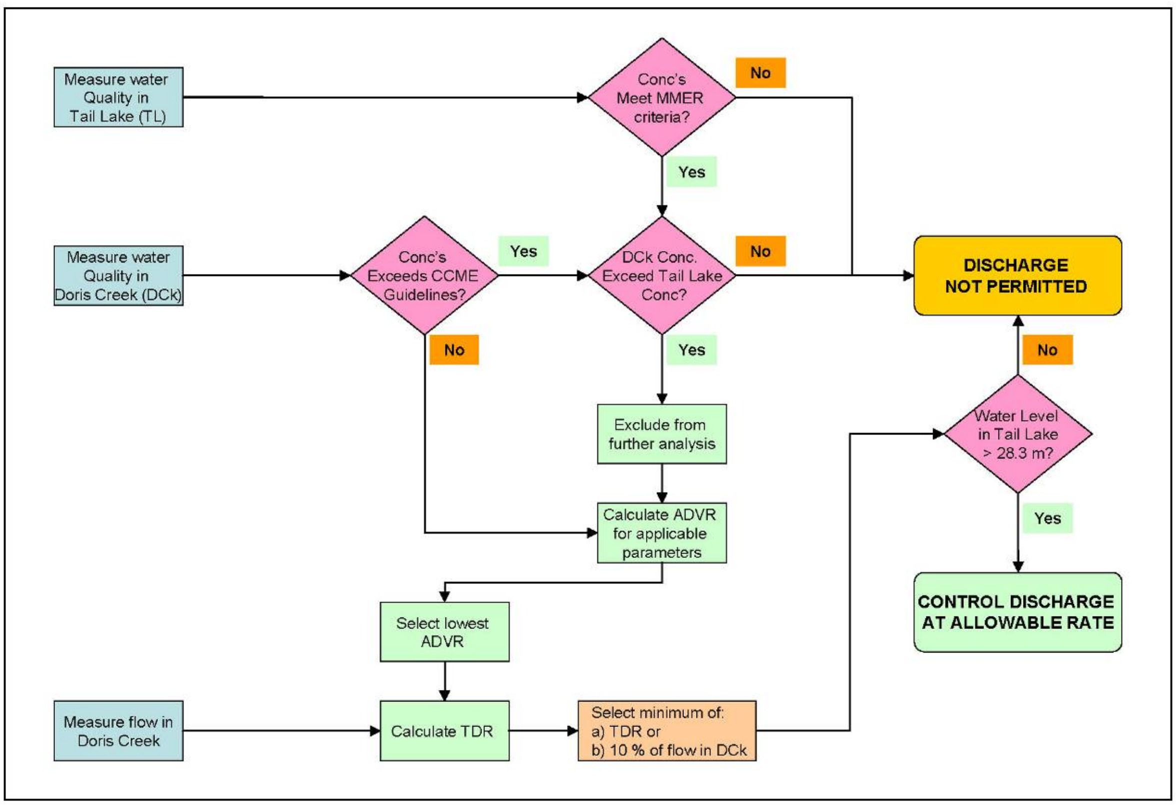

***Figure 9.1*: Decision Flow Diagram for Determining Discharge Flow Rate**

[19] See Section 6, Water Quality Model, Supporting Document S6 to the Revised Water License Application Support Document, April 2007.

The ADVR and TDR will be calculated at least once every 48 hours during the discharge season with the calculation tied to the frequency of water quality monitoring analytical data provided by the on-site environmental laboratory. The ADVR and TDR will be calculated for each set of water quality data obtained.

How often the ADVR and TDR are to be re-calculated should be tied to the rate of change of water quality within Tail Lake and Doris Creek. Given the relative sizes of these water bodies MHBL does not expect that the water quality within the two water bodies will change very quickly. Consequently MHBL has proposed that the ADVR and TDR be re-calculated every second day.

This assumption will be verified through water quality monitoring conducted once operations begin. The results of this monitoring will be plotted for each measured parameter against time. From this data the rate of change for each parameter can be determined and compared to its water quality objective and the operational or active ADVR. For example if the rate of change of copper concentration is less than 2 ppb per month in Tail Lake, and at a dilution of about 20:1 in Doris Creek, the rate of change in the receiving environment would translate to a net incremental increase of 0.1 ppb in the receiving environment over a one month period at the proposed fixed ADVR. In such a case sampling and analysis every second day is not likely to be meaningful. A frequency of once per week will be more reasonable in this case if only to confirm that concentrations are not changing rapidly. The water quality modelling indicates that the rate of change is likely to be very small; in the order of about 0.5 ppb per month during operations. Based on this example, the anticipated change over a one month period would be well within analytical error and could not be reliably detected.

MHBL will determine the rate of change for all key parameters before making a decision to reduce the sampling and analytical frequency. If these calculations indicate that the water quality in Tail Lake is changing at a significantly more rapid rate than predicted then MHBL will return the frequency at which the ADVR and TDR are calculated to once every 24 hours. This will also require a similar increase in the frequency of water quality sampling and analysis for both two sampling points used in this calculation.

9.4 Discharge Control

The discharge system will comprise the installation of a discharge control system that will accurately control and measure the discharge flow rate over a flow range spanning 50 L/s to 275 L/s. A programmable logic controller (PLC) will be used to both control the discharge rate as well as log instantaneous flow rates and cumulative discharge volumes. The flow would be controlled with an actuated flow control valve, with excess flow recycled back to Tail Lake. The PLC will actuate the flow control valve to discharge Tail Lake water at a fixed ratio, equal to the TDR, relative to the flow in Doris Creek.

Discharge will occur 24 hours per day, 7 days per week during the open water season and will commence as soon as practical after the start of the open water season providing that the operating conditions as set out in Section 4.5 are being met. The real time flow monitoring and PLC control will allow the discharge rate to be adjusted on a continuous basis to meet the target discharge rate.

The start of the discharge season will not start until ice conditions allow for flow measurements within the Doris Creek (as described in Section 4.2 above) and the requirements under the MMER are verified, specifically:

- That water quality within Tail Lake meets the MMER regulated discharge limits; and
- The water in Tail Lake passes the LC_{50} fish toxicity test.

The pump intakes in Tail Lake (for the operational period) will be mounted on a floating barge system well away from the tailings discharge point to minimise suspended solids in the intake. Silt curtains will be installed around the pump intake to minimise intake of suspended solids.

The discharge to Doris Creek will be located sufficiently downstream from the flow monitoring location to ensure that the discharge will not interfere with flow measurements in Doris Creek, but sufficiently upstream of the waterfall to ensure complete mixing with Doris Creek water. The outlet will be placed such that the discharge flow will not lead to erosion or degradation of the creek bed. This will be achieved by ensuring that the creek bottom at the point of discharge is armoured either by natural rock or by placing large pieces of non-acid generating rock to provide such armouring to prevent erosive scour at the point of discharge. MHBL will visually monitor the discharge location to ascertain whether significant erosive scour is taking place. MHBL does not feel that a diffuser mechanism will be required but if scour is noted then a diffuser will be installed. Total Suspended Solids will be monitored in the Doris Creek monitoring point to be sited downstream of the waterfall and can be used as a backup to the visual monitoring discussed in the previous sentence.

Discharge from Tail Lake will always be proportional to the background flow in the Doris Creek and will increase flows within Doris Creek by no more than about 5% of background flows. Consequently the risk of downstream bank erosion is considered relatively small. Spring freshet flows are typically the highest natural flows seen in the creek and these occur early in the open water season and quickly drop off (typically within two weeks). Consequently the risk of downstream bank erosion is at its highest during the peak freshet flow and will quickly pass each spring. MHBL will visually monitor for such erosion during daily sampling at the monitoring point located downstream of the waterfall.

In the unlikely event that significant erosion resulting from the MHBL discharge is noted, then MHBL will initiate the following actions:

- Immediately terminate the discharge from Tail Lake to allow Doris Creek to return to natural background;
- Halt further discharge until the measured flow in Doris Creek falls to at least 90% of the measured peak freshet flow. At this point the discharge from Tail Lake can be re-started;

- Conduct additional geotechnical and geo-morphological inspections of the downstream banks where erosion was noted and develop an adaptive management plan; and
- Consult with the KIA, the NWB and DFO once an adaptive strategy has been devised and seek authorization for implementation of such a strategy.

9.5 Operational Strategy

Starting in Year 1, the discharge strategy will be implemented as follows:

- Prior to commencement of milling, the laboratory will be set-up and analytical procedures developed, documented and verified. Sampling protocols will also be documented and verified. The laboratory will be equipped with a low level inductively coupled plasma (ICP) mass spectrophotometer (MS) to enable low detection analyses of metals[20];
- Two weeks prior to commencement of operations (assuming a spring start-up), water quality in Tail Lake and Doris Creek will be monitored every second day to establish baseline conditions. The sampling point for water quality in Tail Lake will be the discharge from the reclaim water pump house set on a floating barge on Tail Lake. This barge will be left in place on the lake year round and equipped with circulation capacity to keep the water below the barge from freezing. This is the same point in the lake from where the discharge pump will draw water for discharge into the Doris Creek. Samples will be obtained from the barge at depths of 1.0 m, 1.5 m and 2.0 m for this initial two week period (the discharge pump intake will be set at a depth of 1.5 m);
- Real-time monitoring of the flows in Doris Creek will commence as soon as practical during the open water season. The pressure transducer would be connected to a programmable logic controller (PLC) that would record flows in Doris Creek and be used to control the discharge flow rate. In addition, a staff gauge will be installed in Doris Creek to enable daily verification of flow rates during periods of active discharge;
- Commencing with the start of tailings deposition, water quality within Tail Lake will be monitored every second day for a further period of two weeks again at a depth of 1.0 m, 1.5 m and 2.0 m. After two weeks the frequency will be lowered to a minimum of once per week at a single depth of 1.5 m on the assumption that, given the relative size of Tail Lake, the water quality within the lake will not change very quickly. Consequently MHBL has proposed that the frequency of sampling be decreased to a minimum of once per week at a depth of 1.5 m after this initial two week period has passed.

[20] Technical information for the proposed ICP-MS is provided in Appendix J of the Water Quality Model, Supporting Document S6 to the Revised Water License Application Support Document, April 2007.

The results of this monitoring will be plotted for each measured parameter against time. From this data the rate of change for each parameter can be determined and compared to its water quality objective and the predicted concentration from the water quality model. MHBL will determine the rate of change for all key parameters before making a decision to reduce the sampling and analytical frequency. If these calculations indicate that the water quality in Tail Lake is changing at a significantly more rapid rate than predicted then MHBL will return the frequency of sampling to once every 24 hours until it can be shown that the water quality within Tail Lake is not varying quickly on a day to day basis; and

- Before any discharge commences, Tail Lake water (taken from the reclaim floating pump house at a depth of 1.5 m) will be submitted for toxicity testing and metals analysis. Only if the water meets MMER criteria will discharge from Tail Lake commence. The flow ratio will be calculated for each sampling event and adjusted as necessary. The discharge flow will be controlled by the automated flow control system which will use the real time flow monitoring in Doris Creek to control the discharge flow rate. Flow rates will automatically be logged by the flow control system.

In subsequent years, it is anticipated that at the start of the open water season the analytical turnaround time will likely prevent discharge for the first few days, however a similar sampling frequency will be used for the first two weeks of the discharge period (daily at depths of 1.0 m, 1.5 m and 2.0 m) and then decreased to once per week at a single depth of 1.5 m for the remainder of the discharge season.

The downstream together with the upstream and Tail Lake water quality monitoring results will be used to verify the performance of the discharge system at regular intervals and to make flow control adjustments as appropriate.

As part of the control strategy, the actual water quality in Tail Lake will be compared with the predicted water quality on a monthly basis to assess the accuracy of the model. If significant deviation is noted then the model will be recalibrated to the actual water quality observed in Tail Lake. The model will be rerun if there is a more than 20 % deviation above the predicted concentrations for any of the critical or significant parameters (MMER, CCME). The model will then be rerun to assess potential implications on the discharge strategy and to determine future operational requirements. This comparison of actual water quality to predicted water quality in Tail Lake will be communicated to the NWB for inclusion in the public registry as part of the monthly Surveillance Network Program reporting. Model calibration would be required only if the model significantly underestimates solute concentrations in Tail Lake AND it is shown to potentially have a significant impact on the water management strategy.

The water quality modeling was undertaken with the explicit purpose of establishing the limitations on the potential for discharging water from the TCA. Therefore measured water quality will be compared to the predicted water quality. The parameters will include MMER criteria as well as the CCME parameters of concern and will include the nutrients. If the predictions over-estimate actual concentrations no additional assessment will be undertaken. In the event that actual concentrations significantly exceed predicted concentrations, the source streams will be analysed and compared to the assumptions that were adopted in the water quality model. The source loadings will accordingly be adjusted in the water quality model to assess future constraints on the discharge strategy. If the modelling shows that there will be no significant impacts on the discharge strategy the progress of water quality will be tracked to ensure that the conclusion holds. In the event that the predictions show a significant constraint on achieving the water management strategy, then measures to contain or limit that source will be investigated. Should it not be possible to control the source then the implications with respect to the discharge strategy/holding time will be assessed. It may then be possible through adaptive management to revise the discharge strategy. In the event that the discharge strategy cannot be revised to accommodate the changes in water quality, water treatment requirements will be established. Because of the long holding time available, it will be possible to design and implement a suitable water treatment system to continue to meet the project objectives of meeting CCME Guidelines in the receiving environment.

9.6 Water Quality Monitoring and Locations

Approved water sampling protocols will be adopted. Water sampling and monitoring for the management of Tail lake water will be as follows.

9.6.1 Tail Lake

The intake to the discharge pipeline will be located on a floating barge system within the northern part of Tail Lake, about 1.5 m below the water surface. Two weeks prior to commencement of operations (assuming a spring start-up), water quality in Tail Lake will be monitored every second day to establish baseline conditions. The sampling point for water quality in Tail Lake will be at the reclaim water pump house set on a floating barge on Tail Lake. This barge will be left in place on the lake year round and equipped with circulation capacity to keep the water below the barge from freezing. This is the same point in the lake from where the discharge pump will draw water for discharge into the Doris Creek. Samples will be obtained from the barge at depths of 1.0 m, 1.5 m and 2.0 m for this initial two week period (the discharge pump intake will be set at a depth of 1.5 m).

After two weeks the frequency will be lowered to a minimum of once per week at a single depth of 1.5 m on the assumption that, given the relative size of Tail Lake, the water quality within the lake will not change very quickly. Consequently MHBL has proposed that the frequency of sampling be decreased to a minimum of once per week at a depth of 1.5 m after this initial two week period has passed. If water quality in Tail Lake is changing at a significantly more rapid rate than predicted then MHBL will return the frequency of sampling to once every 24 hours until it can be shown that the water quality within Tail Lake is not varying quickly on a day to day basis.

Before any discharge commences, Tail Lake water (taken from the reclaim floating pump house at a depth of 1.5 m) will be submitted for toxicity testing and metals analysis. Only if the water meets MMER criteria will discharge from Tail Lake commence.

9.6.2 End of Pipe Discharge

The frequency of sampling and analysis is specified in the MMER to be weekly, at least initially, for regulated parameters. However, there is provision to reduce the frequency of analysis for some parameters based on the results obtained. These results will be correlated with the intake water quality results for further confirmation that the intake monitoring results reasonably reflect actual discharge water quality.

9.6.3 Doris Creek Upstream of Weir

The upstream water quality samples for Doris Creek will be obtained upstream of the flow monitoring point, as dictated by site conditions. Sampling will initially be undertaken every second day to coincide with the intake monitoring samples. As for the intake sampling, MHBL has proposed that the frequency of sampling be decreased to a minimum of once per week after this initial two week period has passed. If water quality in Doris Creek is changing at a significantly more rapid rate than predicted then MHBL will return the frequency of sampling to once every 24 hours until it can be shown that the water quality within Doris Creek is not varying quickly on a day to day basis.

9.6.4 Doris Creek Downstream of Waterfall

Doris Creek downstream of the waterfall will be monitored only during periods of active discharge. The sample location will be established approximately 30 to 50 m downstream of the waterfall, as dictated by site conditions, to ensure that complete mixing of Tail Lake discharge and Doris Creek has occurred. The sampling frequency would follow the frequency for the discharge pump intake and for Doris Creek upstream of the weir, i.e., sampling will initially be undertaken every second day and then the frequency of sampling be decreased to a minimum of once per week after this initial two week period has passed. If water quality in Doris Creek is changing at a significantly more rapid rate than predicted then MHBL will return the frequency of sampling to once every 24 hours until it can be shown that the water quality within Doris Creek is not varying quickly on a day to day basis..

9.6.5 Dam Seepage

If evident, toe seepage at the North and South Dams will be sampled and monitored on a weekly basis. If flows become significant, the seepage will be collected and pumped back to Tail Lake.

9.6.6 Mill Effluent

Mill tailings discharge water will be monitored at a location after all of the effluent streams have been combined into a single flow. Initially the water quality will be sampled daily. MHBL proposes that once a good baseline has established (after 3 months of operation) this frequency be reduced to once per week.

9.6.7 Water Quality Analyses

Onsite Laboratory

Condition 9 of the Doris North Project Certificate issued by the Nunavut Impact Review Board (NIRB) requires:

> *MHBL will fund and install an on-site laboratory for continuous and real-time monitoring of water quality contained within Tail Lake and Doris Creek after discharge. This will be done prior to the commencement of operations. The laboratory shall be certified, with standards to include the calibration of water quality monitoring instruments. MHBL shall file proof of application to become accredited, upon request of the NWB or NIRB's Monitoring Officer.*

MHBL will take the following actions to comply with this condition:

- A low level detection environmental laboratory will be established on site. For convenience the laboratory will be sited near the camp complex, but sufficiently removed from the mill site to prevent contamination. The laboratory will be established prior to commencement of any discharges from Tail Lake;
- Suitably qualified personnel familiar with the operation and maintenance of a low level environmental laboratory will be retained to operate the laboratory. Documented standard operating procedures (SOPs) will be used;
- The laboratory will be equipped with a low level inductively coupled plasma (ICP) mass spectrophotometer (MS) to enable low level detection analyses of metals[21];
- MHBL will seek laboratory accreditation with the Canadian Association for Environmental Analytical Laboratories (CAEAL). The requirements include a well-documented quality assurance/quality control (QA/QC) program, as well as demonstrated proficiency in analysis of performance evaluation (PE) samples. The assessment and accreditation will be updated every two years;
- A documented internal quality control program will be implemented[22] which will include items such as calibration schedules, use of quality control samples, established control specifications with corrective actions if specifications are not met, data validation, equipment maintenance, and staff training and evaluation programs;

- Quality control samples will include:
    - Blanks – analysis of de-ionized water to ensure that there is no contamination due to laboratory procedure;

[21] Technical information for the ICP-MS is provided in Appendix J of the Water Quality Model, Supporting Document S6 to the Revised Water License Application Support Document, April 2007.
[22] See the Quality Assurance/Quality Control Plan, Supporting Document S10k to the Revised Water License Application Support Document, April 2007.

- Duplicates – a replicate analysis of a homogeneous sample to show method precision;
- Spikes – a replicate sample spiked with a known amount of stock standard solution to show both method precision and accuracy and to check for any interferences; and
- Reference materials – a National Institute of Standards and Technology (NIST) or other suitable certified reference material to show method accuracy.

All of the above laboratory QC samples will be run regularly. Results will be compared to Data Quality Objectives (DQOs) and be used to flag sample results where DQOs are not met. Control samples will be run at a minimum frequency of 10% of the samples for analysis. Quality records will be kept and will be available for inspection.

Water Quality Parameters

The parameters that will be monitored regularly, and intermittently, at the site are summarised in Table 9.4. Not all of the parameters will necessarily be measured on-site. Non-critical parameters such as dissolved and total organic carbon would be measured off-site on a less frequent basis.

Table 9.4*: Parameters to be measured for effluent characterization and water quality monitoring*

Deleterious substances and pH[1,2]	Required Effluent Characterization and Water Quality Monitoring Parameters[2,3]:	Required Additional Water Quality Monitoring Parameters	Site-Specific Parameters[6]
Arsenic	Aluminium	Dissolved oxygen[5]	Chromium
Copper	Cadmium	Temperature[5]	Manganese
Lead	Iron		Selenium
Nickel	Mercury[4]		Total phosphorus
Zinc	Molybdenum		Nitrite
Radium 226	Ammonia		Conductivity
Total cyanide	Nitrate		Calcium
Total suspended solids	Alkalinity		Chloride
pH	Total hardness		Magnesium
			Potassium
			Sodium
			Sulphate
			Dissolved organic carbon[5] Total organic carbon [5]

Notes:
1. List of parameters regulated (deleterious substances and pH) as per Schedule 3 of the MMER; concentration limits specified in the regulation (Schedule 4).
2. All concentrations are total values; dissolved concentrations may also be reported; effluent loading (Section 20 of MMER) will also be calculated and reported.
3. List of parameters required for effluent characterization and water quality monitoring as per Schedule 5 of the MMER Analysis of mercury may be discontinued if the concentration of total mercury in effluent is less than 0.10 µg/L in 12 consecutive samples of effluent.
4. In situ measured parameters only for water quality monitoring (in receiving waters).
5. These other parameters are potential contaminants or supporting parameters; analysis is optional and may be added based on site specific historical monitoring data or geochemistry data.

Third Party Verification

Condition 10 of the Doris North Project Certificate issued by the Nunavut Impact Review Board requires:

> *Upon commencement of operations, MHBL shall ensure that the monitoring of Tail Lake and Doris Creek water quality, above and below the waterfall, be verified and reported to NIRB three times during discharge by an independent , third part laboratory. The sampling must be carried out independently or supervised in which case MHBL must provide the sampling and delivery of samples to the independent, third party laboratory, with copies of the results directly to the NWB and NIRB's Monitoring Officer.*

MHBL will comply with this condition upon the commencement of operations (when tailings are first placed into the TCA) as follows:

1. In the first open water season following or during the commencement of operations, MHBL will arrange to have a qualified independent third party come to site on three separate occasions to collect samples from the Water License defined SNP sites in Tail Lake and in the Doris Creek, both above and below the waterfall. These samples will be collected when water is being discharged from Tail Lake into Doris Creek. MHBL staff will take duplicate samples at the same time and from the same locations. The samples collected by the independent third party will be spilt by the independent third party with one set of samples going to an accredited independent laboratory selected by the independent third party who are carrying out the sampling and the second set being analysed by MHBL at the on-site environmental laboratory. The parallel set of samples collected by MHBL at the same time will also be split with one set being analysed at the on-site environmental laboratory and the other set going to the external accredited laboratory used on a regular basis by MHBL for analysis of its compliance samples. All samples will be analysed for the full set of analytical parameters as set for these specific SNP stations in the Water License. This will provide a good set of data to check the analytical accuracy of both the on-site environmental laboratory and the external laboratory used by MHBL to analyse all of its environmental compliance samples. Preparation of chain of custody forms and actual shipping of the samples to the independent third part laboratory will be supervised by the independent third part conducting the sampling, who will also make arrangements to have the resultant analysis sent directly to the NWB and to the NIRB Monitoring Officer and to MHBL. MHBL will provide its analytical results on the spilt and parallel samples to the NWB and NIRB Monitoring Officer through the monthly Water License SNP report.

2. In subsequent years the same sampling and analytical process will be applied however in place of having the independent third party come to site on three occasions, MHBL will arrange to have the independent third party come to site for the first sampling to monitor and verify the sampling and handling techniques being used by MHBL. The actual sampling will be conducted by MHBL personnel and audited by the independent third party. The samples will be handled as in the first year. The independent third party will provide a report on his audit visit to the NWB, the NIRB Monitoring Officer and to MHBL. For the next two sampling rounds in that year, MHBL will conduct the sampling using the same sampling and handling procedures and arrange to have the samples sent to the independent third party lab. Copies of the chain of custody documents for these samples will be sent to the NWB, the NIRB Monitoring Officer and to the independent third party laboratory. The results will be communicated as set out for the first year.

Data Management

Condition 11 of the Doris North Project Certificate issued by the Nunavut Impact Review Board requires:

> *Monitoring information collected under this approval shall contain the following information:*
>
> *a. The name of the person(s) who performed the sampling or took measurements;*
>
> *b. Date, time, and place of sampling or measurement;*
>
> *c. Date of analysis;*
>
> *d. Name of the person who performed the analysis;*
>
> *e. Analytical methods or techniques used; and*
>
> *f. Results of any analysis*

MHBL will comply with this condition. Monitoring information to be collected for each sample taken and analysed will include:

- The name of the person(s) who performed the sampling or took measurements;
- Date, time, and place of sampling or measurement;
- Date of analysis;
- Name of the person who performed the analysis;
- Analytical methods or techniques used; and
- Results of any analysis.

This information will be incorporated into the monthly Water License SNP reports.

Condition 12 of the Doris North Project Certificate issued by the Nunavut Impact Review Board requires:

The results and records of any monitoring, data, or analyses shall be kept for a minimum of the life of the project including closure and post closure monitoring. This time period shall be extended if requested by NIRB, DFO, EC or the NWB.

MHBL will comply with this condition. MHBL will set up and maintain a Laboratory Information Management System (LIMS) to record and manage all the water quality monitoring results. MHBL will consult with NIRB's Monitoring Officer for guidance on presentation of monitoring results and records.

This report, “Water Management Plan, Doris North Project, Nunavut, April 2007”, has been prepared by Miramar Hope Bay Ltd.

Prepared By

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