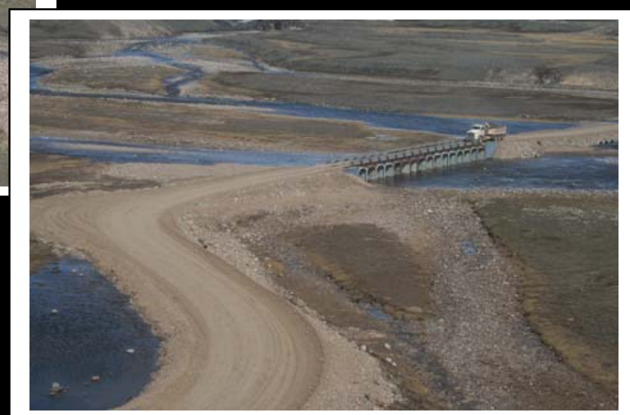
Appendix H

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

2009 ABANDONMENT AND RECLAMATION PLAN



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March 26, 2009

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BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

2009 ABANDONMENT AND RECLAMATION PLAN
(REF. NO. NB102-181/15-1)

Rev. No.	Revision	Date	Approved
0	Issued in Final	March 26, 2009	M.

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BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

2009 ABANDONMENT AND RECLAMATION PLAN
(REF. NO. NB102-181/15-1)

EXECUTIVE SUMMARY

<u>Foreword</u>

The Mary River Project is an advanced iron ore exploration project located in the northern Baffin Island region of Nunavut (Figure 1.1). The project is wholly owned by Canadian mining company Baffinland Iron Mines Corporation (Baffinland). Baffinland has released a Definitive Feasibility Study (DFS) demonstrating the robust potential of full-scale development and has initiated the regulatory approval process for full-scale development. This abandonment and reclamation plan (A&R Plan) was prepared to address closure and reclamation in accordance with best corporate governance practices and as a condition of the surface lease held by Baffinland with the Qikiqtani Inuit Association.

Earlier versions of this A&R Plan were prepared to support environmental screening and permitting activities for the bulk sampling program and to reflect the outcome of the environmental screening and changes to the scope of the work as provided by Amendment No. 2 to the Nunavut Water Board (NWB) water licence as well as the comments made by the NWB (Knight Piésold Ref. No. NB102-00181/6-7, Rev. 2, dated 31-March-2008).

This document is an update to the March 2008 version in consideration of changes to the scope of the work, shipment of the bulk sample as well as the comments made by the NWB and the QIA.

This updated A&R Plan will become the closure document that Baffinland will follow if there were no immediate or pending plans to advance the project towards mine development, subject to any future revisions required to reflect material changes. This plan provides a full cost of implementing closure that addresses all project-related activity areas and infrastructure related to the Mary River Project that will be in place assuming an unplanned (i.e. “worst case” scenario) shut-down as of March 31, 2010. This is a hypothetical date as actual closure timing is currently unknown and coincides with the requirements in the surface lease.

Key differences in the assumptions included in the 2009, compared to the 2008 plan include:

- Mobilization activities in 2008 anticipated continuing to advance the project beyond the bulk sample to full scale development. As a consequence, more fuel and equipment is currently on-site. Demobilization of these resources is included in the revised plan.
- Actual site conditions and changes in site conditions from that which was assumed in the 2008 plan
- Inclusion of activities which were previously accounted for as part of ongoing field operations and not part of reclamation. For example, this plan now includes final landscape grading and contouring of disturbed areas, construction of the landfill and access road plus much of its operation, contractor demobilization and increased supervision as a cost of closure versus being an element of operations of the Bulk Sampling Program.

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Any reconciliation to the previous A&R cost estimate is of little use/relevance since the scopes and underlying assumptions differ.

Site Description

The Mary River Project is an advanced exploration project. Programs and activities are designed to support advancing the Project to full-scale development. In summary, project-related activity areas and infrastructure related to the existing Mary River Project include:

Camps and Related Facilities

- A 100-person winterized exploration tent camp and a 100-person all-season tent camp, and ancillary facilities (e.g. washroom/dry, firehall, workshop, sea containers for storage, camp generators, incinerator, sewage tanks/treatment plants/ponds, mobile equipment, etc) at Mary River.
- An all-season 60 person fully serviced trailer camp, associated facilities and related infrastructure at Milne Inlet constructed to support the Milne Inlet Tote Road construction activities, seasonal re-supply, and barge loading of the bulk sample.
- A temporary tent camp, associated facilities and related infrastructure for approximately 40 people part way along the potential future railway alignment north of Cockburn Lake referred to as the Mid Rail camp constructed to support the geotechnical drill program between Mary River and Steensby Inlet, as well as environmental studies based in the area.
- A temporary tent camp, associated facilities and related infrastructure for approximately 50 people with associated facilities and related infrastructure constructed to support environmental studies, seasonal re-supply, on-ice port site drilling and geotechnical drilling in the general southern area of the rail alignment. A sea-lift in 2008 delivered a trailer camp (12 trailer units still in storage at laydown area) to Steensby Inlet to replace or supplement the tent camp for use in the future field programs.
- Two temporary refuge stations along the Milne Inlet Tote Road and an emergency survival trailer parked at the crusher location near Deposit No. 1.
- Communication towers and repeater stations positioned at Milne Inlet, Mary River camp and two along the Milne Inlet Tote Road. Weather stations located at Mary River and both Milne Inlet and Steensby Inlet. A test wind tower northeast of Mary River Camp.

Bulk Sample Pit and Stockpiles

- A side hill cut single mining bulk sample pit approximately 10 m deep on Deposit No. 1.
- A stockpile containing approximately 28,000 tonnes of surficial weathered ore excavated from the surface of Deposit No. 1 remains on the deposit.
- Approximately 6,000 tonnes of representative (i.e. ore grade) material in the bulk sample pit.
- Stockpiles containing approximately 25,000 tonnes of non-representative ore (i.e. separate lump and fine stockpiles) at the Mary River crusher site.
- An ore stockpile pad containing approximately 24,000 tonnes of non-representative ore at Milne Inlet.
- Approximately 6,000 tonnes of representative (i.e. ore grade) material is stockpiled on the ore pad at Milne Inlet.

Roads and Borrow Sources

- A 105 km road between the Mary River Site and Milne Inlet referred to as the Milne Inlet Tote Road.
- Three main sand and gravel borrow sources, a rock quarry at Mary River, and sand and gravel sources from within the road alignment.
- Mine haulage road from the ridgeline on Deposit No. 1 to the crusher location.
- Two gravel airstrips with temporary lighting at the Mary River airstrip.

Fuel Storage

- A lined bulk fuel storage facility with a capacity of 1.5 million litres, double walled 75,000 litre tank in lined containment and lined re-fuelling stations at the Mary River camp.
- A lined bladder tank farm with an approximate capacity of 8.25-million litres as well as a lined re-fuelling station and re-supply pipeline at the Milne Inlet camp.
- Drum caches in lined containment situated at Milne Inlet, Mary, River, Steensby Inlet and Mid Rail Camps.

<u>Abandonment Scenarios</u>

Two abandonment scenarios have been conceived in this A&R Plan: temporary suspension, and final abandonment. A temporary suspension of activities means the temporary cessation of the current program operations, either as planned or due to unforeseen circumstances, typically lasting for weeks to months but could conceivably last for a year or longer. This could be due to economic or operational difficulties that would cause a temporary cessation of current operations at the project sites, such as a prolonged period of poor weather and related issues, fuel shortages, mechanical problems with critical equipment, unanticipated delays in the project timeline, or availability of financing. All facilities will be secured in a manner similar to the seasonal shutdown of the existing Mary River camp that has occurred in past years.

Final closure would be undertaken if a decision was made to cease all activities at Mary River due to unforeseen circumstances or if there were no immediate or pending plans to advance the project towards mine development.

Final closure and reclamation will include removing all equipment and materials either off-site or into an on-site landfill at Mary River (for inert, non-hazardous, non-combustible materials), and contouring ground surfaces. Equipment and materials to be taken off-site will be transported overland from Mary River Camp to Milne Inlet. Materials and Equipment at Mid Rail Camp will be flown to Steensby Camp or the Mary River Camp. Arrangements will be made with a sealift contractor to collect the shipment of materials and equipment at Milne Inlet and Steensby Inlet and ship materials offsite for re-sale, salvage or disposal.

The timing of final closure and reclamation is largely governed by site access and weather. It is estimated that a total of five months will be required to remove equipment and materials from Mary River with a crew of about 50 people.

Follow-Up and Monitoring

All development areas related to the Project will be subjected to a closure inspection by a company representative or contractor, and a brief closure and reclamation report with photographs will be prepared, documenting the reclamation work completed and the site conditions following closure.

During the follow-up and monitoring period, sand and gravel contaminated with petroleum products will be managed in a land farm at Milne Inlet. This land farm will be decommissioned near the end of the monitoring period.

Monitoring and follow-up inspections will be conducted at the Mary River Project area in order to assess the physical and chemical stability of the various components after closure and reclamation of the facilities. Annual inspections of the affected sites will be carried out for up to five years following the final closure to demonstrate that conditions have not changed and remain both physically and chemically stable.

Estimated Cost

The estimated cost to complete the final closure work described in this A&R Plan is $10,583,928

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(ᓈᓴᐅᑖ. ᓇᐊ102-00181ᑯ15-1)

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ᐱᒋᐊᕈᑎ

ᓄᓈᕘᖕᓂᑦ ᓴᕕᕋᔾᔭᔅᓴᓂᒃ ᕿᓂᖅᓴᖅᑐᑦ ᓴᕕᕋᔾᔭᔅᓵᓚᓪᓕᒃ ᐅᔭᕋᓐᓂᐊᖅᑐᑎᒃ ᕿᓂᖅᓴᐃᔪᑦ ᐃᓱᖃᕐᓂᖓᓐᓄᑦ ᓇᓂᔭᐅᓯᒪᔪᖅ ᕿᑭᖅᑖᓃᑉ ᐅᐊᖕᓇᖕᖑᒍᑦ ᓄᓇᕗᑉ ᐃᓗᐊᓂᑦ (ᑕᑯᔅᓴᖅ 1.1). ᑖᓐᓇ ᐱᓕᕆᓂᐅᔪᖅ ᑕᒪᐃᓐᓂᒃ ᓇᒻᒥᓂᕆᔭᐅᕙᖅ ᑖᒃᑯᓄᖕ ᓄᓈᕘᖕᓂᑦ ᓴᕕᕋᔾᔭᔅᓴᓕᕆᔨᒃᑯᑦ ᐅᔭᕋᓐᓂᐊᖅᑎᑦ ᑯᐊᐳᕇᓴᖕᖑᓐᓄᑦ (ᓴᕕᕋᔾᔭᔅᓴᓕᕆᔨᒃᑯᑦ). ᓴᕕᕋᔾᔭᔅᓴᓕᕆᔨᒃᑯᑦ ᓴᖅᑭᑦᑎᕆᓯᒪᓕᖅᐳᑦ ᑭᒡᓕᓯᓂᐊᖅᑕᖅ ᐱᔪᒥᓇᕐᓂᖕᖓᓄᑦ ᖃᐅᔨᓴᐃᓂᖅ (ᑎᕕᓴ) ᓴᖅᑭᑎᕆᓯᒪᓪᓗᓂ ᑲᔪᓯᔪᓐᓇᑦᑎᐊᕐᓂᖕᖓᓂᒃ ᐊᖏᔪᒥᒃ ᐅᔭᕋᓐᓂᐊᕐᓂᕐᒥᒃ ᐱᒋᐊᖅᑕᐅᓯᒪᓕᖅᓗᓂ ᐊᖏᖅᑕᐅᔾᔪᑎᔅᓴᑦ ᐅᔭᕋᓐᓂᐊᕐᕕᓐᖑᕋᓯᑦᑐᓄᑦ ᒪᓕᒐᖅᑎᒍᑦ. ᕿᒪᑦᑕᐅᒍᓂ ᐃᓕᖅᑯᓯᑐᖃᖕᖓᓄᑦ ᐅᑎᖅᑎᑦᑎᓂᖏᑦ ᐸᕐᓇᐅᑎᖕ (ᕿᒪᐃᓂᕐᒧᑦ ᐸᕐᓇᐅᑦ) ᐱᓕᕆᐊᖑᓚᐅᖅᑐᖅ ᒪᑐᔭᐅᓂᔅᓴᖕ ᓄᓇᖏᑕᓗ ᐃᓕᖅᑯᓯᑐᖃᒥᓄᑦ ᐅᑎᖅᑎᑕᐅᔪᓐᓇᕐᓂᖏᑦ ᒪᓕᒃᓗᒋᑦ ᐱᓐᓇᓯᖃᖅᑐᓄᑦ ᐱᐅᓛᖑᔪᑦ ᐊᑐᖅᑕᐅᕙᑦᑐᑦ ᐊᒻᒪ ᑭᒡᓕᓯᓂᐊᖅᑕᐅᓯᒪᓂᖕᖓᓄᑦ ᓄᓇᒧᑦ ᐊᑐᕈᓐᓇᐅᑎᑎᒍᑦ.

ᓯᕗᓪᓖᑦ ᑎᑎᕋᖅᑕᐅᓯᒪᔪᑦ ᐸᕐᓇᐅᑎᑦ ᐱᒋᐊᖅᑕᐅᓂᑯᓪᒪᑕ ᐃᑲᔪᐃᓇᓱᐊᖅᑐᑎᒃ ᐊᕙᑎᐊᓄᑦ ᕿᒥᕐᕈᐃᔪᓄᑦ ᓄᓇᒧᓪᓗ ᐱᔪᓐᓇᐅᑎᓂᒃ ᐊᑐᓇᐊᓕᑦᑎᓐᓄᑦ ᐊᖏᔪᒧᑦ ᓴᕕᕋᔾᔭᔅᓴᒧᑦ ᖃᐅᔨᓴᐃᓂᖃᖅᑎᓪᓗᑕ ᑕᑯᔅᓴᕈᕋᓱᒃᑐᑎᒍᓪᓗ ᓴᖅᑭᑕᐅᔪᑦ ᐊᕙᑎᒥᒃ ᕿᒥᕐᕈᐃᔪᓄᑦ ᐊᓯᔾᔨᕈᑎᖏᓄᓪᓗ ᐱᓕᕆᐊᖑᔪᑦ ᒪᓕᒃᓗᒍ ᐋᖅᑭᒋᐊᕈᑎ 2 ᓄᓇᕘᑉ ᐃᒪᓕᕆᔨᒃᑯᑦ ᑲᑎᒪᔨᖏᑕ ᐃᒪᕐᒧᑦ ᓚᐃᓴᓐᓯᖕ ᐃᓚᒋᓪᓗᒋᑦ ᐅᖃᐅᓯᕆᔭᐅᔪᑦ ᐃᒪᓕᕆᔨᒃᑯᓐᓄᑦ (ᓇᐃᑦ ᐲᓴᐅᓪᓕᑦ ᓈᓴᐅᑖ ᓇᐸ102-00181/6-7, ᐊᓯᔾᔨᖅᑕᖅ 2, ᐅᓪᓗᖓ ᒪᔾᔭ 31, 2008).

ᑖᓐᓇ ᑎᑎᕋᖅᑕᐅᓯᒪᔪᖅ ᓄᑖᖑᕆᐊᕈᑎ ᒪᔾᔭ 2008 ᑎᑎᕋᖅᑕᐅᓯᒪᓂᕕᓂᐊᓄᑦ ᐃᓱᒪᒋᔭᐅᓪᓗᑎᒃ ᐱᓕᕆᐊᑦ ᐊᓯᔾᔨᖅᑕᐅᓂᖏᓐᓄᑦ ᐃᖅᑲᓇᐃᔮᕆᔭᑦ, ᓇᔅᓯᐅᑎᔭᐅᓂᖕᖓᓄᑦ ᓴᕕᕋᔾᔭᔅᓴᖅ ᖃᐅᔨᓴᖅᑕᐅᔪᔅᓴᖅ ᐊᒻᒪᓗ ᐅᖃᐅᓯᐅᔪᑦ ᐃᒪᓕᕆᔨᒃᑯᓐᓄᑦ ᕿᑭᖅᑕᓂᒃᑯᓐᓄᓪᓗ.

ᐅᓇ ᓄᑖᖑᕆᐊᖅᓯᒪᔪᖅ ᕿᒪᐄᑎᓂᕐᒧᑦ ᐸᕐᓇᐅᑦ ᒪᑐᔭᐅᓂᔅᓴᖕᖓᓄᑦ ᑎᑎᕋᖅᓯᒪᔪᖅ ᐊᑐᖅᑕᐅᓂᐊᖅᑐᑦ ᓴᕕᕋᔾᔭᔅᓴᓕᕆᔨᒃᑯᓐᓄᑦ ᐱᓗᐊᖅᑐᒥᒃ ᒫᓐᓇᑲᐅᑎᒋᒃᑯᑦ ᓯᕗᓂᐊᒍᓪᓗᓈᓅᑦ ᐱᕙᓪᓕᐊᔾᔮᖕᖏᒃᑯᑎᒃ ᐅᔭᕋᓐᓂᐊᕐᕕᖕᖑᖅᑎᑕᐅᓂᖕᖓᓄᑦ, ᑖᒃᑯᐊ ᑐᖕᖓᓚᓚᔪᖅᑐᑎᒃ ᓯᕗᓂᔅᓴᒥᑦ ᐊᓯᔾᔨᐅᑎᔪᓄᑦ ᑕᑯᔅᓴᕈᕐᓗᒋᑦ ᑲᓪᐸᓂᐅᔪᒥ. ᐅᓇ ᐸᕐᓇᐅᑎ ᐃᓗᓕᖅᑐᖅ ᐊᑭᓪᓗᐊᖕᖏᓐᓂᒃ ᐊᑐᓕᖅᑕᐅᒍᓂ ᒪᑐᔭᐅᓂᖕ ᑕᒪᐃᓐᓂᒃ ᐱᓕᕆᐊᖑᔪᓄᑦ ᓄᓇᓄᑦ ᐅᖃᐅᓯᖅᑲᖅᓱᓂ ᐱᖁᑎᖃᐊᖑᔪᓪᓗ ᓄᓈᕘᖕᓂᑦ ᐃᓂᓪᓚᕐᕿᖅᓯᒪᔪᑦ ᐅᓪᓗᒥᒧᑦ ᐃᓱᒪᒋᔭᐅᓪᓗᓂ ᐸᕐᓇᑦᑕᐅᓯᒪᓐᖏᑦᑐᐃᑦ (ᓱᕐᓗ "ᐱᐅᓐᖏᑦᓖᖅ ᓴᖅᑭᑦᑐᖅ") ᒪᑐᓚᔪᕈᓂ ᒪᔾᔭ 31, 2010-ᒥᑦ. ᑖᓐᓇ ᓂᕈᐊᖅᑕᐅᔪᖅ ᐅᓪᓗᖓ ᐃᓱᒪᒋᔭᐅᑐᐃᓐᓇᖅᓯᒪᔪᑦ ᓱᖃᐃᒻᒪ ᒪᑐᓂᔅᓴᓚᕆᐊ ᓇᓗᓇᖅᑐᖅ ᐊᒻᒪᓗ ᓄᓇᒧᑦ ᐊᑐᕈᓐᓇᐅᑎᖕᖓᑕ ᐱᔪᓐᓇᐅᑎᖕᖓᓄᑦ ᒪᓕᒋᐊᓕᖕᖏᓐᓄᑦ.

ᐊᔾᔨᐅᖕᖏᓐᓂᑦ ᑕᑯᓪᓗᒋᑦ ᐃᓱᒪᒋᔭᐅᓯᒪᔪᓄᑦ ᑕᒪᑐᒪᓂ 2009-ᒥᑦ, ᓴᓂᓕᓇᓪᓗᒍ 2008-ᒥᑦ ᐸᕐᓇᐅᑎᒋᔭᐅᓚᐅᖅᑐᖅ ᐃᓚᖏᑦ:

- ᐊᐅᓚᔾᔭᐃᒋᐊᕈᑏᑦ ᐱᓕᕆᐊᖑᓚᐅᖅᑐᑦ 2008-ᒥ ᓂᕆᐅᒋᔭᖃᓚᐅᕐᒪᑕ ᑖᓐᓇ ᐅᔭᕋᓐᓂᐊᕐᕕᖕᖑᕐᓂᐊᕐᓂᖓᓄᑦ ᐅᖓᑖᒍᑦ ᐊᖏᔫᑉ ᓴᕕᕋᔾᔭᔅᓴᐅᑉ ᖃᐅᔨᓴᖅᑕᐅᓂᖓᓂᒃ. ᐸᕐᓇᑦᑕᐅᓂᖏᑦ ᒪᓕᒃᓗᒋᑦ, ᐊᖏᓂᖅᓴᓂᒃ ᐅᖅᓱᐊᓗᓐᓂᒃ ᐱᕐᑯᑎᓂᓪᓗ ᓄᓈᕘᑉ ᓄᓇᖏᓃᑦᑐᖅᑲᖅᐳᖅ. ᐲᔭᖅᑎᖅᑕᐅᓂᖏᑦ ᐃᓂᓪᓚᖓᔪᑦ ᐃᓚᓕᐅᑎᔭᐅᓯᒪᔪᑦ ᐸᕐᓇᐅᑎᒧᑦ.
- ᐅᓪᓗᒥ ᓄᓇᖏᑕ ᐃᓕᖅᑯᓯᓪᓚᕆᖏᑦ ᐊᒻᒪ ᐊᓯᔾᔨᐅᑎᔪᑦ ᓄᓇᐅᑉ ᐃᓕᖅᑯᓯᖏᓐᓂᒃ ᐃᓱᒪᒋᔭᐅᓂᑯᑦ 2008 ᐸᕐᓇᐅᑎᐊᒍᑦ
- ᐃᓚᓕᐅᔾᔭᐅᓂᖏᑦ ᐱᓕᕆᐊᖑᔪᑦ, ᓯᕗᕐᖓᒍᑦ ᓇᓗᓇᐃᖅᑕᐅᕙᓚᐅᖅᑐᑦ ᐅᔭᕋᓐᓂᐊᕐᓂᕐᒧᑦ ᐱᔭᔅᓴᐅᓂᖕᖓᓂᒃ ᓴᓂᕋᒍᑦ ᐱᔭᐅᓪᓗᑎᒃ ᕿᒪᕈᐃᓂᕐᒨᖕᖏᑦᑐᖅ. ᑐᑭᓕᐅᑎᓗᒍ, ᑖᓐᓇ ᐸᕐᓇᐅᑎ ᐃᓚᖃᓕᖅᑎᑦᑎᔪᖅ ᑭᖑᓪᓕᖅᐹᒥᒃ ᓄᓇᐅᑉ ᖃᐹᖕᖓᓐᓂᒃ ᒪᓂᖅᑭᔅᓴᐃᓂᕐᒥᒃ ᓴᓇᔭᐅᕕᐅᓂᑯᑦ ᓄᓇᐃᑦ ᐃᓕᖅᑯᓯᖅᓯᓕᖅᑎᑕᐅᓂᖏᑦ, ᓴᐅᔭᐅᓂᖏᑦ ᐊᒃᑕᑯᖃᕕᑦ ᐊᖅᑰᑕᓗ ᓴᓇᓂᖕ ᐊᐅᓚᓂᓇᔪᖕᖓᓗ, ᑳᓐᑐᕋᖅᑐᑦ ᓄᖅᑲᖅᑎᑕᐅᓂᖏᑦ ᐅᓄᕐᓂᖅᓴᓂᓪᓗ ᑲᒪᔭᖅᑲᕐᓂᒥᒃ ᒪᑐᔭᐅᓂᖕᖏᑦ ᐊᑭᑭᔪᕐᖓᓄᑦ ᐊᑐᖕᖏᕐᖁᑎᓄᑦ ᓴᕕᕋᔾᔭᔅᓴᒥᒃ ᖃᐅᔨᓴᐃᓂᕐᒧᑦ ᐱᓕᕆᐊᖑᑎᑐᑦ.

ᐊᔾᔨᒃᑲᓇᐊᖕᖓᓂᒃ ᓯᕗᓂᐊᒍᑦ ᓇᓚᐅᑦᑖᖅᑕᐅᓯᒪᔪᓄᑦ ᒪᑐᔭᐅᓂᖕᖓᓄᑦ ᐋᑐᑎᒃᑦᑎᐊᓐᖏᓪᓚᑦ/ᐊᑦᑐᐊᓂᒃᓐᖏᓪᓚᑦ ᐱᓪᓗᒍ ᐊᒃᑎᒋᓂᖕ ᑐᓐᖓᕕᒋᔭᐅᔪᓪᓗ ᐃᓱᒪᓕᐅᕈᑏᑦ ᐊᔾᔩᓐᖏᓪᓚᓇᓚᑕ.

ᓄᓇᐅᑉ ᖃᓄᐃᑦᑑᓂᖓ

ᓄᓘᔮᕐᓂᑦ ᓴᕕᕋᔭᒃᓴᖅᓯᐅᖅᑐᑦ ᐱᓕᕆᓂᖓ ᐅᖓᕙᖅᓯᒪᔪᖅ ᕿᓂᖅᓴᐃᓂᖅ ᐱᓕᕆᓂᖓ. ᐊᑐᖅᑕᐅᔪᑦ ᐱᓕᕆᔭᒃᓴᐃᓪᓗ ᓴᓇᓯᒪᔫᑦ ᐃᑲᔪᐃᓇᓱᐊᖅᓗᑎᒃ ᐱᓕᕆᐊᕐᒍᔪᒥᒃ ᐅᔭᕋᓐᓂᐊᕐᕕᓪᓚᕆᓐᖑᖅᑎᑕᐅᓇᓱᐊᖅᓗᓂ. ᓇᐃᓕᒋᐊᕐᓗᒍ, ᐱᓕᕆᓂᕐᒧᑦ-ᐊᑦᑐᐊᔪᑦ ᓄᓇᖏᑦ ᐊᒻᒪᓗ ᐱᕐᑯᑎᕐᔪᐊᖑᔪᑦ ᐅᓪᓗᒥᐅᔪᖅ ᐱᓕᕆᐊᖑᔪᓄᑦ ᓄᓘᔮᕐᓂᑦ ᐃᓚᖃᐅᖅᓗᑎᒃ ᒪᑯᓂᖓ:

ᐃᓄᖃᕐᕖᑦ ᐊᑦᑐᐊᔪᓪᓗ ᐱᕐᑯᑎᕐᔪᐊᖏᑦ

- 100-ᓄᑦ ᐃᓄᖃᐱᓐᓇᖅᑐᖅ ᐅᑭᐅᒃᑯᑦ ᐊᑐᕋᒃᓴᐅᓪᓗᓂ ᑐᐱᖃᐅᖅᑐᑦ ᐊᒻᒪᓗ 100-ᓄᑦ ᐃᓄᖃᐱᓐᓇᖅᑐᖅ ᐊᕐᕋᒍᓕᒫᖅ ᑐᐱᖃᕐᕕᒃ ᑕᒻᒫᕐᕕᒃ, ᐊᒻᒪᓗ ᐊᐅᓚᓂᖏᓄᑦ ᐊᑐᖅᑕᐅᕙᑦᑐᑦ (ᓲᕐᓗ, ᐊᓇᕐᕖᑦ/ᐋᓄᕋᐃᔭᕐᕖᑦ, ᖃᑦᑎᕆᕝᑯᕕᒃ, ᓴᓇᔪᓕᕆᕝᕕᑦ, ᐅᒥᐊᕐᔪᐊᒃᑯᑦ ᐅᓯᒃᖅᑕᐱᑏᑦ ᓴᕕᕋᔭᐃᑦ, ᐆᒪᖅᑯᑎᖃᐅᑏᑦ, ᐃᑯᐊᓚᑎᑦᑎᕝᕖᑦ, ᐊᓇᕐᓗᖃᕐᕖᑦ/ᓴᓗᒻᒪᖅᓴᐃᕝᕖᑦ/ᑯᕕᖅᓴᕐᕖᑦ, ᓄᓇᓯᐅᑎᑦ ᐅᖃᒪᐃᑦᑑᑎᑦ, ᐊᓯᖏᓪᓗ) ᓄᓘᔮᕐᓂᑦ.
- ᐊᕐᕋᒍᓕᒫᕐᒧᑦ ᐊᑐᕈᓐᓇᖅᑐᖅ 60-ᓄᑦ ᐃᓄᖃᐱᓐᓇᖅᓗᓂ ᑲᑎᓐᖓᐅᖅᑐᑦ ᐃᒡᓗᕋᖏᑦ, ᐃᓚᒋᔭᖏᑦ ᐃᒡᓗᕐᑯᑎᖏᑦ ᐊᒻᒪ ᐊᑦᑐᐊᔪᑦ ᐱᕐᑯᑎᕐᔪᐊᑦ ᕿᓐᖑᐊᓂᑦ ᓴᓇᔭᐅᓂᑯᑦ ᐱᓕᕆᐊᖑᑎᓪᓗᒍ ᐊᖅᑯᑎᖓ ᕿᓐᖑᐊᓂᑦ ᓄᓘᔮᕐᓄᑦ ᐊᖅᑯᓯᕆᔪᓄᑦ, ᐅᒥᐊᕐᔪᐊᒃᑯᑦ ᓂᐅᕋᖅᑕᐅᔪᑦ ᑐᖅᑯᖅᑕᐅᕗᖏᑦ ᐊᒻᒪᓗ ᓴᕕᕋᔭᒃᓴᖅ ᐅᓯᓕᖅᓱᖅᑕᐅᓂᖓᓄᑦ ᐅᒥᐊᕐᔪᐊᓄᑦ ᖃᐅᔨᓴᖓᒃᓴᐅᔪᖅ
- ᐊᑐᖅᑕᐅᑲᐃᓐᓇᖅᑐᖅ ᑐᐱᖃᕐᕕᑦ, ᐃᓚᒋᔭᖏᑦ ᐃᒡᓗᕐᑯᑎᖏᑦ ᐊᒻᒪ ᐊᑦᑐᐊᔪᑦ ᐱᕐᑯᑎᕐᔪᐊᑦ ᐃᓄᖃᐱᓐᓇᖅᓗᓂ 40-ᓂᒃ ᕿᑎᖓᒍᑦ ᓄᓇᓯᐅᑎᑰᑉ ᐊᖅᑯᑎᒃᓴᖓᓂᑦ ᐅᐊᖕᓇᖓᑕ ᑕᓯᑰᑉ ᑲᒃᔾᓐ ᑕᐃᒎᖅᑕᐅᔪᖅ ᕿᑎᕋᖅᑐᖅ-ᓄᓇᓯᐅᑎᑰᑉ ᑕᒻᒫᕐᕕᖓ ᓴᓇᔭᐅᓂᑯ ᐃᑲᔪᐃᓂᕐᒧᑦ ᓄᓇᐅᑉ ᖃᐅᔨᓴᖅᑕᐅᓂᖓᓄᑦ ᐃᑰᑕᖅᑐᓄᑦ ᐊᑯᓐᓂᐊᒍᑦ ᓄᓘᔭᑉ ᑲᖏᖅᓱᐊᕐᔫᓪᓗ, ᐃᓚᒋᓪᓗᒋᑦ ᐊᕙᑎᒥᒃ ᖃᐅᔨᓴᕈᑏᑦ ᓄᓇᖏᓐᓂᒃ ᐊᑐᖅᑕᐅᔪᑦ
- ᐊᑐᖅᑕᐅᑲᐃᓐᓇᖅᑐᖅ ᑐᐱᖃᕐᕕᑦ, ᐃᓚᒋᔭᖏᑦ ᐃᒡᓗᕐᑯᑎᖏᑦ ᐊᒻᒪ ᐊᑦᑐᐊᔪᑦ ᐱᕐᑯᑎᕐᔪᐊᑦ ᐃᓄᖃᐱᓐᓇᖅᓗᓂ 50-ᓂᒃ ᓴᓇᔭᐅᓪᓗᑎᒃ ᐃᓚᒋᔭᖏᑦ ᐃᒡᓗᕐᑯᑎᖏᑦ ᐊᒻᒪ ᐊᑦᑐᐊᔪᑦ ᐱᕐᑯᑎᕐᔪᐊᑦ ᐃᑲᔪᐃᓪᓗᑎᒃ ᐊᕙᑎᒥᒃ ᖃᐅᔨᓴᐃᔪᓄᑦ, ᐊᐅᔭᒃᑯᑦ ᓂᐅᕋᐃᕙᒃᓴᓂᒃ, ᐅᒥᐊᕐᔪᐊᓄᑦ ᐃᓯᓕᖅᓱᕐᕕᐅᑉ ᑕᕆᐊᖓᒍᑦ ᐃᑰᑕᖅᑐᑦ ᐊᒻᒪᓗ ᓄᓇᐅᑉ ᐃᑭᐊᖕᒐᓐᓂᒃ ᖃᐅᔨᓴᐃᔪᑦ ᓄᓇᓯᐅᑎᑰᑉ ᐊᖅᑯᑎᒃᓴᖓᑕ ᓂᒋᖅᐸᓯᖓᒍᑦ. ᐅᒥᐊᕐᔪᐊᒃᑯᑦ ᓂᐅᕋᖅᑕᐅᔪᑦ 2008-ᒥᑦ ᐃᓚᖃᓚᐅᖅᐳᑦ ᑲᑎᓐᖓᐅᖅᑐᓂᒃ ᐃᒡᓗᓂᒃ ᑕᒻᒫᕐᕕᒃᓴᒥᒃ (12 ᐃᒡᓗᕋᓛᑦ ᓱᓕ ᑐᖅᑯᖅᑕᐅᓯᒪᔪᑦ) ᑕᐃᑯᖓ ᑲᖏᖅᓱᕐᔪᐊᒧᑦ ᑭᖑᕚᓂᐊᖅᑐᖅ ᑐᐱᐅᔪᓂᒃ ᐅᑉᐸᓗ ᐊᑐᕆᐊᖅᐸᑎᒃ ᓴᓂᕐᕙᑦᑕᐅᓯᒪᔪᑦ ᓄᓇᓂᒃ ᖃᐅᔨᓴᐃᔭᕆᐊᖃᓕᕐᒥᒍᑎᒃ
- ᒪᕿᒃ ᑐᐊᕕᕐᓇᖅᑐᖃᕐᓂ ᕿᒫᑲᐃᓐᓇᕐᕖᒃ ᐃᒡᓗᕋᓛᒃ ᐊᖅᑯᑎᖓᒍᑦ ᕿᓐᖑᐊᓂᑦ ᓄᓘᔮᕐᓄᑦ ᐊᒻᒪᓗ ᑐᐊᕕᕐᓇᖅᑐᖃᖅᑐᒧᑦ ᐋᓇᐅᒪᓇᓱᐊᕐᕕᒃ ᓯᖃᓕᕝᕕᐅᑉ ᖃᓂᒋᔭᖓᓐᓂᑦ ᓇᓂᔭᐅᓯᒪᔫᑉ ᓴᕕᕋᔭᒃᓴᐅᑉ ᓄᓇᖏᑕ
- ᐅᖃᓚᐅᑎᓄᑦ ᓇᑉᐸᖅᑯᑏᑦ ᐊᒻᒪᓗ ᓈᓚᐅᑎᓄᑦ ᐅᖓᕙᕆᐊᕈᑏᑦ ᓇᑉᐸᖅᑯᑏᑦ ᐃᓂᖃᖅᓗᑎᒃ ᕿᓐᖑᐊᓂᑦ, ᓄᓘᔮᕐᓂᑦ ᐊᒻᒪᓗ ᒪᕿᒃ ᐊᖅᑰᑕᑕ ᕿᓐᖑᐊᓂᑦ ᓄᓘᔮᕐᓄᑦ. ᓯᓚᓐᓂᐊᕈᑏᑦ ᐃᓂᖃᖅᑐᑦ ᓄᓘᔮᕐᓂᑦ ᕿᓐᖑᐊᓂᓪᓗ ᐊᒻᒪ ᑲᖏᖅᓱᕐᔪᐊᒥᑦ. ᖃᐅᔨᓴᕈᑎ ᐊᓄᕆᑐᓂᖓᓄᑦ ᐆᒪᖅᑯᑎᖃᕈᓐᓇᕐᓂᖓᓄᑦ ᓄᓘᔭᑉ ᐅᐊᖕᓇᖓᒍᑦ.

ᐊᖏᔪᖅ ᓴᕕᕋᔭᒃᓴᖅ ᖃᐅᔨᓴᕐᕕᕕᓂᖅ ᐊᒻᒪ ᑲᑎᖅᓱᖓᐃᑦ ᓴᕕᕋᔭᒃᓴᑦ

- ᓯᕙᓪᓕᓂᐅᑉ ᖄᖅᑲᐅᑉ ᐃᓚᖓ ᐲᔭᖅᑎᖅᑕᐅᓯᒪᔪᖅ ᐃᑎᖅᓴᕈᖅᓯᒪᓪᓗᓂ ᐃᒻᒪᖄ 10 ᒦᑕᒥᒃ ᓴᕕᕋᔭᒃᓴᖃᕐᓂᐊᒍᑦ 1
- ᑲᑎᖅᓱᖓᖅ ᓴᕕᕋᔭᒃᓴᖅ ᐃᓗᓕᖅᑲᖅᓗᓂ ᐃᒻᒪᖄ 28,000 ᑖᓐᓂᒃ ᖄᕚᕕᓂᖅ ᓴᕕᕋᔭᒃᓴᖅ ᐲᔭᖅᑕᐅᓂᑯ ᓱᓕ ᓄᓇᖓᓂᑦ ᑲᑎᖅᓱᖅᓯᒪᑐᐃᓐᓇᖅᐳᖅ
- ᐃᒻᒪᖄ 6,000 ᑖᓐ ᑭᓪᓚᖅᑐᖅᑐᑦ (ᓲᕐᓗ ᓴᕕᕋᔭᒃᓴᖅ) ᖃᐅᔨᓴᐃᕚᓪᓕᒃ ᓴᕕᕋᔭᒃᓴᐅᑉ ᐃᑎᖅᓴᓕᐊᖑᔪᒥᒃ
- ᑲᑎᖅᓱᖓᐃᑦ ᐃᓗᓕᖅᑲᖅᓗᑎᒃ ᐃᒻᒪᖄ 25,000 ᑖᓐᓂᒃ ᐊᔾᔨᖃᑦᑎᐊᓐᖏᑦᑐᑦ ᓴᕕᕋᔭᒃᓴᒐᓚᐃᑦ (ᓲᕐᓗ ᐊᒡᒍᖅᓯᒪᔪᑦ ᓴᕕᕋᔭᒃᓴᑦ ᐊᒻᒪ ᓯᖃᓕᓯᒪᔪᑦ ᐊᖏᓗᐊᖅᑐᒥᒃ ᐃᓚᖃᖅᑐᑦ ᒦᓐᓚᓃᕐᒥᒃ ᐅᔭᕋᐃᑦ) ᓄᓘᔭᑉ ᓯᖃᓕᕝᕙᐊᑕ ᐊᕙᑎᖓᓂᑦ
- ᓴᕕᕋᔭᒃᓴᓄᑦ ᑐᖅᑯᐃᕝᕕᒃ ᐃᓗᓕᖅᑲᖅᓗᓂ ᐃᒻᒪᖄ 24,000 ᑖᓐᓂᒃ ᐊᔾᔨᖃᑦᑎᐊᓐᖏᑦᑐᒥᒃ ᓴᕕᕋᔭᒃᓴᒥᒃ ᕿᓐᖑᐊᓂᑦ
- ᐃᒻᒪᖄ 6,000 ᑖᓐ ᑭᓪᓚᖅᑐᐃᔪᖅ (ᓲᕐᓗ ᓴᕕᕋᔭᒃᓴᓪᓚᕆᒃ) ᓯᖃᓕᓯᒪᔪᖅ ᑲᑎᖅᓱᖓᖅ ᑐᖅᑯᖅᓯᒪᔪᖅ ᓴᕕᕋᔭᒃᓴᓄᑦ ᑐᖅᑯᐃᕕᓪᓕᒥᑦ ᕿᓐᖑᐊᓂᑦ

ᐊᖅᑯᑏᑦ ᐊᒻᒪ ᐅᔭᕋᑦᑕᕐᕖᑦ

- 105 ᑭᓛᒥᑕᒥᒃ ᐅᖓᓯᓐᓂᓕᒃ ᐊᖅᑯᑎ ᐊᑯᓐᓂᐊᒍᑦ ᓄᓘᔭᑉ ᕿᓐᖑᐊᑕᓗ ᑕᐃᒎᖅᑕᐅᔪᖅ ᕿᓐᖑᐊᑕ ᐊᖅᑯᑎᖓ
- ᐱᖓᓱᑦ ᐊᑐᓪᓗᐊᑕᖅᑕᑦ ᓯᐅᕋᖅᑕᕐᕖᑦ ᐅᔭᕋᑦᑕᕐᕖᑦ, ᐅᔭᕋᑦᑕᕐᕕᒃ ᓄᓘᔮᕐᓂᑦ, ᐊᒻᒪᓗ ᓯᐅᕋᖅᑕᕐᕖᑦ ᑐᐊᑉᑕᕐᕖᓪᓗ ᐃᓚᖏᒍᑦ ᐊᖅᑯᑎᒃᓴᐅᑉ ᓄᓇᓯᐅᑎᑰᑉ ᓄᓇᖏᑕ

- ᐊᖅᑯᓯᐅᖅᑕᐅᓂᑯ ᐅᓯᑲᖅᑕᖅᑐᓄᑦ ᓴᕕᕋᔭᒃᓴᓂᒃ ᓇᖅᓴᐅᔭᖓᑕ ᓄᓘᔮᑉ ᖃᖅᑲᖓᑕ ᓯᖃᓕᕝᕕᒻᒧᑦ ᑎᑭᐅᒪᓪᓗᓂ
- ᒪᕐᕉᒃ ᖃᐱᔾᔭᖅᓯᒪᓐᖏᑦᑐᑦ ᒥᑦᑕᕐᕖᒃ ᐃᑲᒪᖅᑲᐃᓐᓇᖅᓗᓂ ᑕᐃᑲᓂ ᓄᓘᔮᑉ ᒥᑦᑕᕐᕕᓐᖑᓐᓂᑦ

ᐅᖅᓱᐊᓗᖅᕖᑦ

- ᐃᑭᐊᖅᓕᖅᑐᖅ ᐊᖏᔪᒻᒥᒃ ᐅᖅᓱᐊᓗᒻᒥᒃ ᑐᖅᑯᐃᕝᕕᒃ ᐃᒪᖅᑲᕈᓐᓇᖅᓗᓂ 1.5 ᒥᓕᐊᓐ ᓖᑕᓂᒃ, ᒪᕐᕿᓐᓂᒃ ᐊᕙᓗᓕᒃ ᐅᖅᓱᐊᓗᖃᐅᑎ ᐃᑭᐊᖅᓕᖅᑐᒥᒃ ᓴᐳᓗᑕᓕᒃ ᐊᒻᒪᓗ ᐃᑭᐊᖅᓕᖅᑐᑦ ᐅᖅᓴᔅᓴᐃᕖᑦ ᓄᓇᓯᐅᑎᓄᑦ ᓄᓘᔮᓐᓂᑦ
- ᐃᑭᐊᖅᓕᖅᑐᖅ ᐴᑰᒃ ᐅᖅᓱᐊᓗᒻᒧᑦ ᐃᒻᒥᖅᑕᐅᔪᓐᓇᖅᓗᓂ ᐊᒃᑎᒋᓂᖅᑐᒥᒃ ᐃᒻᒪᖄ 8.25 ᓖᑕᓂᒃ ᐊᒻᒪᓗ ᐃᑭᐊᖅᓕᖅᑐᖅ ᐅᖅᓴᔅᓴᐃᕝᕕᒃ ᐊᒻᒪᓗ ᐃᒻᒥᖅᓱᐃᔾᔪᑎ ᐅᖅᓴᔅᓴᐃᔭᓄᑦ ᓄᓇᓯᐅᑎᓄᑦ ᕿᓐᖑᐊᓂᑦ
- ᖃᑦᑕᐅᔭᓃᑦᑐᑦ ᐅᖅᓱᐊᓗᐃᑦ ᐃᑭᐊᖅᓕᖅᑐᒥᒃ ᓴᐳᓗᑕᖃᖅᑐᑎᒃ ᕿᓐᖑᐊᓂᑦ, ᓄᓘᔮᓐᓂᑦ, ᑲᖏᖅᓗᕐᔪᐊᕐᒥᑦ ᐊᒻᒪ ᐊᖅᑯᑎᔅᓴᒧᑦ ᑕᖕᒫᕐᕕᐅᔪᓂᒃ

ᕿᒪᑦᑕᐅᓚᔭᕈᓂ ᐃᓱᒪᓐᖑᐊᓕᖅᑕᐅᓯᒪᔪᑦ

ᒪᕐᕉᒃ ᕿᒪᑦᑕᐅᓚᔭᕈᓂ ᐃᓱᒪᓐᖑᐊᓕᖅᑕᐅᓯᒪᔫᒃ ᑕᕙᓂ ᐸᕐᓇᐅᑎᒥᒃ ᓴᖅᑭᑎᑕᐅᓯᒪᔫᒃ ᕿᒪᑦᑕᐅᓂᖓᓄᑦ: ᓄᖅᑲᖓᑲᐃᓐᓇᕐᓂᖅ ᐅᑕᖅᑭᓂᖏᓂᒃ, ᐊᒻᒪᓗ ᑭᖑᓪᓕᖅᐹᒥᒃ ᕿᒪᕉᑎᓂᖏᑦ ᐱᓕᕆᐊᒥᓂᒃ. ᓄᖅᑲᖓᑲᐃᓐᓇᕐᓂᖅ ᐅᑕᖅᑭᓂᖏᓐᓂᒃ ᐱᓕᕆᐊᒥᓂᒃ ᐃᓚᖃᕐᒪᑦ ᓄᖅᑲᖅᑎᑦᑎᓂᕐᒥᒃ ᐱᓕᕆᐊᖑᔪᓂᒃ ᐅᓪᓗᒥᐅᔪᖅ, ᓇᓪᓕᐊᑐᐃᓐᓇᑎᒍᑦ ᐸᕐᓇᑦᑕᐅᓯᒪᓗᓂ ᐅᕝᕙᓗ ᓂᕆᐅᒋᓐᖏᑦᑕᒥᓄᑦ ᓄᖅᑲᖅᑎᑕᐅᒍᑎᒃ, ᑕᒪᒃᑯᐊ ᓄᖅᑲᖓᓂᐅᔪᑦ ᐱᓇᓱᐊᕈᓯᓚᓕᐅᔪᓐᓇᖅᑐᑎᒃ ᑕᖅᑭᒐᓴᓐᓄᑦ ᑎᑭᓪᓗᖑ ᑭᓯᐊᓂ ᓄᖅᑲᖓᑐᐃᓐᓇᓇᐊᓕᒃ ᐊᕐᕌᒍᓕᒫᕐᒧᑦ ᐅᖓᑖᓄᓪᓗᓐᓃᑦ. ᑕᒪᓐᓇ ᑐᓐᖓᕕᖃᕈᓐᓇᖅᑐᖅ ᑮᓇᐅᔭᐃᑦ ᐊᑐᐃᓐᓇᐅᖏᓐᓂᖓᓄᑦ ᐅᕝᕙᓗ ᐊᐅᓚᓂᖏᓐᓄᑦ ᐃᓗᐊᓐᖏᔾᔪᑏᑦ ᐱᓕᕆᕝᕕᐅᔪᓂᒃ ᓄᓇᓂᒃ, ᓱᕐᓗ ᓯᓚᑦᑎᐊᕙᐅᓐᖏᓐᓂᖓᑕ ᐊᑯᓂᐅᓂᕆᔭᖏᑦ ᐃᓚᒋᔭᖏᓪᓗ, ᐅᖅᓱᐊᓗᑭᔅᓵᓃᑦ ᐱᓕᕆᐊᔅᓴᓄᑦ, ᓱᕋᐅᔾᔨᖅᓯᒪᒍᑎᒃ ᓄᓇᓯᐅᑎᒥᓂᒃ ᐊᑐᓇᐊᓕᓪᓚᓇᒻᒥᒃ, ᑭᖑᕙᓇᐊᖅᑕᐅᓗᐊᕈᓂ ᐅᔭᕋᓐᓂᐊᕐᕕᐅᑉ ᐱᒋᐊᕐᕕᔅᓴᖓ, ᐅᕝᕙᓗ ᑮᓇᐅᔭᖃᖅᑎᑦᑎᔪᑦ ᐊᑐᐃᓐᓇᕈᐃᔪᒪᓐᖏᒃᑯᑎᒃ ᐱᒋᐊᕈᑎᖏᓐᓄᑦ. ᑕᒪᒃᑯᐊ ᐱᖁᑎᕐᔪᐊᑦ ᓄᖅᑲᖓᓂᐊᕈᑎᒃ ᒪᑐᔭᐅᑲᐃᓐᓇᕈᑎᑎᑐᑦ ᑕᖕᒫᕐᕕᖏᓐᓂᒃ ᐅᑭᐅᓐᖑᕿᖅᓚᑦ ᒪᓕᑦᑕᐅᑐᐃᓐᓇᕋᔭᖅᓗᓂ ᐅᓪᓗᒥ ᐊᑐᖅᑕᐅᔪᒧᑦ ᓄᓘᔮᕐᓂᑦ ᓯᕗᓂᐊᒍᑦ ᐊᑐᖅᑕᐅᕙᓐᓂᑯᐃᑦ.

ᑭᖑᓪᓕᖅᐹᒥᒃ ᒪᑐᔭᐅᓂᖅ ᐊᑐᖅᑕᐅᓚᔭᖅᓗᓂ ᐱᔾᔪᑎᒋᓗᒋᑦ ᓂᕆᐅᒋᔭᐅᓐᖏᑦᑐᑦ ᓴᖅᑭᑲᓪᓚᒃᑯᑎᒃ ᓄᓘᔮᕐᓂᑦ ᐱᓕᕆᐊᖑᔪᑦ ᓄᖅᑲᕐᓗᑎᒃ ᐅᕝᕙᓗ ᐊᑐᖅᑕᒥᓂᒃ ᐸᕐᓇᔅᓯᒪᔭᖏᑦ ᐱᑕᖃᓐᖏᒃᑯᑎᒃ ᐃᓂᓪᓚᔅᓯᕙᓪᓕᐊᓂᕐᒧᑦ ᑎᑭᓐᓇᓱᓪᓗᒍ ᐅᔭᕋᓐᓂᐊᕐᕕᓐᖑᕐᓂᖅ.

ᑭᖑᓪᓕᖅᐹᒥᒃ ᒪᑐᔭᐅᓂᖓ ᐊᒻᒪ ᐃᓕᖅᑯᓯᑐᖃᖅᓗᓄᑦ ᐅᑎᖅᑎᑕᐅᓂᖓ ᓄᓇ ᐃᓚᖃᖅᐳᖅ ᐲᔭᐃᓂᕐᓂᒃ ᓴᓇᔪᖅᓯᐅᑎᖏᓐᓂᒃ ᐊᒻᒪ ᐊᑐᖅᐸᑦᑕᖏᑦ ᓯᓚᑖᓄᑦ ᓄᓇᓄᑦ ᐅᕝᕙᓗ ᓄᓇᖏᑕ ᐃᓚᖏᓂᒃ ᐊᒃᑕᑯᖅᕕᒻᒧᑦ ᓄᓘᔮᓐᓂᑦ (ᓱᕿᔭᓐᖏᑦᑐᓄᑦ, ᐅᑐᕆᐊᓇᓐᖏᑦ), ᐃᑭᑦᑐᓇᓐᖏᑦᑐᑦ ᐊᑐᖅᑕᐅᓂᑯᑦ), ᐊᒻᒪ ᖄᐸᖏᑦ ᓄᓇᐅᑉ ᐃᓕᖅᑯᓯᖅᓯᓕᖅᑎᑕᐅᓗᑎᒃ. ᓴᓇᔪᖅᓯᐅᑎᖏᑦ ᐊᑐᖅᐸᑦᑕᖏᓪᓗ ᐅᓯᔭᐅᓗᑎᒃ ᓄᓘᔮᕐᓂᑦ ᕿᓐᖑᐊᓄᑦ ᑐᖅᑯᖅᑕᐅᓗᑎᒃ. ᓴᓇᔪᖅᓯᐅᑎᖏᑦ ᐊᑐᖅᐸᑦᑕᖏᓪᓗ ᓄᓇᓯᐅᑎᑯᑖᑉ ᐊᖅᑯᑎᔅᓴᔅᓴᓗᑦ ᖁᓕᒥᒨᒃᑯᑦ ᐅᓯᑲᖅᑕᖅᑕᐅᓗᑎᒃ ᑲᖏᖅᓗᕐᔪᐊᕐᒧᑦ ᐅᕝᕙᓗ ᓄᓘᔮᓄᑦ. ᐅᓯᑲᖅᑕᖅᑎᓂᒃ ᐅᒥᐊᕐᔪᐊᓂᒃ ᕿᓂᕿᔭᖅᑐᒍᑦ ᑖᒃᑯᐊ ᕿᓐᖑᐊᓂᑦ ᐅᕝᕙᓗ ᑲᖏᖅᓗᕐᔪᐊᕐᒥᑦ ᕿᒻᒪᑯᑦ ᐃᓯᓚᖅᓯᖅᑕᐅᓗᑎᒃ ᐊᒻᒪᓗ ᓂᐅᕐᕈᑕᐅᓗᑎᒃ, ᐊᑐᖅᑕᐅᒃᑲᓐᓂᕐᓗᑎᒃ ᐅᕝᕙᓗ ᐃᒋᑕᐅᓗᑎᒃ.

ᑕᒪᒃᑯᐊ ᐅᓪᓗᖁᑎᖏᑦ ᑭᖑᓪᓕᖅᐹᒥᒃ ᒪᑐᔭᐅᓂᖓᓄᑦ ᓄᓇᐃᓪᓗ ᐃᓕᖅᑯᓯᖏᓄᑦ ᐅᑎᖅᑎᑕᐅᓂᖏᑦ ᒪᓕᓐᓂᐊᖅᑐᑦ ᐃᓯᖅᑕᐅᓂᖏᑦ ᓯᓚᑦᑎᐊᕙᐅᓂᖓᑕᓗ ᓄᓇᖅᑭᑕ ᐅᖃᐅᓯᐅᔪᑦ. ᐃᓱᒪᒋᔭᐅᓯᒪᕗᖅ ᐃᒻᒪᖄ ᑕᓪᓕᒪᓂᒃ ᑕᖅᑭᓂᒃ ᐱᓕᕆᔭᕆᐊᖃᖅᓴᖅᑐᑦ ᓴᓇᔪᖅᓯᐅᑎᑦ ᐊᑐᖅᑕᐅᕙᑦᑐᓪᓗ ᐲᔭᖅᑎᑕᐅᑎᓪᓗᒋᑦ ᓄᓘᔮᕐᓂᑦ ᐃᖅᑲᓇᐃᔭᖅᑎᖃᖅᓯᕐᓗᑎᒃ 50-ᓂᒃ.

ᑭᖑᕐᖓᒍᑦ ᑕᑯᓐᓇᑦᑕᐅᓂᖏᑦ ᐅᔾᔨᖅᓱᖅᑕᐅᓂᖏᓪᓗ

ᑕᒪᐃᓐᓂᒃ ᓄᓇᐃᑦ ᐱᓕᕆᕝᕕᐅᓯᒪᔪᑦ ᐅᔭᕋᓐᓂᐊᕐᕕᐊᒍᑦ ᓄᓘᔮᑉ ᒪᓕᒋᐊᖃᕐᓂᐊᖅᐳᑦ ᒪᑐᔭᐅᓂᖓᓄᑦ ᕿᒥᕐᕈᐃᓂᕐᒥᒃ ᑳᒻᐸᓂᒃᑯᑦ ᑭᓪᒐᖅᑐᖅᑎᖓᓄᑦ ᐅᕝᕙᓗ ᑳᓐᑐᕿᑦᑕᐅᓯᒪᔪᒧᑦ, ᐊᒻᒪᓗ ᓇᐃᑦᑐᒥᒃ ᕿᒪᑦᑕᐅᓂᖓᓄᑦ ᓄᓇᖏᓪᓗ ᐃᓕᖅᑯᓯᑐᖃᖓᓄᑦ ᐱᔭᐅᓂᖏᑦ ᐅᓂᒃᑳᓇᔭᐅᓗᑎᒃ ᐊᔾᔨᖑᐊᖃᕐᓗᑎᒃ, ᓴᖅᑭᐸᐸᓪᓕᐊᓗᒥᑦ ᐱᓕᕆᓐᖑᕐᒍᔪᕕᓃᑦ ᓄᓇᖏᓪᓗ ᐃᓕᖅᑯᓯᕆᓕᖅᑕᖅᑐᑦ.

ᐅᔾᔨᖅᓱᖅᑕᐅᓂᖏᑦ ᐊᒻᒪ ᑭᖑᕐᖓᒍᑦ ᑕᑯᓚᑦᑕᐅᓕᖏᑦ ᕿᓂᕐᕈᐃᓃᑦ ᐱᓕᕆᐊᖑᓚᐅᖅᑐᖅ ᓄᓘᔮᑉ ᐅᔭᕋᓐᓂᐊᕐᕕᔅᓴᐅᑉ ᓄᓇᖏᒍᑦ ᕿᒥᕐᕈᔭᐅᓗᑎᒃ ᓱᐱᐃᐊᓐᓇᖅᓂᕐᓇᑕᓗ ᐊᔾᔨᓪᓕᖏᖅᓯᑦ ᐊᑐᖅᑕᐅᔪᑦ ᒪᑐᔭᐅᑎᓪᓗᒍ ᐊᒻᒪ ᓄᓇᖅᑕ ᐃᓕᖅᑯᓯᖅᓯᓕᕈᑎᒃ. ᐊᕐᕌᒍᑕᒫᖅ ᖃᐅᔨᓴᖅᑕᐅᕙᓪᓗᓂ ᑎᑭᓐᓇᓯᐊᕐᓗᒋᑦ ᑕᓪᓕᒪᑦ ᐊᕐᕌᒍᐃᑦ ᒪᑐᔭᐅᓯᒪᓕᕈᓂ ᓇᓗᓇᐃᖅᓯᓇᓱᓪᓗᑎᒃ ᓄᓇᖏᑦ ᓱᕋᓐᓂᖏᒃ ᐊᒻᒪ ᓱᕋᓐᓂᖏᑕ ᕿᒪᑦᑕᐅᓂᑯᐃᑦ ᓱᕈᐃᖏᓐᓂᖏᑕᓗ ᑕᒪᒃᑯᐊ.

<u>ᐃᓱᒪᒋᔭᐅᔪᖅ ᐊᑭᓪᓗᐊᖓ</u>

ᑕᒪᒃᑯᐊ ᓇᓚᐅᑦᑖᖅᑕᐅᓯᒪᔪᑦ ᐊᑭᓪᓗᐊᙳᑦ ᐱᔭᕇᖅᑕᐅᓇᓱᐊᕐᓂᙳᓐᓄᑦ ᒪᑐᔭᐅᓐᓂᕈᓂ ᕿᒪᐃᓂᕐᒧᑦ ᐃᓕᖅᑯᓯᙳᓄᑦ ᐅᑎᖅᑎᑦᑎᓂᕐᒧᑦ ᐸᕐᓇᐅᑎᙵᒍᑦ ᐃᒪᓐᓇᐅᕗᖅ $10,583,928.

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

2009 ABANDONMENT AND RECLAMATION PLAN
(REF. NO. NB102-181/15-1)

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Knight Piésold
CONSULTING

BAFFINLAND IRON MINES CORPORATION
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(REF. NO. NB102-181/15-1)

SECTION 1.0 - INTRODUCTION

The Mary River Project is an advanced iron ore exploration project located in the northern Baffin Island region of Nunavut (Figure 1.1). The project is wholly owned by Canadian mining company Baffinland Iron Mines Corporation (Baffinland). Baffinland has released a Definitive Feasibility Study (DFS) demonstrating the robust potential of full-scale development and has initiated the regulatory approval process for full-scale development. This abandonment and reclamation plan (A&R Plan) was prepared to address closure and reclamation in accordance with best corporate governance practices and as a condition of the surface lease held by Baffinland with the Qikiqtani Inuit Association.

Earlier versions of this A&R Plan were prepared to support environmental screening and permitting activities for the bulk sampling program and to reflect the outcome of the environmental screening and changes to the scope of the work as provided by Amendment No. 2 to the Nunavut Water Board (NWB) water licence as well as the comments made by the NWB (Knight Piésold Ref. No. NB102-00181/6-7, Rev. 2, dated March 31, 2008).

This document is an update to the March 2008 version in consideration of changes to the scope of the work, shipment of the bulk sample as well as the comments made by the NWB and the QIA.

This updated A&R Plan will become the closure document that Baffinland will follow if there were no immediate or pending plans to advance the project towards mine development, subject to any future revisions required to reflect material changes. This plan provides a full cost of implementing closure that addresses all project-related activity areas and infrastructure related to the Mary River Project that will be in place assuming an unplanned (i.e. "worst case" scenario) shut-down as of March 31, 2010. This is a hypothetical date as actual closure timing is currently unknown and coincides with the requirements in the surface lease.

Key differences in the assumptions included in the 2009, compared to the 2008 plan include:

- Mobilization activities in 2008 anticipated continuing to advance the project beyond the bulk sample to full scale development. As a consequence, more fuel and equipment is currently on-site. Demobilization of these resources is included in the revised plan.
- Actual site conditions and changes in site conditions from that which was assumed in the 2008 plan
- Inclusion of activities which were previously accounted for as part of ongoing field operations and not part of reclamation. For example, this plan now includes final landscape grading and contouring of disturbed areas, construction of the landfill and access road plus much of its operation, contractor demobilization and increased supervision as a cost of closure versus being an element of operations of the Bulk Sampling Program.

Any reconciliation to the previous A&R cost estimate is of little use/relevance since the scopes and underlying assumptions differ.

1.1 EXISTING PERMITS

Exploration is focused on Federal Mineral Leases 2483, 2484 and 2485 that were established in the 1960s before the Nunavut Land Claims Agreement and are wholly held by Baffinland.

The exploration and geotechnical activities, the bulk sample program and any future closure and reclamation activities that may be undertaken, are subject to the terms and conditions of the following core authorizations issued to Baffinland:

Type of Authorization	Approval No.	Authorizing Agency	Governing Activity	Period Valid
Water License (Type B)	2BB-MRY0710 (including Amendments 1 and 2)	NWB	Water use and waste disposal	July 16, 2007 to Dec 31, 2010
Land Use Permit	N2006C0036	INAC	Exploration and Geotechnical Activities on Crown Land	April 4, 2007 to April 4, 2010
Land Use Permit	N2007F0004	INAC	Road Construction on Crown Land	July 6, 2007 to July 6, 2009[2]
Commercial Lease for Inuit Owned Lands	Q07L3C001	QIA	Mining and exploration activities on Inuit Owned Land	August 1, 2007 to October 31, 2009[1]
Quarry Permit	2007QP0098	INAC	Quarrying on Crown Land	July 6, 2007 to June 25, 2009[2]
Letter of Advice	File No. NU-06-0084, dated July 25, 2007	DFO	Crossing installations at Category Small Watercourses	Not applicable
HADD Authorization *Fisheries Act* S.35(2)	File No. NU-06-0084, dated August 3, 2007	DFO	Crossing installations within fish habitat at 25 watercourses	Not applicable
Navigable Waters Protection Act Approval	8200-07-10265 8200-07-10266 8200-07-10267 8200-07-10268 8200-07-10269 8200-07-10270 8200-07-10271 8200-07-10272 8200-07-10273 8200-07-10274	Transport Canada	Construction of crossings in 10 navigable waters	September 6, 2007 to June 30, 2015(pending)

NOTES:
1. Q05L2C14 includes an extension provision that Baffinland intends to exercise in 2009.
2. At the time of this Plan, an application has been submitted to INAC requesting a one (1) year extension to the land use permit and the issuance of a new, one (1) year quarry permit.

1.2 APPLICABLE GUIDELINES

The following guidelines were referenced during the development of this A&R Plan:

- *Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories*, by the Northwest Territories Water Board, September 1990

- *Mine Site Reclamation Policy for Nunavut,* by Indian and Northern Affairs Canada, 2002

- *Mine Site Reclamation Guidelines for the Northwest Territories*, by Indian and Northern Affairs Canada, January 2007

- *Mine Reclamation in Northwest Territories and Yukon*, Prepared by Steffen, Robertson and Kirsten (B.C.) Inc. for the Northern Affairs Program of the Department of Indian Affairs and Northern Development, April 1992

The Mary River Project is not a mine site but rather an advanced exploration project. Programs and activities are designed to support advancing the Project to full-scale development. Although the above listed policies and guidelines do not apply to exploration or advanced exploration stages of the development of a mineral property, and only apply to new and developed mines and their mining-related activities, they have been considered when preparing this A&R Plan.

SECTION 2.0 - CLOSURE & RECLAMATION PLAN OBJECTIVES

In accordance with the objectives outlined in the cited guidelines, the general closure and reclamation goals of this A&R Plan are to:

- Provide for the long-term physical and chemical stability of the Project areas so as to protect the public's health and safety
- Enhance natural recovery of the disturbed areas to a state that is compatible with surrounding land uses and to allow for future use by people and wildlife
- Implement reclamation designs that limit the need for long-term maintenance and monitoring

This A&R Plan is written with a view to address all project-related activity areas and infrastructure.

SECTION 3.0 - SITE DESCRIPTION

3.1 OVERVIEW

3.1.1 Brief Overview of Past Project Activities

Baffinland resumed mineral exploration activities in 2004 after a 40-year hiatus in activity at Mary River. Baffinland has since continued to undertake programs and activities in support of advancing its Mary River Project.

Initially, a camp and support facilities was established at Mary River, adjacent to an existing airstrip, temporary facilities were constructed at Milne Inlet for receiving materials and supplies, equipment was off-loaded at Milne Inlet by sea-lift and moved into the site over winter road, and drilling on Deposit No. 1 recommenced. Investigatory geotechnical drilling programs at potential infrastructure sites associated with a full-scale mining development also commenced.

Additional exploration drilling and resource evaluation on Deposit No's. 1, 2 and 3, geotechnical drilling at Project development areas, environmental baseline and monitoring studies, a Bulk Sample Program with the addition of a new camp along the proposed rail alignment and upgrades and expansions to the existing camps, related infrastructure and the Tote Road to support the different programs has followed.

Figures 3.1 to 3.5 shows the location of activity areas related to the Mary River Project.

Baffinland has released a Definitive Feasibility Study (DFS) demonstrating the robust potential of full-scale development and has initiated the regulatory approval process for full-scale development. Baffinland has worked in earnest with its financial advisors in seeking a strategic partner or partners needed for the proposed transition from exploration to development and eventually production.

3.1.2 2009 Work Plan

The current world financial crisis and economic outlook has had a major dampening effect on the resource sector, adding time and complexity to the strategic partnering initiative, and the resources currently available to support the 2009 work plan. Although at the time of writing the Company's work plan is still in the development stage, the current economic climate is expected to result in a significant decrease in development planning efforts undertaken in 2009. This will translate into a deferral in advancement of further engineering design, geotechnical drilling, and other technical support studies required for the detailed planning of the proposed Mary River Project. Field programs instead will focus on infill exploration drilling on Deposits No. 2 and/or 3 with a goal of transitioning resources currently in the 'inferred' category to the 'indicated' category'. Ultimately, the 2009 work plan will be based, in part, on availability of financing and the outcome of the strategic partnering initiative.

Key programs and activities that will be undertaken in 2009 in support of continued advancement of the Mary River Project include:

- Off-season presence at the Mary River site in the interest maintaining site access and security
- Operation of the Mary River camp to support a modest and approximate 2,200 metre exploration drill program between June and September
- Planning and execution of a training program for driller helpers to support 2009 exploration
- Transport of needed fuel and supplies stored at Milne Inlet to the Mary River camp site using the upgraded Milne Inlet Tote Road
- Helicopter and fixed wing aircraft support as required to service the exploration drilling program and other general site activities, including environmental monitoring
- Follow-up construction and ongoing monitoring activities in accordance with the No Net Loss and Monitoring Plan under the Fisheries Authorization issued in relation to the Tote Road
- Continued progressive reclamation of areas of current and past use in association with exploration drilling, geotechnical drilling, and bulk sample programs
- Upon further treatment and/or confirmation that effluent criteria as stipulated by the Water Licence have been met, discharge of the polishing/waste storage pond contents at Mary River and Milne Inlet to the approved receiving locations
- Demobilization of contractors' equipment and supplies used to support the bulk sample program that is not required for near term activities by a single dry cargo sea-lift from Milne Inlet
- Demobilization of barrel fuel currently stored and in place to support field studies and geotechnical drilling by a single dry cargo sea-lift from Steensby Inlet. In 2009, it is expected that the Steensby, Mid Rail, and Milne Inlet Camps will remain unoccupied.

Should additional financing become available, Baffinland may increase field activities accordingly. Equipment, infrastructure, consumables and regulatory permits are currently in place to support a substantially larger exploration drilling program, resumption of the geotechnical drilling program needed to support engineering planning, as well as undertaking any further environmental baseline and other scientific and engineering studies required for project planning.

3.2 BULK SAMPLE PIT AND STOCKPILES

3.2.1 Bulk Sample Pit

A single mining bulk sample pit positioned across the crest and east side of the North Limb of Deposit No. 1 was constructed as a side-hill cut in 2008. Two 5 m high benches were blasted using explosives and excavated down the east slope of the deposit (680 and 685 benches, respectively). The pit was designed to be free-draining (i.e. side hill cut) so that no water is impounded. The approximate location of the bulk sample pit is shown on Figure 3.2.

3.2.2 Stockpiles

Stockpiles created during the bulk sampling program at Deposit No. 1, Mary River and Milne Inlet include:

Deposit No. 1 - A stockpile containing approximately 28,000 tonnes of surficial weathered ore excavated from the surface of Deposit No. 1 remains on the deposit. The weathered ore stockpile location is shown on Figure 3.2. The roadbed between the stockpile and the pit was also constructed from weathered ore. Approximately 6,000 tonnes of representative (i.e. ore grade) material was left in the bulk sample pit.

Mary River - Stockpiles containing approximately 25,000 tonnes of non-representative ore (i.e. separate lump and fine stockpiles) remain at the Mary River crusher site. The approximate location of the two stockpiles at the crusher are shown on Figure 3.2.

Milne Inlet - The ore stockpile pad containing approximately 24,000 tonnes of non-representative ore remains at Milne Inlet. Approximately 6,000 tonnes of representative (i.e. ore grade) material is stockpiled on this pad at Milne Inlet. The approximate stockpile locations at Milne Inlet are shown on Figure 3.3.

3.2.3 Geochemistry

In addition to metallurgical testing of the bulk sample ore, an environmental geochemical testing program was undertaken in 2008 to assess the potential for waste rock, residual ore and the exposed pit to leach metals and/or acidity that could potentially degrade the quality of receiving surface waters (appended to Baffinland Iron Mines Corporation Mary River Project, 2008 Annual Report to the Nunavut Water Board). This testing program was carried out according to the general requirements recommended by Price, 1979 which is generally regarded as being representative of industry best practice within Canada.

In general, mine wastes have the potential to degrade surface water quality when they contain sulphide minerals, which oxidize when exposed to the atmosphere and release soluble acidity and metals, or when they contain soluble minerals, which will leach metals when they dissolve in contact water.

In planning for the bulk sample program, the risk for poor quality run-off was predicted to be low, based upon existing knowledge gained from testing of samples collected elsewhere from Deposit No. 1. The 2008 environmental geochemical testing program was developed to test representative samples of the materials and landforms generated from the bulk sample program in order to validate these predictions.

Representative geological samples were collected and submitted to the analytical laboratory of SGS Lakefield Research Ltd. for major elements content characterization, modified acid-base accounting (ABA) to assess acid generating characteristics, and short-term leach testing (modified synthetic precipitation leaching procedure) to assess susceptibility to leach metals. Representative samples were collected from the i) weathered ore stockpiled on the Deposit No. 1, ii) non-representative ore stockpiled at the Mary River crusher site and the stockpile pad at Milne Inlet, and iii) representative ore left exposed in the bench walls of the pit and stockpiled at Milne Inlet.

The results from this program validated predictions that were made during the environmental screening. Test results showed low to non-detectable levels of sulphide-sulphur. All samples contained sulphide-sulphur at concentrations below the laboratory analytical detection limit of 0.01% (by weight) except for one sample of representative ore (measured at 0.01% sulphide-sulphur) and one sample of nonrepresentative ore (measured at 0.02% sulphide-sulphur).

The mean ratio of neutralization potential (NP) to acid potential (AP) of samples of; i) the weathered ore stockpiled on the Deposit No. 1, ii) non-representative ore stockpiled at the Mary River crusher site and the stockpile pad at Milne Inlet, and iii) representative ore left exposed in the bench walls of the pit and stockpiled at Milne Inlet were measured at 6.2, 5.9, and 8.1, respectively. These measurements compare to commonly referenced screening criteria by Price, 1997 which classifies samples with an NP/AP ratio greater than 4 as being non-acid generating.

Short -term leach test results indicated a low risk of significant metal leaching. This risk is likely to be further diminished by the dry arid climate at the site. Metal concentrations from short-term leach tests were all below concentration limits established for: i) the bulk sample water license (Section 3.2.1), ii) concentration limits listed under Schedule 4 of the Metal Mines Effluent Regulations (MMER), and iii) most metal concentrations were below the more stringent CCME guidelines for the Protection of Aquatic Life (CCME-PAL). Note that Schedule 4 MMER limits are generally applied to end-of-pipe discharges from metal mines in Canada and CCME-PAL are applicable to receiving water quality.

3.3 CAMPS AND RELATED FACILITIES

Camp facilities are described below and locations are shown on Figure 3.1.

Mary River camp is a 100-person winterized exploration tent camp and a 100-person all-season tent camp, with ancillary facilities. Specifically there are 26 Weatherhaven tents, 11 Norseman tents, 3 Weatherhaven washroom/dry tents, 1 Weatherhaven firehall tent, 1 Weatherhaven kitchen (old) tent, 3 Weatherhaven workshop tents, 40 sea containers used for storage, three main camp generators, incinerator, 3 concrete sewage tanks, 1 plastic sewage tank, 1 sewage treatment plant, 3 sewage ponds, 13 fuel bladder tanks, mobile equipment along with laydown areas. The existing all-season exploration camp, primary ancillary facilities and related infrastructure at Mary River are shown on Figure 3.2.

The Milne Inlet camp is an all-season fully serviced trailer camp for approximately 60 people, associated facilities and related infrastructure. Specifically there are 10 accommodation trailers, 9 work tents, 1 large Weatherhaven workshop tent, two main generators, incinerator, oil/water separator, 1 sewage treatment plant, 1 sewage pond, 73 fuel bladder tanks, mobile equipment along with a laydown area. Milne Inlet camp will remain essentially unoccupied in 2009 except for maybe a 2 person skeleton crew. The existing site layout at Milne Inlet is shown on Figure 3.3.

The Mid Rail camp used to support the geotechnical drill program between Mary River and Steensby Inlet, as well as environmental studies based in the area is a temporary seasonally occupied tent camp for approximately 40 people part way along the potential future railway alignment north of Cockburn Lake. There are 18 wooden structure accommodation/working tents for the kitchen and dining, living quarters, washrooms, laundry and water storage, generator, etc along with a small laydown area. The camp will be unoccupied in 2009. The existing site layout at Mid Rail camp is shown on Figure 3.4.

The Steensby Inlet camp is a seasonally occupied tent camp for approximately 50 people with associated facilities and related infrastructure used to support environmental studies, on-ice port site drilling and geotechnical drilling in the general southern area of the rail alignment. Specifically there are 16 wooden structure accommodation/working tents (for the kitchen and dining, living quarters, washrooms, laundry and water storage, generator), two main generators, incinerator, 6800 fuel drums, mobile equipment (4 pieces) along with a laydown area. A sea-lift in 2008 delivered a trailer camp (12 trailer units still in storage at laydown area) to Steensby Inlet to replace or supplement the tent camp for use in the future field programs. The camp will be unoccupied in 2009. The existing site layout at Steensby Inlet is shown on Figure 3.5.

There are two temporary refuge stations consisting each of a small half size trailer with bottled water and fuel storage area for 4 fuel drums located at kilometre 33 and 68 of the Milne Inlet Tote Road.

An emergency survival trailer is parked at the crusher location near Deposit No. 1

Communication towers and repeater stations are positioned at Milne Inlet, Mary River and two along the Milne Inlet Tote Road. Weather stations are located at Mary River and both Milne Inlet and Steensby Inlet. A 60-m high test wind tower lying on the tundra is located approximately 19.6 km northeast of Mary River Camp to record information on wind speeds and direction.

3.4 EQUIPMENT

A portion of the equipment and materials used for the Bulk Sample Program and no longer required was backhauled to southern Canada in 2008. Only a portion of the equipment and materials intended for demobilization was removed from site in 2008 as the loading of a second sea-lift was terminated early as a result of weather. The remaining portion will likely be removed in 2009 with a single dry cargo sea-lift from Milne Inlet.

A list of equipment anticipated on-site after the planned sea-lifts in 2009 includes the following:

Item	No. of Units	Item	No. of Units
Snowmobile/ATV	11	Excavators	2
Camp	6	Fork Lifts (ZoomBooms)	4
Incinerator	7	Fuel Tanks (steel)	2
Airstrip Lights	1	Rescue Boat	1
Sewage Treatment Facilities	3	Emergency Trailers	2
Camp Gensets	10	Radio Towers	4
Aux Gensets	10	Rigmats	48
Haul Road Trucks	4	Office Trailers	7
Haul Road Truck Pups	2	Graders	1
Dozers	3	Water Tanks	2
Loaders	2	Waste Tank	1
Supervisor Vehicles	4	Drills	10
Light Plants	2	Maintenance Vehicles	2
Fuel Truck	1	Emergency Vehicles	1

3.5 ROADS AND AIRSTRIPS

There are two existing gravel airstrips used for the project. Temporary lighting is installed at the Mary River airstrip.

The Milne Inlet Tote Road is an existing 105 km road between the Mary River Site and Milne Inlet. The existing road was upgraded in 2007 and 2008 and generally included excavating sand and gravel for the road bed from within the road alignment, and supplemented with material from large designated borrow/quarry areas, adding the fill to the roadbed where required and installing crossing structures of various sizes (mainly culverts) at watercourses and drainages. Subject to future permitting, it is planned that the road will continue to be used to provide all-season access throughout construction of the mine. Figure 3.1 shows the existing road alignment and the borrow sources identified for quarrying. There are smaller access roads to Deposit No. 1, the salt station and explosives storage area.

3.6 BORROW SOURCES

Fill materials needed for upgrade of the Tote Road, the mine haul road and other site civil works were obtained from within the road alignment and from three main borrow sources and one quarry, at locations shown on Figure 3.1. Approximately 1,093,029 m3 of sand and gravel have been excavated from within the road alignment and these main borrow sources and quarries to support the project.

Recontouring of borrow areas has commenced, with further work to be undertaken in 2009 to confirm that the as-built conditions are suitable for eventual decommissioning and to determine reclamation requirements to meet closure permits and provide a simple scope for each borrow area. Recontouring of borrow areas from within the road alignment to minimize ponding, erosion and sediment run-off to receiving waters will be ongoing in 2009 for those areas identified as requiring additional work.

3.7 FUEL STORAGE

Fuel storage facilities are located at the camp and crusher area at Mary River, at Milne Inlet, Refuge Stations, Mid Rail Camp and at Steensby Inlet Camp.

Bulk fuel storage facilities include:

- An 8.25-million litre capacity bulk fuel storage facility at Milne Inlet, consisting of seventy three 114,000 L fuel bladders in a lined containment as well as a lined re-fuelling station and resupply pipeline
- Bulk fuel bladder tank farm near the Mary River Camp with a capacity of 1.5 million litres, consisting of thirteen 114,000 L bladders in lined containment. A double walled 75,000 litre tank in lined containment.

Refuelling stations at Milne Inlet and Mary River are equipped with a lined and bermed area to contain any minor spills or leaks during refuelling. The liner is protected by sand bedding and vehicles and equipment drive onto the lined area to refuel.

In addition, drum caches in lined containment are also situated at Milne Inlet, Mary, River, Steensby Inlet and Mid Rail Camps. The total number of 200 L drums currently stored on-site is approximately 10,102.

Most of the barrel fuel currently stored at Steensby Inlet in place to support field studies and geotechnical drilling is currently planned to be demobilized in 2009 by a single dry cargo sea-lift from Steensby Inlet.

3.8 CHEMICALS

Some chemicals and potentially hazardous materials associated with project operations include:

- Oils, greases, lubricants, and drilling additives for mining and heavy equipment
- Calcium chloride flakes for drill water for exploration drilling
- Lead acid batteries and cleaning supplies at camp sites
- Waste oils generated from mobile equipment and generators

Lubricants and oils, as well as both new and used batteries, are stored in containers. Waste oils are stored in drums in lined containment, until transported to Milne Inlet and sent offsite via sealift to a registered hazardous waste disposal facility or to recycling depots. Calcium chloride flakes are stored in designated locations remote from water at Milne Inlet and Mary River.

Included in a 2008 sea-lift backhaul was a portion of the hazardous and non-landfillable wastes generated from current and historic activities at Mary River destined for licenced disposal and recycling facilities. Only a portion intended for demobilization was removed from site in 2008 as the loading of the final sea-lift was terminated early as a result of weather.

3.9 EXPLOSIVES

A portion of the pre-packaged emulsion and high explosives (Class A) required for the Bulk Sample Program remains and are stored in the 3 explosives magazines used for transport of the explosives to Mary River. The self contained explosives magazines are positioned in conformance with the *NWT/Nunavut Mine Health and Safety Act* and regulations. Detonators and explosives are stored in separate magazines, and inventory is strictly controlled with supervisory control. The explosives magazines are located away from other infrastructure in accordance with the British Table of Distances, and warning signs are prominently posted.

3.10 WASTE AND WATER MANAGEMENT

Water is supplied to each camp as follows:

- The water supply and treatment system (heated intake, ultra-violet disinfection) at Mary River supplies water to the combined population at the camp site
- Water supply at the Milne Inlet site consists of holding tanks that are filled by truck from a nearby lake and treated using an ultra-violet (UV) disinfection system
- Drinking water at the Mid Rail Camp comes from the adjacent unnamed lake, stored in holding tanks and treated using an ultra-violet (UV) light disinfection system

- Drinking water at Steensby Inlet Camp, is sourced from the unnamed in-land freshwater lake and treated using an ultra-violet (UV) disinfection system

Sewage and greywater is treated and disposed of at each camp as follows:

- Sewage and grey water at Mary River is treated using a pre-engineered rotating biological contractor sewage treatment plant followed by ultraviolet disinfection. Three polishing waste storage ponds (PWSP) are in place to receive treated sewage not meeting criteria for direct discharge via a 2 km heat traced pipeline into Sheardown Lake. Two of these ponds are full and there are plans to decant them in 2009. A Tanks-A-Lot sewage treatment system exists but is no longer used.
- There is a rotating biological contractor sewage treatment plant followed by ultraviolet disinfection at Milne Inlet camp to treat the sewage and grey water. A polishing waste stabilization pond is in place to receive treated sewage not meeting criteria for direct discharge to the receiving environment. The pond is planned to be decanted in 2009. Treated effluent is discharged by truck to a surface drainage channel discharging to Milne Inlet. During 2009 Milne Inlet camp will remain essentially unoccupied and latrine toilets (commercially purchased "Pacto" systems) will be used. Any toilet waste will be collected from the outhouses and incinerated in a dual-stage, forced air incinerator.
- Toilet wastes collected from the outhouses at Steensby Inlet and Mid Rail Camp is incinerated in a dual-stage, forced air incinerator at each of the camps. Greywater is disposed of in a sump established at each camp. During 2009, Steensby Inlet and Mid Rail Camp will be unoccupied.

Solid wastes are stored and disposed of as follows:

- Camp incinerators exists at each of the Mary River, Milne Inlet, Steensby Inlet and Mid Rail camps for disposal of inert combustible non-hazardous solid wastes. Ash is collected in containers to help prevent wind distribution.
- Inert non-combustible wastes such as scrap metal, plastic, rubber, metals, wood that is not burned and ashes from the incinerator is collected and stored in preparation for disposal in the landfill at Mary River or hauled to Milne Inlet for disposal off site
- Wastes generated at the refuge stations is stored in containers or ore sacks and backhauled to Mary River for disposal by incineration or eventual landfilling, as appropriate or to Milne Inlet for shipment off site
- Waste oil and other hazardous and recyclable wastes are collected, temporarily stored on-site in a lined containment area and backhauled to Milne Inlet or Steensby Inlet in preparation for shipment off site. Used batteries are collected in sealed containers and transported off site. Empty fuel drums are crushed and packaged and temporarily stored on-site in preparation for transport off-site by sealift where they will be recycled.
- The planned access road and landfill as approved by the Nunavut Water Board has not yet been constructed at Mary River. This closure plan assumes the construction and operation of the landfill will be performed as part of final closure.

SECTION 4.0 - TEMPORARY SUSPENSION

A temporary suspension of activities means the temporary cessation of the current program operations, either as planned or due to unforeseen circumstances.

A planned shutdown occurs when there is a potential for economic or operational difficulties that would cause a temporary cessation of current operations at the project sites. The program could be temporarily suspended because of unforeseen circumstances such as a prolonged period of poor weather and related issues, fuel shortages, mechanical problems with critical equipment, unanticipated delays in the project timeline, or availability of financing. Temporary suspension typically could last for a period of weeks to several months but could conceivably last for a year or longer. The intention however, would be to immediately resume operations as soon as all issues have been resolved. All facilities will be secured in a manner similar to the seasonal shutdown of the existing Mary River camp that has occurred in past years.

4.1 BULK SAMPLE PIT

Mining from the side-hill cut bulk sample pit was completed in 2008. The bulk sample pit was confirmed by land survey at its completion in 2008 to be free-draining. The pit will be visually inspected as part of the monitoring program to identify any indications of acid generation or metal leaching, and the drainage that collects downstream of the bulk sample pit will be sampled and tested for general chemistry and metals during the semi-annually (twice per year) site visits (discussed below).

4.2 STOCKPILES

The weathered ore at top of Deposit No. 1, including the weathered ore roadbed between the stockpile and the pit has been progressively reclaimed and is expected to be physically stable in the long term. Inspection will be carried out to verify this. Side slopes of the non-representative ore at the crusher location and residual ore stockpiles at Milne Inlet will be re-graded prior to temporary suspension. Any seepage observed from the stockpiles will be sampled and tested for general chemistry and metals during the semi-annual (twice per year) site visits (discussed below).

4.3 CAMP AND RELATED FACILITIES

The following measures have been performed at the Milne Inlet, Steensby and Mid Rail camps and will be undertaken at the Mary River camp facilities in a temporary suspension scenario:

- Tents and camp facilities (i.e., kitchens, outhouses, showers, warehouses, etc.) will be thoroughly cleaned and all open food and wastes incinerated. All unopened food supplies will be contained in sealed and secure containers so as not to attract any wildlife to the site.
- Oil stoves and propane systems will be shut off and supply oil drums and propane cylinders firmly closed
- Diesel generators will be shut down and winterized according to their manufacturer’s procedures; fuel hoses will be drained and storage tanks connected to the power supply will be sealed and inspected

4.4 EQUIPMENT

Heavy equipment and vehicles will be consolidated at either the Mary River or Milne Inlet camps. Small equipment will be returned to a designated warehouse where they will be securely stored.

4.5 ROADS AND AIRSTRIPS

No closure measures are proposed for roads and airstrips during temporary suspension. An inspection of the airstrips and roads will be undertaken to ensure there is no impeded drainage or substantial erosion that requires attention.

4.6 BORROW AREAS

Progressive reclamation of borrow areas as part of operations has commenced, including maintaining stable side slopes and grading for natural drainage. The borrow areas that have not been inspected at the onset of temporary suspension will be inspected, and re-grading will be completed as required to ensure there are no drainage issues or risk for substantial erosion that require attention.

4.7 FUEL STORAGE

Bulk fuel storage facilities at Mary River and Milne Inlet sites will be inspected for leaks and all valves and dispensers closed and secured. Drums of fuel will be left within the lined containment areas.

4.8 CHEMICALS

All chemicals present, such as cleaning supplies, lubricants, antifreeze, oils, and greases will be stored away in secure buildings and properly sealed.

4.9 EXPLOSIVES

All explosives will be placed in the explosives magazines and locked.

4.10 WATER SUPPLY AND WASTE MANAGEMENT

The water supply systems (tanks, pipes, and lines) will be completely drained, removed and stored away. Waste water treatment facilities will be shut down according to manufacturer's procedures, and any remaining sewage or sludge will be directed to the polishing/waste stabilization ponds.

Combustible non-hazardous inert wastes will be incinerated and any non-combustible inert wastes will be stored securely at their respective remote locations to be eventually landfilled.

Hazardous waste will remain stored in a manner that minimizes environmental risk in preparation for final off-site disposal and/or recycling.

4.11 MONITORING

Baffinland will arrange semi-annual (twice per year) site visits to inspect the camps, and repairs will be made as necessary. These visits would continue until activities resume. Under this scenario, Baffinland would notify the NWB and QIA of planned site visits so that the NWB and QIA could chose to attend if desired. QIA and NWB will be copied on all follow-up reports.

Water quality monitoring will be carried out at the stockpile locations and the bulk sample pit as indicated above, and in accordance with the conditions of the water license.

SECTION 5.0 - FINAL CLOSURE

Final closure would be undertaken if a decision was made to cease all activities at Mary River due to unforeseen circumstances or if there were no immediate or pending plans to advance the project towards mine development.

Final closure and reclamation will include removing all equipment and materials either off-site or into an on-site landfill at Mary River (for inert, non-hazardous, non-combustible materials), and contouring ground surfaces. Equipment and materials to be taken off-site will be transported overland from Mary River Camp to Milne Inlet. Materials and Equipment at Mid Rail Camp will be flown to Steensby Camp or the Mary River Camp. Arrangements will be made with a sealift contractor to collect the shipment of materials and equipment at Milne Inlet and Steensby Inlet and ship material offsite for re-sale, salvage or disposal.

Most materials and equipment found at the project sites will have some residual value for either re-sale or relocation to another exploration site. It is possible some or all of the camp infrastructure and equipment could be airlifted or sealifted to another exploration site or could possibly be donated to the local communities.

5.1 BULK SAMPLE PIT

As described in Section 3.3.2, there is virtually no potential for enhanced release of acidity or metals in response to oxidative weathering of the material in the ore left exposed in the bench walls of the pit. The walls and floor of the pit will be visually inspected as part of the monitoring program to identify any indications of acid generation or metal leaching, and any seepage that collects in or downstream of the bulk sample pit will be sampled and tested for general chemistry and metals during the site visits (discussed below).

The shallow side-hill cut pit area created on Deposit No. 1 will be inspected for any physically unstable surfaces and to validate that the pit is draining properly. The bulk sample pit was confirmed by land survey at its completion in 2008 to be free draining and will be left open. There were no stability issues noted by the Mine Inspector during his inspection in September of 2008. Rehabilitation measures will be undertaken if necessary to ensure that unstable areas do not remain. This may include additional blasting, excavation or backfilling using weathered ore.

5.2 STOCKPILES

It has been demonstrated from the 2008 environmental geochemical testing program that there is virtually no potential for enhanced release of acidity or metals in response to oxidative weathering of the material in the i) weathered ore stockpiled on the Deposit No. 1, ii) non-representative ore stockpiled at the Mary River crusher site and the stockpile pad at Milne Inlet, and iii) representative ore left exposed in the bench walls of the pit and stockpiled at Milne Inlet. Any seepage observed below the weathered ore stockpile during follow-up monitoring will be sampled and tested for general chemistry and metals during the annual post-closure site visits (discussed below).

The weathered ore stockpiled at top of Deposit No. 1, including the weathered ore roadbed between the stockpile and the pit has been progressively reclaimed and is expected to be physically stable in the long term. Inspection will be carried out to verify this.

The representative (i.e. ore grade) material left in the bulk sample pit was contoured and left in a stable and free draining state at the end of the 2008 field season.

The non-representative ore stockpiled at the Mary River crusher site will be re-graded as required to ensure the area is physically stable.

The stockpile of representative ore at Milne Inlet will be re-graded as required over the non-representative ore pad to ensure the area is physically stable and covered in 0.3 m of locally available borrow material for aesthetics purposes and to prevent dusting of the beach head.

The contingency plan involving mixing of neutralizing material with potentially ARD/ML material that was included in the previous A&R Plan is no longer required. The results from the 2008 environmental geochemical testing program and short term leach tests have demonstrated that there is virtually no potential for enhanced release of acidity or metals in response to oxidative weathering of the material sampled.

5.3 CAMP AND RELATED FACILITIES

Most materials found at the camp sites are either control burned, landfilled at the Mary River landfill, or backhauled for disposal or salvage. Most materials found at the camp sites will have residual value and may be salvaged for resale and relocated off-site by sea-lift. Tent facilities and Quonset buildings will be dismantled and, with the pre-fabricated trailers, will be transported overland to Milne Inlet, landfilled at the Mary River landfill, or control burned. Wooden structures such as warehouses, outhouses, tent floors, bunk beds and tables will be dismantled, salvaged for re-use by others, or burned on site. Only clean wood, wood that has not been coated with preservative chemicals or paint, will be considered for burning.

All camp areas will be inspected for signs of fuel spills and any contaminated materials excavated as described in Section 5.10. Ground surfaces will be re-contoured if necessary to ensure long-term physical stability.

Generators will be prepared for travel, transported overland to Milne Inlet, and sent off-site on sealift for re-sale. Fuel storage, hoses and filters associated with the power supply will be drained. Waste oil, residual fuels and oil/fuel filters will be managed as hazardous waste, contained and removed from site to a licensed waste disposal facility.

Drill sites in operation or undergoing progressive reclamation will be closed as per the operational licensing and permitting requirements. Exploration drill core will be transferred to sea containers for long term storage adjacent to airstrip. Geotechnical core will be disposed of in the landfill.

5.4 ROADS AND AIRSTRIPS

Airstrips will remain to allow for future access to the site for exploration, site inspections and other monitoring activities. Temporary airstrip lighting at Mary River will be removed.

The temporary roads including Milne Inlet Tote Road, access road to Deposit No. 1, landfill, salt station, and explosives access will be inspected and any areas of significant erosion will be re-graded to improve stability and minimize sediment run-off to receiving waters. Four (4) sea can crossings and six (6) culvert crossings deemed as navigable waters under authorization by Transport Canada and the Federal Department of Fisheries and Oceans along the Milne Inlet Tote Road are required to be removed and the crossing re-graded at closure. The culverts and sea-cans will be disposed of in an inert landfill at Mary River. Alternately the sea cans may be hauled to Milne Inlet and shipped off site for disposal or recycling. The roadbed will remain for other users, in accordance with the road's designation of public access in the Nunavut Land Claim Agreement.

5.5 BORROW AND QUARRY AREAS

Progressive reclamation of borrow and quarry areas has commenced as part of operations, including maintaining stable side slopes and grading for natural drainage to minimize ponding, erosion and sediment run-off to receiving waters. Reclamation of borrow areas from within the road alignment will continue in 2009 as part of operations and be completed during final closure for those areas identified as requiring additional work. The three primary borrow sites and one quarry will require reclamation at final closure. Final re-grading will be completed as required for drainage control and limit the potential for excessive erosion. Borrow and quarry areas will be revisited as part of the post-closure monitoring program, to document that no substantial thaw settlement has occurred that will necessitate further remedial action.

5.6 FUEL STORAGE

Drums of fuel will be consolidated, inspected and securely sealed. Any open drums of diesel, off-specification fuel and waste oil will be shipped to registered hazardous waste disposal facilities or to recycling depots. Sealed fuel drums may be sold locally or to other users in the region. Drums will be transported overland to Milne Inlet or by air to Steensby Inlet and loaded onto sealift. Empty fuel drums will be crushed and sealifted off-site for steel recycling or, if suitable for reuse, transported by sealift off-site where they will be returned to the vendor. Fuel could also be burned at site assuming that any necessary permits are secured.

Fuel bladders will be drained using compressed air, transferred to a truck, and relocated to Milne Inlet where they will be removed offsite for salvage. Any fuel remaining will be loaded onto a sealift and transported to other users or will be shipped to registered hazardous waste disposal facilities or to recycling depots. Fuel could also be burned at site assuming that any necessary permits are secured. The Mary River fuel storage facility will be emptied and decommissioned first, followed by the Milne Inlet facility once any excess fuel has been taken off site.

Containment for each fuel storage facility consists of an earthen berm lined with a petroleum-resistant geomembrane liner. Any bedding material inside the liner will be tested for petroleum hydrocarbons before being removed. Liners will be sent off-site for disposal at a licensed facility. Soil beneath the lined areas will also be tested for petroleum hydrocarbons. Disposal of contaminated soils is described in Section 5.10.

5.7 CHEMICALS

Chemicals, such as cleaning supplies, lubricants, antifreeze, oils, and greases will be placed in a sea container and will be transported off-site for either re-use or disposal.

Waste oil will be shipped to registered hazardous waste disposal facilities or to recycling depots. Used batteries and any other hazardous waste will be taken off-site to a licensed disposal facility for recycling or proper disposal.

5.8 EXPLOSIVES

Unused explosives will be securely contained in magazines and removed from site. The three explosives magazines located at Mary River will be transported to Milne Inlet and sent offsite via sealift to a licensed recipient for proper disposal or re-use.

5.9 WASTE AND WATER MANAGEMENT

An access road and landfill as approved by the Nunavut Water Board will be constructed and operated at Mary River as described in the Bulk Sampling Program Landfill Design and Operations (Baffinland Iron Mines Corporation, Submission of an Addendum to the Landfill Site Design Report for the Mary River Project. NWB File: 2BB-MRY0710/Part D19, October 27, 2008) for the disposal of bulky inert wastes, including wood, steel, rubber and plastics. Bulky wastes remnant of historic exploration activities will be relocated to the landfill. No organic or hazardous wastes will be disposed of in the landfill. The landfill site will be covered with a 1.5 m thick layer of inert overburden.

Combustible non-hazardous inert wastes will be incinerated on site. Non-combustible non-hazardous inert bulky waste that has no salvage value will be landfilled on-site.

Existing bulky wastes from the 1960s, equipment and materials associated with recent project activities, will be inspected for any hazardous materials. Oil pans and fuel tanks will be drained and the oil or fuel shipped to registered hazardous waste disposal facilities or to recycling depots. Any remaining hazardous components such as batteries, tanks and filters will be removed from site to a licensed off-site facility.

The water supply system (tanks and lines) will be drained, dismantled, and will be either dismantled for disposal in the landfill at Mary River or will be transported to Milne Inlet for salvage or disposal off-site.

Grey-water sumps will be backfilled and contoured to grade. Sewage treatment plants will be decommissioned in accordance with manufacturer procedures/recommendations, and any remaining sewage or sludge will be sent to the polishing/waste storage pond. The polishing/waste stabilization ponds will be decanted and the solids left to dry. Dried solids will either be buried in situ or disposed of at the on-site landfill upon confirmation as non-hazardous waste. Liners will be removed and the polishing/waste stabilization ponds will be contoured. This material could also serve as a contingency for use in contouring other areas, if required, without triggering borrow royalty fees. The treatment plants will be prepared for shipping and will be transported to Milne Inlet to be loaded onto sealift and shipped to other users or disposed of at site in the landfill. The concrete tanks associated with Tanks-A-Lot treatment facility will broken-up and disposed of in the inert landfill at Mary River.

5.10 CONTAMINATED SOILS

Any contaminated soils may be managed in-situ on site or excavated using the skid steers or excavators and loaded into fibreglass ore sacks and removed off-site for disposal at a licensed treatment or disposal facility.

During the follow-up and monitoring period, sand and gravel contaminated with petroleum products will be managed in a land farm at Milne Inlet. This land farm will be decommissioned near the end of the monitoring period.

5.11 TIMING AND SCHEDULE OF FINAL CLOSURE

The timing of closure and reclamation is largely governed by weather. Activities such as removal of lined containment facilities and the testing and excavation of affected soils are better completed during summer months when the ground surface is not frozen. Overland access can be year-round until the ten (10) navigable crossings are removed from the Milne Inlet Tote Road which will occur upon final retreat from Mary River camp. Timing of shipping off-site for proper disposal will be governed by sealift schedule, which is possible only during the open water period of August to October.

The reclamation activities are expected to be undertaken primarily during the months between March and October under favourable weather conditions although most reclamation can occur through the winter period.

If final closure was implemented earlier, a similar schedule would apply, considering the timing constraints for reclamation activities and demobilization.

It is estimated that a total of five months will be required to complete closure and reclamation activities with a crew of about 50 people. The current Mary River Camp will be scaled down to a 50-person capacity, initially, and then removed completely once all other reclamation activities are complete. The reclamation crew will move to Milne Inlet and then to the Steensby Inlet and Mid Rail to complete reclamation at these camps.

Final closure could be undertaken under favourable weather conditions, leading up to sealift in August through October.

SECTION 6.0 - FOLLOW-UP MONITORING

Monitoring and follow-up inspections will be conducted at the Mary River Project area in order to assess the physical and chemical stability of the various components after closure and reclamation of the facilities. Annual inspections of the affected sites will be carried out for up to five years following the final closure to demonstrate that conditions have not changed and remain both physically and chemically stable. The monitoring program may be discontinued earlier than five years, only if monitoring results indicate that site conditions are stable, and agreement can be reached with the landowner(s) and Nunavut Water Board.

The physical stability of the bulk sample pit, weathered ore and waste rock stockpile, Milne Inlet Tote Road and other project components shall be monitored through visual inspection.

During the follow-up and monitoring period, sand and gravel contaminated with petroleum products will be managed in a land farm at Milne Inlet. This land farm will be decommissioned near the end of the monitoring period.

The chemical stability of the site will be monitored through visual inspection as well as surface water sampling and analyses, during the closure period and for up to five years post-closure, or as otherwise dictated by the water license to document that its quality is not adversely affected by the closed Project components. The monitoring plan will continue through closure and post-closure periods.

At the conclusion of the post-closure monitoring period (i.e., in the fifth year of monitoring), all development areas related to the Project will be subjected to a closure inspection by a company representative or contractor, and a brief closure and reclamation report with photographs will be prepared, documenting the reclamation work completed and the site conditions following closure.

SECTION 7.0 - ESTIMATED CLOSURE COSTS

The estimated cost to complete the final closure work described in this A&R Plan is shown on Table 7.1. This plan provides a full cost of implementing closure that addresses all project-related activity areas and infrastructure related to the Mary River Project that will be in place assuming an unplanned (i.e. "worst case" scenario) shut-down as of March 31, 2010. This is a hypothetical date that corresponds with the requirements of the surface lease, as actual closure timing is currently unknown. The state at the time of closure is different from the 2008 Plan based on (a) actual results of the bulk sample program and (b) a current plan to continue to plan for full-scale development.

The following assumptions have been made in developing the cost estimate:

- Contractor and Baffinland equipment that are at site after the completion of the bulk sample program and the 2009 sea-lifts will be available to carry out the final abandonment activities
- Reclamation is carried out by a third-party contractor
- Demobilisation activities will be coordinated with the numerous community sealifts performed each year in the area
- The monthly cost to operate the camp at Mary River during final closure will be based on actual camp costs estimated from experience to date
- A dedicated tanker ship sealift will be used to remove the bulk fuel from the project
- That fuel is represented as a non-cash contribution to the execution of closure
- Progressive reclamation to be completed in 2009 is an operational cost and therefore not included in final closure costs
- Baffinland corporate office costs during abandonment, reclamation and post-closure monitoring are excluded from the cost estimate
- No contingency is applied to the cost estimate
- No cost escalation or inflation is applied to the cost estimate
- All significant work is assumed to be completed in 2009 and 2010. Schedule delay could add cost.

The estimated cost to complete the final closure work described in this A&R Plan is $12,043,131.

Items of significant value such as the barge loader, large gensets, large equipment and the new trailers at Steensby that will be backhauled by sealift and items required to be removed from site such as the estimated 2.2 million litres of fuel backhauled by tanker ship will have salvage value. A salvage value of $1,459,203 million based on the items and fuel removed from site at closure has been estimated. The total estimated cost, less salvage value is $10,583,928.

SECTION 8.0 - ESTIMATED CLOSURE COSTS USING RECLAIM

As required by the Nunavut Water Board (NWB) General Conditions of the water licence, a supplemental reclamation cost assessment for an assumed closure and reclamation of Baffinland's Mary River project in 2010 was completed using the RECLAIM model (version 5.1). The RECLAIM modelling was based on this abandonment and reclamation plan.

The prescribed methodology of assessing the full cost for closure and reclamation is with the RECLAIM model (version 5.1), which is based on a unit cost table that is part of the model. The unit cost table lists common reclamation activities that may be carried out at a particular mine site and the associated unit costs (based on 2005 data) for each activity. An attempt was made to include all reclamation activities identified within the A&R Plan into the RECLAIM model. The limitations of the RECLAIM model include the use of prescribed rates which may not exactly match the proposed reclamation activity and are based on a historic database and therefore may not be current. Although the unit rates in the table can be altered, the intent of performing the cost estimate using the RECLAIM model wasn't to alter the model to mimic the method, and thus the cost estimate presented in this Abandonment and Reclamation Plan, but to incorporate unit rates provided in the model as much as possible to come up with an estimate. In a few cases, unit rates were specified. In most cases the unit number for each line item in the RECLAIM model is a known quantity based on the actual physical layout, inventory, distances, etc. at the site. In cases where quantities were unknown conservative estimates were incorporated into the model.

The estimated cost to complete the final closure work using the RECLAIM model less salvage is $6,750,361. A summary of the estimated cost using RECLAIM is shown on Table 8.1. The results of the RECLAIM model are attached.

The estimated cost less salvage to complete the final closure work included in the A&R Plan was $10,583,928. This cost was determined based on Baffinland's experience operating in North Baffin Island and Knight Piésold's experience with closure work in Canada and internationally.

The costs presented in the A&R Plan are higher than those calculated using the RECLAIM model.

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SECTION 9.0 - REFERENCES

1. Indian and Northern Affairs Canada. Mine Site Reclamation Policy for Nunavut. Ottawa, 2002.

2. Indian and Northern Affairs Canada. Mine Site Reclamation Policy for Nunavut. Indian and Northern Affairs Canada, 2007.

3. Knight Piesold. Bulk Sampling Program Abandonment and Reclamation Plan. Ref. No. NB102-00181/6-7, Rev. 2, dated 31-March-2008).

4. Northwest Territories Water Board. Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories. September 1990.

5. Martin van Rooy. Report of an Inspector of Mines - Mary River Project. Nunavut Workers' Safety and Compensation Commission, September 22/23, 2008.

6. Price. W.A. Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia. Smithers, B.C.: Ministry of Employment and Investment, Energy and Minerals Division, 1997.

7. Steffen, Robertson and Kirsten (B.C.) Inc. Mine Reclamation in Northwest Territories and Yukon. Prepared under contract for the Northern Water Resource Studies Program, Water Resources Division, Natural Resources and Environment Branch, Department of Indian Affairs and Northern Development. April 1992.

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SECTION 10.0 - CERTIFICATION

This report was prepared, reviewed and approved by the undersigned.

Prepared by:

Reagan McIsaac, Ph.D.
E.I.T.

PERMIT TO PRACTICE
KNIGHT PIÉSOLD LTD.
Signature
Date MARCH 26/2009
PERMIT NUMBER: P 547
The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

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MAR 26 2009
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TABLE 7.1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

ESTIMATED COSTS FOR FINAL CLOSURE

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Components and Tasks	Labour	Equipment	Task Reclamation	Component Reclamation	Basis for Estimate
Bulk Sample Pit					
Bulk Sample Pit	$ -	$ -	$ -	$ -	Ore removed for the bulk sample program produced a small side hill cut. The pit was confirmed by land survey at its completion in 2008 to be free draining. Slopes were stabilized in 2008 (see Mr. Martin van Rooy's (Mine Inspector with the Nunavut WSCC) Report dated September 22 and 23, 2008). The results from the 2008 environmental geochemical testing program and short term leach tests have demonstrated that there is virtually no potential for enhanced release of acidity or metals in response to oxidative weathering of the material sampled. The pit will not require any reclamation.
Mineral Exploration Areas (Deposits No. 1, 2, 3)					
Mineral exploration areas	$ 44,800	$ 102,000	$ 146,800	$ 146,800	Exploration holes are backfilled, residual casing is cut at surface, and sumps are graded to natural contours. Salt mixing stations and water pump stations are dismantled and removed from site. Drills are dismantled and removed from exploration areas. Exploration drill core is transferred to sea containers for long term storage.
Remote Sites					
Remote sites	$ 35,000	$ 500,500	$ 535,500	$ 535,500	Geotechnical drill holes are backfilled, residual casing/thermistors are cut at surface, and sumps are graded to natural contours. Equipment and materials at remote sites (wind tower, communications towers, metrological stations, hydrology stations, current meters) are decommissioned and removed.
Stockpiles					
Stockpiles	$ 13,200	$ 33,000	$ 46,200	$ 46,200	The weathered ore stockpiled at top of Deposit No. 1, including the weathered ore roadbed between the stockpile and the pit has been progressively reclaimed and is expected to be physically stable in the long term. Inspection will be carried out to verify this. The representative material left in the bulk sample pit was contoured and left in a stable and free draining state at the end of the 2008 field season. The non-representative ore stockpiled at the Mary River crusher site is re-graded. The stockpile of representative ore at Milne Inlet is re-graded over the non-representative ore pad and covered in 0.3 m of locally available borrow material for aesthetics purposes and to prevent dusting of the beach head.
Camps and Related Facilities					
Mary River camp	$ 475,528	$ 649,872	$ 1,125,400		In general, reclamation of the Mary River camp assumes; decommissioning and landfilling of the 100-person weatherhaven camp, stand alone accommodation/work structures including 26 Weatherhaven and 11 Norseman tents, 3 Weatherhaven washroom/dry tents, 1 Weatherhaven firehall tent, 1 Weatherhaven kitchen (old) tent, 3 Weatherhaven workshop tents. Decommissioning and packaging of three main generators and the incinerator. Mobile equipment is prepared for travel to Milne Inlet. A load, haul and dump operation for materials landfilled. Trucking material to Milne Inlet for removal off-site. Light truck and electrician support. Organizing and package Boart, Springdale, Nunas and BIMs material for shipment. Isolating gensets. Disassemble water and sewage pipes and recover electrical wire. Site cleanup and coarse contouring and final grading.
Refuge Sites	$ 4,200	$ 4,500	$ 8,700		Decommission, package and organize material for shipment and trucking material to Milne Inlet for removal.
Milne Inlet camp	$ 208,800	$ 135,984	$ 344,784		In general, reclamation of the Milne Inlet camp assumes; decommissioning and packaging of the 10 ATCO trailers, 9 work tents, 1 large Weatherhaven workshop tent. Decommissioning and packaging of two main generators and the incinerator. Operation of oil/water separator. Prepare mobile equipment for removal. A load, haul and dump operation for materials landfilled at Mary River. Organizing and package Nuna containers and miscellaneous material for shipment. Prepare BIM barge loader for removal. Isolate genset. Disassemble sewage lines and recover electrical wire. Site cleanup and coarse contouring and final grading.
Mid-Rail Camp	$ 45,600	$ 90,000	$ 135,600		In general, reclamation of the Mid-Rail camp assumes; decommissioning, burning and packaging of the 18 wood structure tents. Decommissioning and packaging of generator and incinerator. Decommissioning of laydown areas. Organize material for shipment. Transport material via helicopter to Mary River camp for removal/landfilling. Site cleanup.
Steensby Inlet Camp	$ 73,200	$ 76,600	$ 149,800	$ 1,764,284	In general, reclamation of the Steensby Inlet camp assumes; decommissioning, burning and packaging of the 25 wooden structure tents. Decommission, prepare and package the generator, incinerator, laydown areas. Remove floating dock and water line. Organizing material for shipment and sealift support. Site cleanup.

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TABLE 7.1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

ESTIMATED COSTS FOR FINAL CLOSURE

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Components and Tasks	Labour	Equipment	Task Reclamation	Component Reclamation	Basis for Estimate
Roads and Airstrips					
Roads	$ 221,543	$ 553,857	$ 775,400		During closure the Tote Road will be maintained while hauling equipment and material between Mary River and Milne Inlet. Erosion damage occurring during closure on Milne Inlet Tote Road and the access road to Deposit No. 1 will be repaired. The roadbed will remain for other users, in accordance with the road's designation of public access in the Nunavut Land Claim Agreement. The temporary roads including Milne Inlet Tote Road, access road to Deposit No. 1, landfill, salt station, and explosives access are graded and contoured. Four (4) sea can crossings and six (6) culvert crossings deemed as navigable waters under authorization by Transport Canada and the Federal Department of Fisheries and Oceans along the Milne Inlet Tote Road are removed and the crossing re-graded.
Airstrips	$ 13,800	$ 14,400	$ 28,200	$ 803,600	Airstrips will remain to allow for future access to the site for exploration, site inspections and other monitoring activities. Temporary airstrip lighting at Mary River is removed and airstrip lighting ditches are backfilled and graded.
Borrow/Quarry Areas					
Borrow/Quarry Areas	$ 88,710	$ 216,400	$ 305,110	$ 305,110	Progressive reclamation of borrow and quarry areas has commenced as part of operations, including maintaining stable side slopes and grading for natural drainage to minimize ponding, erosion and sediment run-off to receiving waters. Reclamation of borrow areas from within the road alignment will continue in 2009 as part of operations and be completed during final closure for those areas identified as requiring additional work. At closure, the primary borrow and quarry sites are contoured and graded as required. Borrow material royalties for the material required for reclamation have been included. Berm material from the sewage ponds and fuel farms is available without attracting the borrow royalty fee.
Fuel Storage Facilities (Bulk and Drums)					
Mary River Fuel Farm	$ 12,600	$ 7,650	$ 20,250		Excess fuel at Mary River camp is delivered to Milne Inlet. 11 bladder tanks are drained, folded and containerized (including piping). Geomembrane liner is removed, cut and packaged. Remaining borrow material in the berms is re-contoured.
Milne Inlet Fuel Farm	$ 53,400	$ 25,950	$ 79,350	$ 99,600	Excess fuel in Milne Inlet bulk fuel farm is transferred to a dedicated tanker ship sealift. 73 bladder tanks are drained, folded and containerized. Piping is removed from fuel farm. Geomembrane liner is removed, cut and packaged. Remaining borrow material in the berms is re-contoured.
Explosives					
Explosives	$ 3,600	$ 4,200	$ 7,800	$ 7,800	Three explosives magazines are prepared for shipment and trucked to Milne Inlet.
Waste Management					
Landfill	$ 81,000	$ 202,500	$ 283,500		Excavate, load, haul and place borrow material to construct (i.e. access road and berms), operate (i.e. daily cover) and cap (i.e. 1.5 m cover) Mary River landfill as approved by Nunavut Water Board.
Prepare chemicals for shipping/disposal cost of hazardous material	$ 41,400	$ 76,725	$ 118,125		Prepare hazardous material inventory for shipping. Disposal cost of hazardous material in the South (except hydrocarbon impacted soil which will be landfarmed) as detailed in the QE hazardous material inventory completed in Aug 2008.
Sewage lagoons at Mary River camp	$ 21,647	$ 2,803	$ 24,450		The polishing/waste stabilization ponds will be decanted in 2009 and the solids left to dry. Excavate, load, haul and place dried solids at the on-site landfill. Liner is removed, cut and packaged. Remaining borrow material in the berms is re-contoured.
Sewage lagoons at Milne Inlet	$ 2,400	$ 6,000	$ 8,400	$ 434,475	The polishing/waste stabilization pond will be decanted in 2009 and the solids left to dry. Excavate, load, haul and place dried solids at the on-site landfill. Liner is removed, cut and packaged. Remaining borrow material in the berms is re-contoured.
Hydrocarbon Impacted Soils					
Hydrocarbon Impacted Soils	$ 288,040	$ 110,850	$ 398,890	$ 398,890	Collect and test soil samples including bedding material inside liner of Milne Inlet fuel storage area. Operate oil/water separation and activated carbon at Milne Inlets bermed/lined landfarm each year for 3 years. Till hydrocarbon impacted soil each year for 3 years. Mobilize/demobilize workers each year. Operate 2-person trailer for 2 months each year for 3 years. Freight community sealift backhaul in 2013 to remove liner, tilling equipment, and trailer. Third party consultant to verify site cleanup completion.

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TABLE 7.1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

ESTIMATED COSTS FOR FINAL CLOSURE

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Components and Tasks	Labour	Equipment	Task Reclamation	Component Reclamation	Basis for Estimate
General Site Area					
General Site Area	$ 495,000	$ -	$ 495,000	$ 495,000	Assume 6 person civil contractor support staff (i.e. administration, supervisor(s), surveyor, etc) during reclamation period.
Sealift Materials from Milne Inlet and Steensby Inlet to Montreal					
Sea-lifts from Milne	$ 23,400	$ 1,418,335	$ 1,441,735		Loading and vessel costs for 2 freight backhaul sealifts. Vessel cost for 1 bulk fuel backhaul sealift. Backhaul shipping volumes have been estimated based upon incoming sea lift volumes, airlift volumes, estimated consumption, estimated burn quantities and estimated landfill quantities. Loading from beach to ship & ship to dock included in vessel cost.
Sea-lifts from Steensby	$ -	$ 359,957	$ 359,957		Vessel cost for 1 freight backhaul sealift on a cargo vessel used to supply regional communities. Backhaul shipping volumes have been estimated based upon incoming sea lift volumes, airlift volumes, estimated consumption, estimated burn quantities and estimated landfill quantities. Loading from beach to ship & ship to dock included in vessel cost.
Landfreight	$ -	$ 600,000	$ 600,000	$ 2,401,692	Land freight costs from regional centre to final destination assuming oversize trucks.
Camp Operating Costs					
Camp Operations during closure	$ 1,145,970	$ 2,891,110	$ 4,037,080	$ 4,037,080	Includes camp operations with support staff (i.e. cooks, dishwashers, labourers, bearmonitors, etc), food, commercial flights, fixed wing support from Iqaluit including fuel purchases. Miscellaneous helicopter support. Standby costs for equipment during decommissioning and shipment.
Environmental Monitoring					
Environmental Monitoring	$ 240,600	$ 326,500	$ 567,100	$ 567,100	Environmental supervision & reporting for 5 years during ongoing monitoring following final closure and includes annual site visits by two persons, water sampling (collection and testing) and helicopter support with a mobilization fee on each occasion.
Salvage					
Salvage	$ -	$ 1,459,203	$ 1,459,203	$ 1,459,203	Items of significant value such as the barge loader, large gensets, large equipment and the new trailers at Steensby that will be backhauled by sealift and items required to be removed from site such as the estimated 2.2 million litres of fuel backhauled by tanker ship will have salvage value. Equipment salvage was based on 50% of the depreciated fixed asset value projected to December 2009. Fuel salvage value was based on 25% of the fuel value assuming a $1.11/litre bulk fuel cost.
Total				$ 10,583,928	

I:\102-00181-15\Assignment\Report\Report 1, Rev. 0 - 2009 Update to A&R Plan\Tables\[Table 7.1 - 2009 - Closure Cost Estimate Summary Table (Rev 0).xls]Table 7.1 2009 Closure Cost

NOTES:

THE FOLLOWING ASSUMPTIONS HAVE BEEN MADE IN DEVELOPING THE COST ESTIMATE:

1. CONTRACTOR AND BAFFINLAND EQUIPMENT THAT ARE AT SITE AFTER THE COMPLETION OF THE BULK SAMPLE PROGRAM AND THE 2009 SEA-LIFTS WILL BE AVAILABLE TO CARRY OUT THE FINAL ABANDONMENT ACTIVITIES.
2. RECLAMATION IS CARRIED OUT BY A THIRD PARTY CONTRACTOR.
3. DEMOBILIZATION ACTIVITIES WILL BE COORDINATED WITH THE NUMEROUS COMMUNITY SEALIFTS PERFORMED EACH YEAR IN THE AREA.
4. A DEDICATED TANKER SHIP SEALIFT WILL BE USED TO REMOVE THE BULK FUEL FROM THE PROJECT.
5. THE MONTHLY COST TO OPERATE THE CAMP AT MARY RIVER DURING FINAL CLOSURE WILL BE BASED ON ACTUAL CAMP COSTS ESTIMATED FROM EXPERIENCE TO DATE.
6. THAT FUEL IS REPRESENTED AS A NON-CASH CONTRIBUTION TO THE EXECUTION OF CLOSURE.
7. PROGRESSIVE RECLAMATION TO BE COMPLETED IN 2009 IS AN OPERATIONAL COST AND THEREFORE NOT INCLUDED IN FINAL CLOSURE COSTS.
8. EQUIPMENT RATES ARE PRIMARILY $125/HR. LABOUR RATES ARE PRIMARILY $600/DAY. THE RATES DO NOT INCLUDE THE COST FOR FUEL. THE FUEL ON SITE HAS BEEN PAID FOR AND IS AVAILABLE FOR RECLAMATION ACTIVITIES.
9. BAFFINLAND CORPORATE OFFICE COSTS DURING ABANDONMENT, RECLAMATION AND POST-CLOSURE MONITORING ARE EXCLUDED FROM THE COST ESTIMATE.
10. NO CONTINGENCY IS APPLIED TO THE COST ESTIMATE.
11. NO COST ESCALATION OR INFLATION IS APPLIED TO THE COST ESTIMATE.
12. ALL SIGNIFICANT WORK IS ASSUMED TO BE COMPLETED IN 2009 AND 2010. SCHEDULE DELAY COULD ADD COST.

0	MAR26'09	ISSUED WITH -Report NB102-181/15-1	RSM	SRA	SRA
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

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TABLE 8.1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SUMMARY OF ESTIMATED COSTS FOR FINAL ABANDONMENT BASED ON THE RECLAIM MODEL

Print Mar/26/09 15:18:10

SUMMARY OF COSTS

Capital Costs

COMPONENT TYPE	COMPONENT NAME	TOTAL COST	Land Liability	Water Liability
OPEN PIT	Bulk Sample Pit	$78,000.00	$78,000	$0
~~UNDERGROUND MINE~~	0	**NO UNDERGROUND MINE**		
~~TAILINGS~~	0	**NO TAILINGS FACILITY**		
ROCK PILE	0	$31,994.00	$31,994	$0
BUILDINGS AND EQUIPMENT	0	$1,521,716.80	$1,395,794	$125,923
CHEMICALS AND SOIL MANAGEMENT	0	$737,567.00	$698,191	$39,376
WATER MANAGEMENT	0	$1,507.50	$0	$1,508
POST-CLOSURE SITE MAINTENANCE		$171,725.38	$80,139	$91,587
SUBTOTAL		**$2,542,511**	**$2,284,118**	**$258,393**
		Percentages		
MOBILIZATION/DEMOBILIZATION	0	$4,812,527		
MONITORING AND MAINTENANCE	0	$524,000		
SALVAGE		$1,459,203		

PROJECT MANAGEMENT - Project Management costs have already been included in the Monitoring and Maintenance costs

ENGINEERING	3 %	$76,275
CONTINGENCY	10 %	$254,251
TOTAL		**$6,750,361**

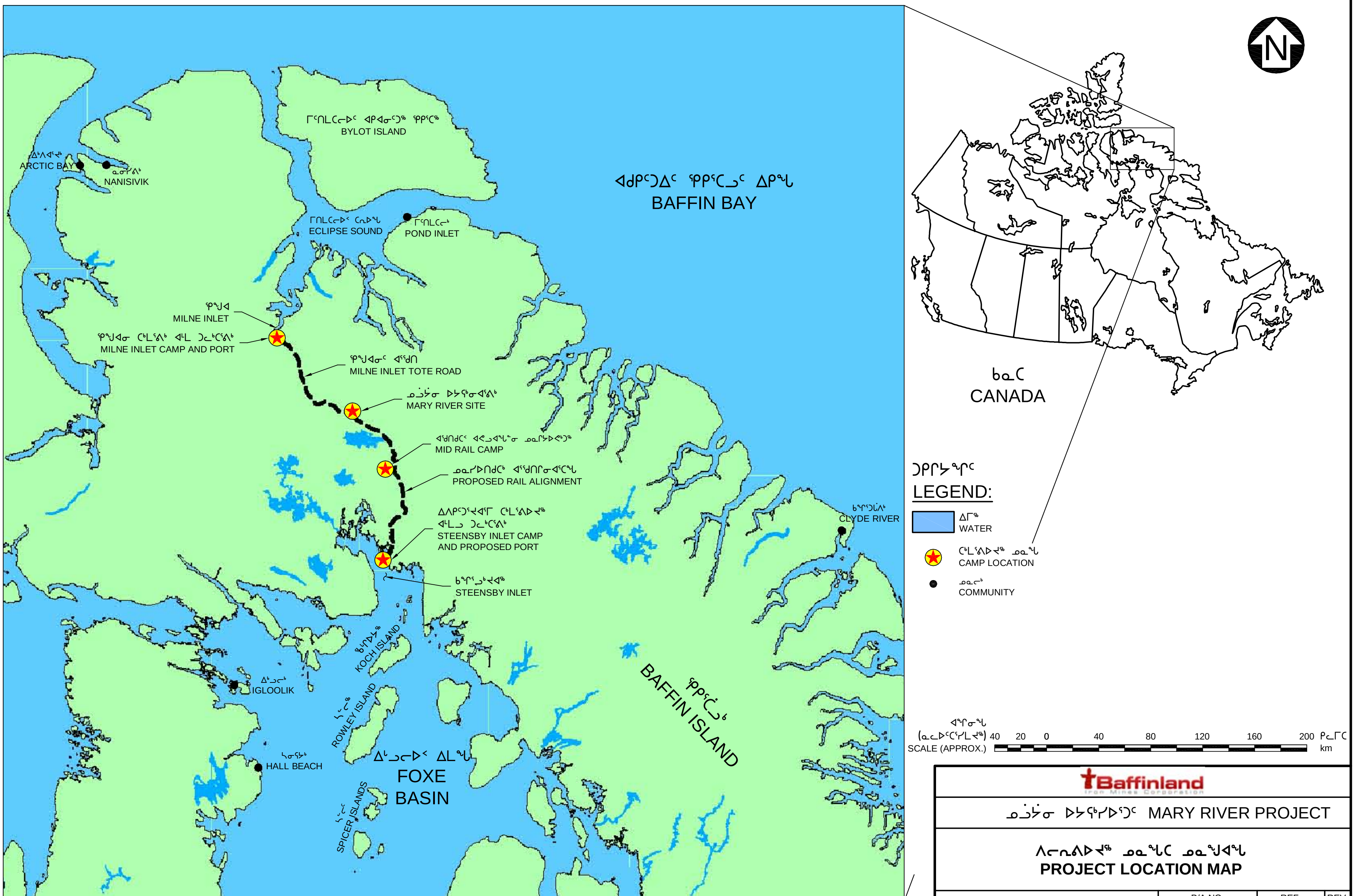
I:\102-00181-15\Assignment\Report\Report 1, Rev. 0 - 2009 Update to A&R Plan\Tables\[Table 7.1 - 2009 - Closure Cost Estimate Summary Table (Rev 0).xls]Table 7.1 2009 Closure Cost

NOTE:

1. TABLE DEVELOPED BASED RECLAIM MODEL 5.1 FORMAT.

0	MAR26'09	ISSUED WITH - Report NB102-181/15-1	RSM	SRA	SRA
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

XREF FILE(S): IMAGE FILE(S): 4 Baffinland logo-big corp Baffinland logo_new logo-big corp NORTH BAFFINLAND



Baffinland Iron Mines Corporation

MARY RIVER PROJECT

PROJECT LOCATION MAP

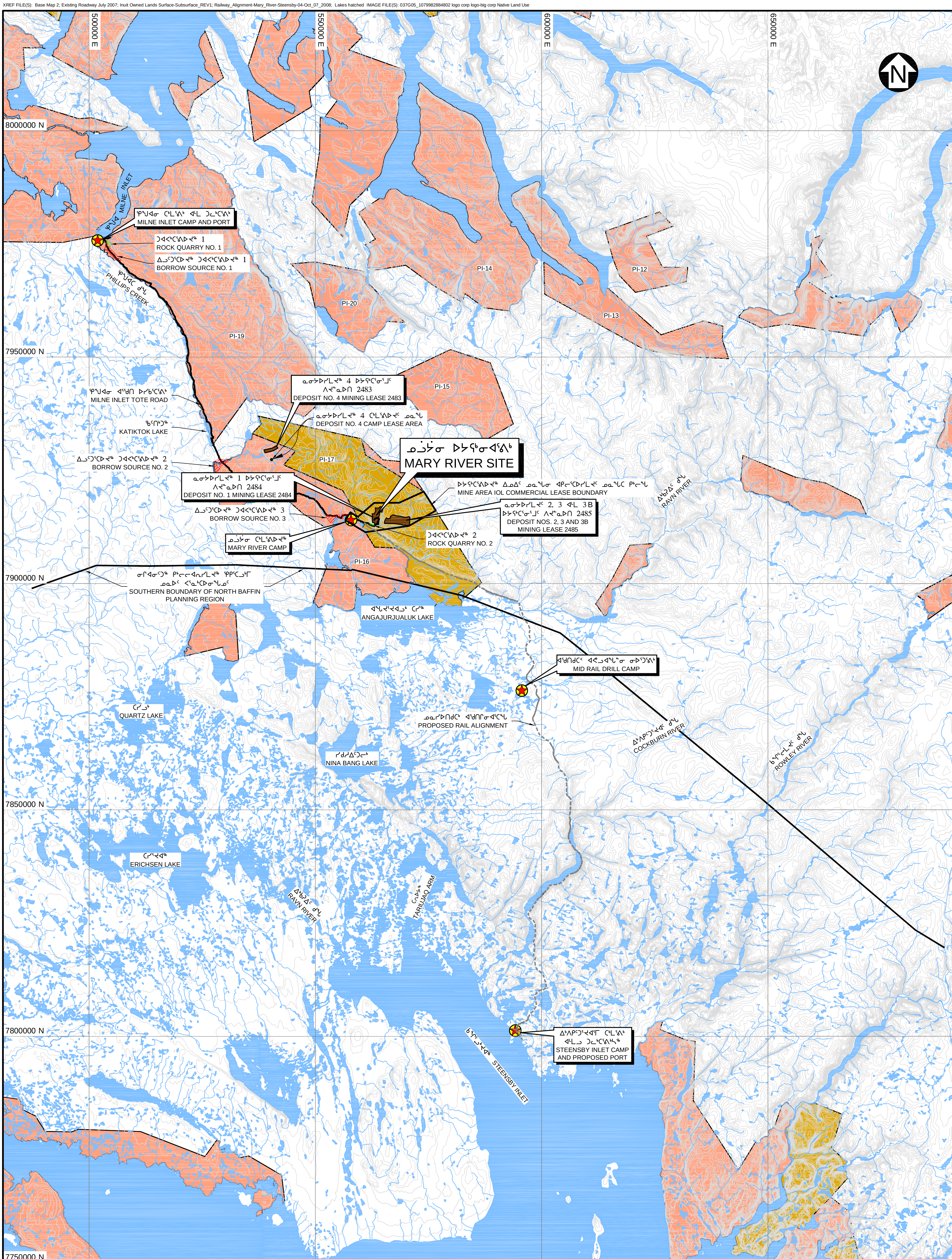
Knight Piésold CONSULTING

P/A NO.	REF.	REV.
NB102-00181/15	1	0

FIGURE 1.1

NORTH BAY ON. SAVED: I:\102-00181-15\Assignment\Acad\Figs\A09 , 3/25/2009 1:12:51 PM PRINTED: 3/25/2009 1:13:25 PM , A_Landscape, mdemers

XREF FILE(S): Base Map 2; Existing Roadway July 2007; Inuit Owned Lands Surface-Subsurface_REV1; Railway_Alignment-Mary_River-Steensby-04-Oct_07_2008; Lakes hatched IMAGE FILE(S): 037G05_1079982884802 logo corp logo-big corp Native Land Use



LEGEND:

- WATER
- INUIT OWNED LAND - SURFACE ONLY EXCLUDING MINERALS
- INUIT OWNED LAND - SURFACE AND SUBSURFACE INCLUDING MINERALS
- MINERAL LEASE BOUNDARY
- CROWN LAND
- EXISTING BORROW AREA (IOL COMMERCIAL LEASE)
- EXISTING ROCK QUARRY (IOL COMMERCIAL LEASE)
- RIVER/STREAM/DRAINAGE
- MILNE INLET TOTE ROAD
- PROPOSED RAIL ALIGNMENT
- CONTOUR

1.
2. UTM (NAD83) ZONE 17
3.
4. CANARAIL CONSULTANTS INC

NOTE(S):

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA, DEPARTMENT OF NATURAL RESOURCES (2004). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL VARIES.
4. PROPOSED RAIL ALIGNMENT PROVIDED BY CANARAIL CONSULTANTS INC.

SCALE 10 5 0 10 20 30 40 km

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

LOCATION OF PROJECT ACTIVITIES

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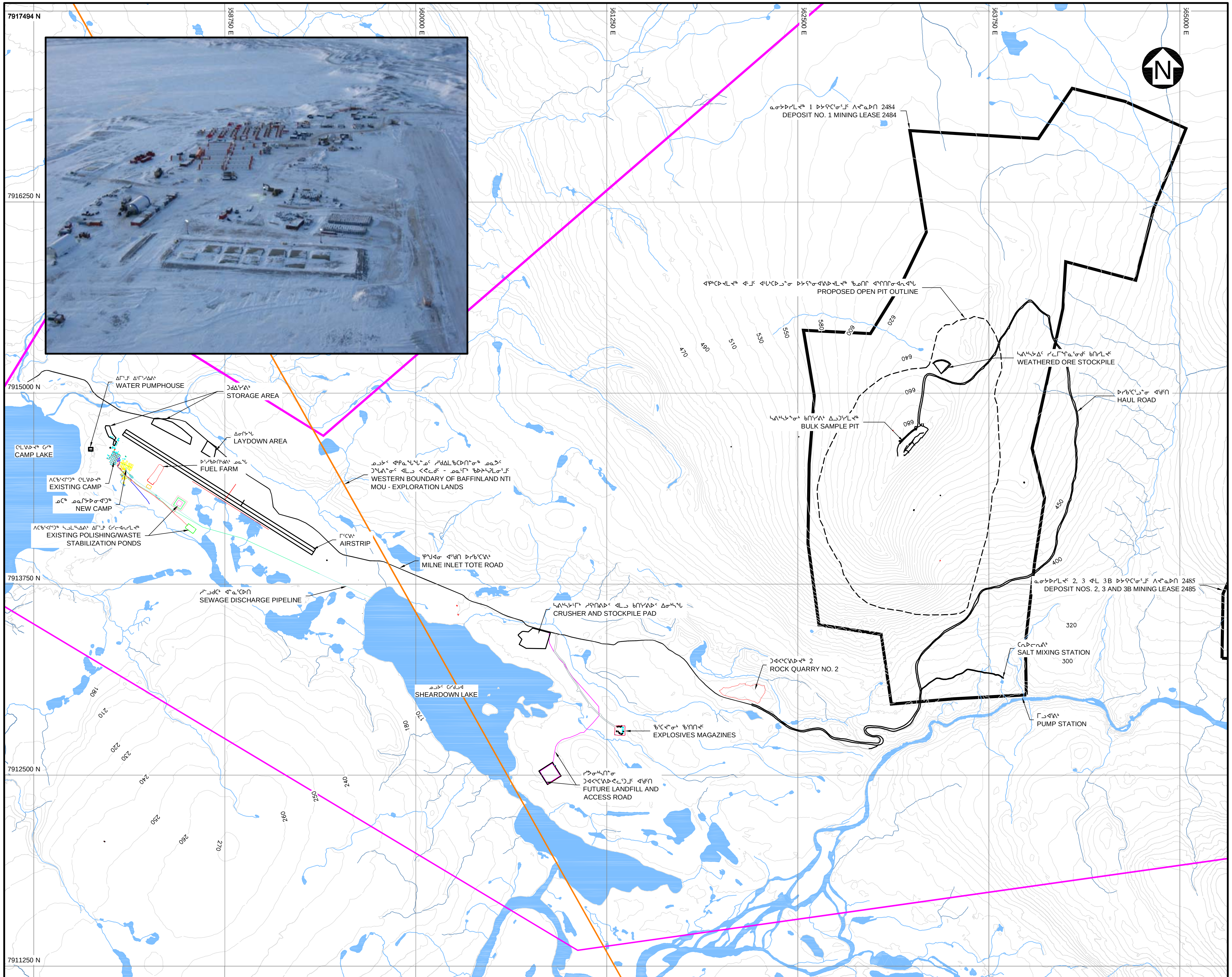
P/A NO.	REF.	REV.
NB102-00181/15	1	0
FIGURE	3.1	

NORTH BAY ON. SAVED: I:\102-00181-15\Assignment\Acad\Figs\853 , 3/25/2009 1:17:21 PM PRINTED: 3/25/2009 1:18:14 PM, B_Portrait, mdemers



LEGEND:

- WATER
- RIVER/STREAM/DRAINAGE
- BAFFINLAND'S COMMERCIAL LEASE ON INUIT OWNED LAND
- MINING LEASE BOUNDARY
- WESTERN BOUNDARY OF BAFFINLAND NTI MOU - EXPLORATION LANDS

NOTE(S):

1. COORDINATE GRID IS UTM (NAD83) ZONE 17 AND IS IN METRES.
2. CONTOUR INTERVAL IS 10 METRES.
3. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
4. MINE SITE INFORMATION PROVIDED BY GENIVAR DECEMBER 9, 2008.

SCALE 250 125 0 250 500 750 1000 1250 m

Baffinland Iron Mines Corporation

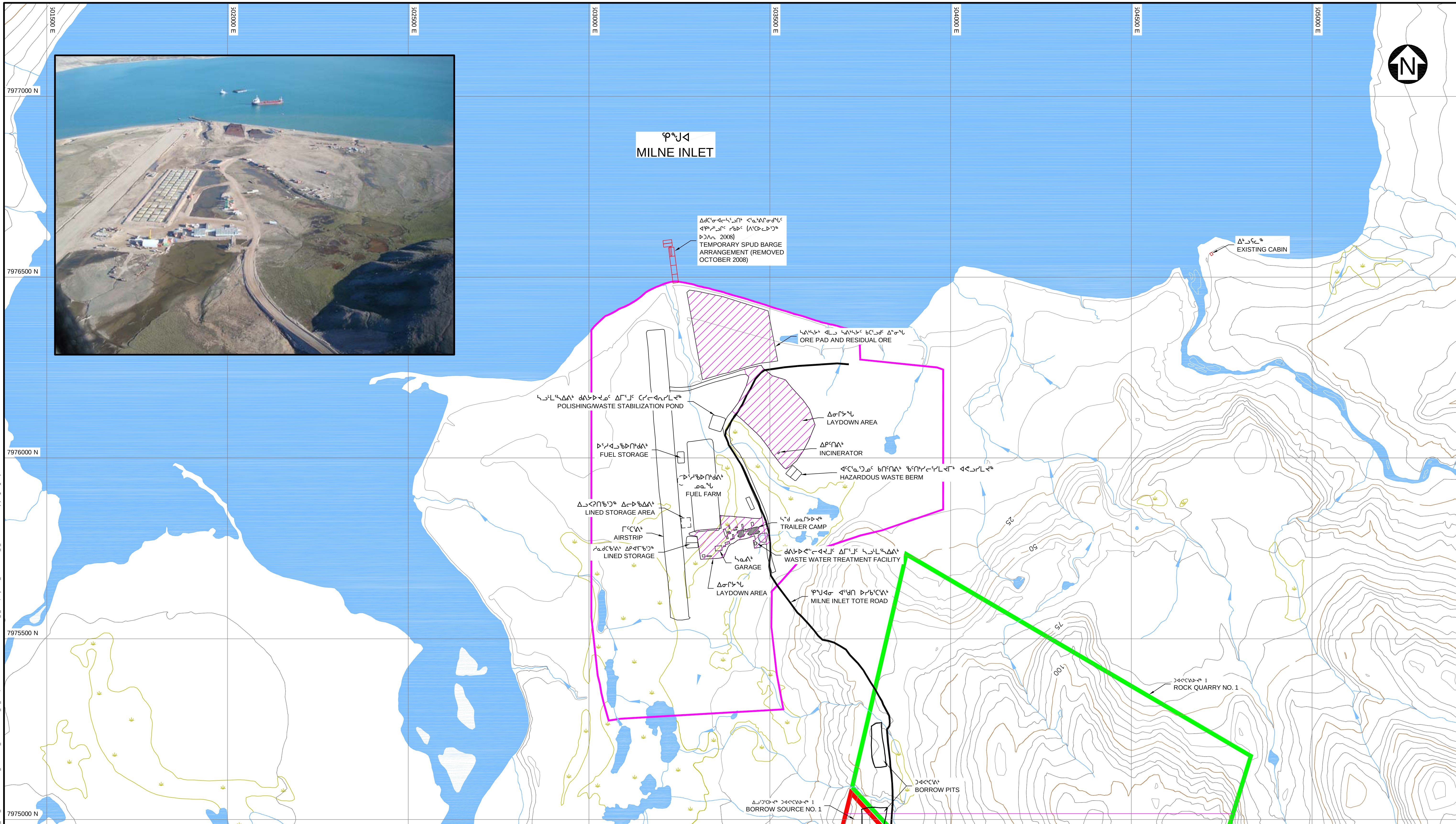
MARY RIVER PROJECT

EXISTING SITE LAYOUT AT MARY RIVER

Knight Piésold CONSULTING

P/A NO.	REF.	REV.
NB102-00181/15	1	0

FIGURE: 3.2



ᑐᑭᒧᐊᒃᓯᒋᑦ
LEGEND:

- ᐃᒥᖅ WATER
- ᓴᕿᐅᓂᖓ ᓄᓇ WETLAND
- ᐃᓂᒋᔭᖓ LAYDOWN AREA
- ᓄᓇᐅᑦ ᖃᖓᓂ ᐱᕐᓇᐅᑎᒋᔭᐅᔪᑦ (ᐃᓄᐃᑦ ᓄᓇᖓᓂ ᑲᓇᔭᖅᓴᐅᑕᐅᔪᑦ) BAFFINLAND'S COMMERCIAL LEASE ON INUIT OWNED LAND
- ᑰᒃᑐᖅ/ᑯᓪᓚᒃᑐᖅ/ᑯᕕᐊᐅᔪᖅ RIVER/STREAM/DRAINAGE
- ᓇᒧ ᑰᐸᓪᓚᒃᒪᖔᑦ ᐃᒪᐅᓂᖓᓂᖔᕐᑐᖅ DIRECTION OF SURFACE WATER RUNOFF
- ᕿᖑᐊᓂ ᐊᖅᑯᑎ ᐅᓯᒃᑖᕐᕕᒃ MILNE INLET TOTE ROAD
- ᐊᖅᑯᑎ ROAD
- ᑐᐊᒃᑖᕐᕕᐅᔪᖅ (ᐃᓄᐃᑦ ᓄᓇᖁᑎᖓᓂ ᑲᓇᔭᖅᓴᐅᑕᐅᔪᖅ) EXISTING ROCK QUARRY (IOL COMMERCIAL LEASE)
- ᑐᐊᒃᑖᕐᕕᐅᔪᖅ (ᐃᓄᐃᑦ ᓄᓇᖁᑎᖓᓂ ᑲᓇᔭᖅᓴᐅᑕᐅᔪᖅ) EXISTING BORROW AREA (IOL COMMERCIAL LEASE)

ᖃᐅᔨᒪᔭᖅᓴᐃᑦ

1. ᓄᓇᖑᐊᓕᐅᕐᑦ EAGLE MAPPING (2005)
2. ᓄᓇᖑᐊᑉ ᑎᑎᕋᓕᓂᖓ ᒪᓕᒃᑐᖅ UTM (NAD83) ZONE 17
3. ᑎᑎᕋᒪᔪᑦ ᒥᑕ: ᐊᖁᓐᓂᖏᑦ ᐅᖓᓯᒃᑎᒋᒃᑐᑦ 5 ᒥᑕ

NOTE(S):

1. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 5 METRES.

ᐊᖏᓂᖓ SCALE 100 50 0 100 200 300 400 500 ᒥᑕ m

Baffinland Iron Mines Corporation

ᓄᓘᔾᔭᓂ ᐅᔭᕋᕐᔭᐅᑦᑐᑦ MARY RIVER PROJECT

ᒪᓐᓇ ᖃᓄᐃᓕᖓᓂᖓ ᒥᑎᒪᑕᐅᑉ ᕿᖑᐊᓂ
EXISTING SITE LAYOUT AT MILNE INLET

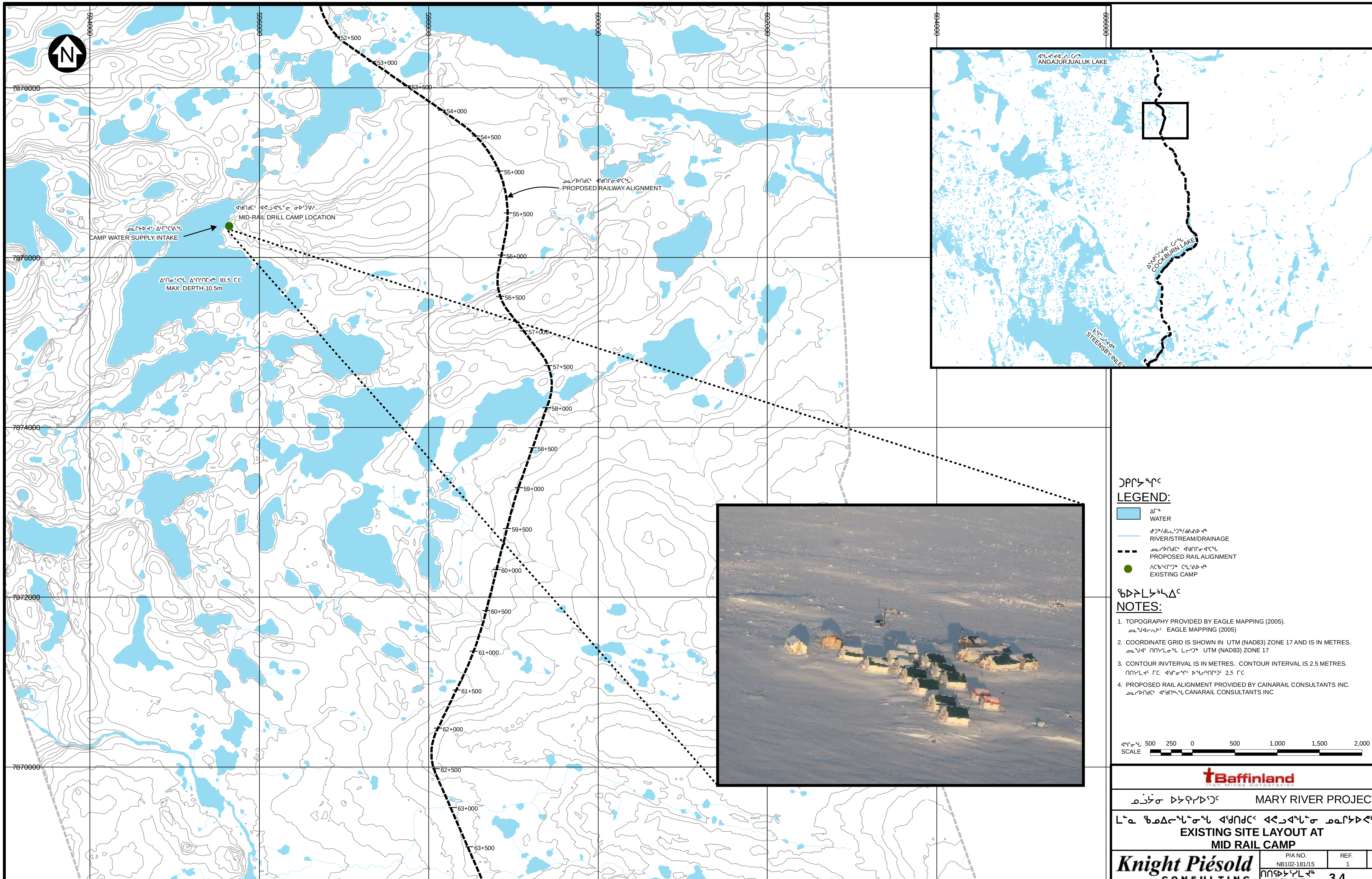
Knight Piésold CONSULTING

P/A NO.	REF.	REV.
NB102-00181/15	1	0

ᑎᑎᕐᐅᔭᕐᓯᒪᔪᖅ FIGURE 3.3

XREF FILE(S): Contours-5m_Interval-01-Sep_18_2008; Milne_Inlet_Tote_Road-As-Built-From_Genivar-KP_Modified-02-Oct_06_2008; Infrastructure-Milne-Detailed-01-Oct_7_2008; Laydown_Areas-01-Oct_7_2008 IMAGE FILE(S): logo-big.corp MILNE - OCT 08

NORTH BAY ON. SAVED: I:\102-00181-15\Assignment\Acad\Figs\B55 , 3/25/2009 1:30:21 PM PRINTED: 3/25/2009 1:31:44 PM, B_Landscape, mdemers



ᑐᑭᒥᔭᖅᒋᑦ
LEGEND:

- ᐃᒥᖅ WATER
- ᑯᒃᑐᖅ/ᑯᒡᓚᒃᑐᖅ/ᑯᕕᕕᐅᔪᖅ RIVER/STREAM/DRAINAGE
- ᓄᓇᓯᐅᑎᑯᑦ ᐊᖁᑎᒋᓂᐊᕐᑕᖓ PROPOSED RAIL ALIGNMENT
- ᐱᑕᖃᕐᐸᒌᕐᑐᖅ ᑕᒫᕕᐅᔪᖅ EXISTING CAMP

ᖃᐅᔨᒪᔭᒃᓴᐃᑦ
NOTES:

1. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
ᓄᓇᖑᐊᓕᐅᕆᔩᑦ EAGLE MAPPING (2005)
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
ᓄᓇᖑᐊᕐ ᑎᑎᕐᓯᒪᓂᖓ ᒪᓕᒃᑐᖅ UTM (NAD83) ZONE 17
3. CONTOUR INVTERVAL IS IN METRES. CONTOUR INTERVAL IS 2.5 METRES.
ᑎᑎᕐᓯᒪᔪᑦ ᒥᑕ: ᐊᖁᓐᓂᖅᑦ ᐅᖓᓯᒃᑎᒋᒃᑐᑦ 2.5 ᒥᑕ
4. PROPOSED RAIL ALIGNMENT PROVIDED BY CAINARAIL CONSULTANTS INC.
ᓄᓇᓯᐅᑎᑯᑦ ᐊᖅᑯᑎᒃᓴᖓ CANARAIL CONSULTANTS INC

ᐊᖏᓂᖓ SCALE 500 250 0 500 1,000 1,500 2,000 ᒥᑕ m

ᓄᓖᔮᓂ ᐅᔭᖅᓯᐅᕐᑐᑦ MARY RIVER PROJECT

ᒫᓐᓇ ᖃᓄᐃᓕᖓᓂᖓ ᐊᖁᑎᑯᑕᐸ ᐊᕙᓗᐊᖓᓂ ᓄᓇᒥᔭᐅᕙᒃᑐᖅ
EXISTING SITE LAYOUT AT MID RAIL CAMP

P/A NO.	REF.	REV
NB102-181/15	1	0

ᑎᑎᖅᐅᔭᕐᓯᒪᔪᖅ FIGURE 3.4

ᑐᑭᓯᔾᔪᑎᑦ
LEGEND:

ᐃᒥᖅ
WATER

ᑰᒃᑐᖅ/ᑯᒻᒪᒃᑐᖅ/ᑯᕕᕙᐅᔪᖅ
RIVER/STREAM/DRAINAGE

ᓴᕐᕕᓂᖓ ᓄᓇ
WETLAND

NOTE(S):

1. COORDINATE GRID IS UTM (NAD83) ZONE 17 AND IS IN METRES.
2. CONTOUR INTERVAL IS 5 METRES.
3. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
4. PROPOSED RAIL ALIGNMENT PROVIDED BY CANARAIL CONSULTANTS INC. OCTOBER 7, 2008.
5. STEENSBY INLET INFRASTRUCTURE PROVIDED BY GENIVAR. DECEMBER 9, 2008.

ᖃᐅᔨᒪᔭᕐᓴᐃᑦ

1. ᓄᓇᖑᐊᕐ ᑎᑎᕐᓯᒪᓂᖓ ᒪᓕᒃᑐᖅ UTM (NAD83) Zone 17
2. ᑎᑎᕐᓯᒪᔪᑦ ᒥᑕ: ᐊᕐᑯᓂᖏᑦ ᐅᖓᓯᒃᑎᒋᒃᑐᑦ 5 ᒥᑕ
3. ᓄᓇᖑᐊᓕᐅᕆᑦ Eagle Mapping (2005)
4. ᓄᓇᓯᐅᑎᑯᑖᒃ ᐊᕐᖁᑎᒃᓴᖓ Canarail Consultants Inc
5. ᐅᔾᔨᕐᑖᕐᕕᐅᔪᖅ ᑎᑎᕋᐅᔭᕐᓯᒪᓂᖓ Genivar

SCALE A — 100 50 0 100 200 300 400 500 m (ᒥᑕ)

Baffinland Iron Mines Corporation

ᓄᓘᔾᔭᓂ ᐅᔾᔨᕐᓱᐅᕐᑐᑦ MARY RIVER PROJECT

ᒫᓐᓇ ᐃᒃᐱᒋᑦᑐᕐᔪᐊᖅ ᖃᓄᖅ ᐊᕐᕿᒃᓯᒪᓂᖓ
EXISTING SITE LAYOUT AT STEENSBY INLET

Knight Piésold CONSULTING

P/A NO.	REF.	REV.
NB102-00181/15	1	0

ᑎᑎᕋᐅᔭᕐᓯᒪᔪᖅ FIGURE: **3.5**

Knight Piésold
CONSULTING

APPENDIX A

RECLAIM MODEL RESULTS

(Pages A-1 to A-20)

SUMMARY OF COSTS

Capital Costs

COMPONENT TYPE	COMPONENT NAME	TOTAL COST	Land Liability	Water Liability
OPEN PIT	Bulk Sample Pit	$78,000.00	$78,000	$0
~~UNDERGROUND MINE~~	0	NO UNDERGROUND MINE		
~~TAILINGS~~	0	NO TAILINGS FACILITY		
ROCK PILE	0	$31,994.00	$31,994	$0
BUILDINGS AND EQUIPMENT	0	$1,521,716.80	$1,395,794	$125,923
CHEMICALS AND SOIL MANAGEMENT	0	$737,567.00	$698,191	$39,376
WATER MANAGEMENT	0	$1,507.50	$0	$1,508
POST-CLOSURE SITE MAINTENANCE		$171,725.38	$80,139	$91,587
SUBTOTAL		**$2,542,511**	**$2,284,118**	**$258,393**
		Percentages		
MOBILIZATION/DEMOBILIZATION	0	$4,812,527		
MONITORING AND MAINTENANCE	0	$524,000		
SALVAGE		$1,459,203		

PROJECT MANAGEMENT - Project Management costs have already been included in the Monitoring and Maintenance costs

ENGINEERING	3 %	$76,275
CONTINGENCY	10 %	$254,251
TOTAL		**$6,750,361**

Truck waste from Milne Inlet Camp to Mary River Camp for landfilling. Backhaul from Milne to

Mary River already accounted

1 **Open Pit Name:** ***Bulk Sample Pit*** **Pit #** ***1***

	ACTIVITY/MATERIAL	Units	Quantity	Cost Code	Unit Cost	Cost	% Land	Land Cost	Water Cost
A	OBJECTIVE: CONTROL ACCESS								
.	• Controlled access is not required.								
B	OBJECTIVE: STABILIZE SLOPES								
.	• Slopes were stabilized in 2008 (see Mr. Martin van Rooy - Mine Inspector with the Nunavut WSCC Report dated September 22 and 23, 2008).								
C	OBJECTIVE: COVER/CONTOUR SLOPES								
.	• Weathered shallow bulk sample pit will not require capping. The results from the 2008 environmental geochemical testing program and short term leach tests have demonstrated that there is virtually no potential for enhanced release of acidity or metals in response to oxidative weathering of the material sampled. Any seepage observed below the weathered ore stockpile during follow-up monitoring will be sampled and tested for general chemistry and metals during the annual post-closure site visits.								
.	OBJECTIVE: SPILLWAY								
.	• Spillway is not required at this site as pit is self-draining. The bulk sample pit was confirmed by land survey at its completion in 2008 to be free draining								
E	OBJECTIVE: FLOOD PIT								
.	• Shallow pit is self draining and thus will not be flooded.								
F	RECLAIM QUARRIES								
.	Recontour borrow areas and quarries as required using dozer	m3	40000	DRh	1.95	$78,000	100%	$78,000	$0
H	OTHER ITEMS								
.									
	Subtotal					$78,000	100%	$78,000	$0
						Total Pit	Percent Land	Total Land	Total Water

Truck waste from Milne Inlet Camp to Mary River Camp for landfilling. Backhaul from Milne to Mary River already accounted for.

1 **Underground Mine Name ________ UG Mine # *1***

NO U/G MINE

	ACTIVITY/MATERIAL	Units	Quantity	Cost Code	Unit Cost	Cost	% Land	Land Cost	Water Cost
A	OBJECTIVE: CONTROL ACCESS								
	Fence	m		#N/A	0	$0		$0	$0
.	Signs	each		#N/A	0	$0		$0	$0
.	Ditch, mat'l A	m3		#N/A	0	$0		$0	$0
.	, mat'l B	m3		#N/A	0	$0		$0	$0
.	Berm	m3		#N/A	0	$0		$0	$0
.	Block adits	m3		#N/A	0	$0		$0	$0
.	Cap shaft	m3		#N/A	0	$0		[illegible]	$0
.	Cap raise #1	m3		#N/A	0	[illegible]		$0	$0
.	Cap raise #2	m3		#N/A	0	[illegible]		$0	$0
.	Backfill adits	m3		#N/A	0	[illegible]		[illegible]	$0
.	Backfill shaft	m3		#N/A	0	[illegible]		$0	$0
.	Backfill raise #1	m3		#N/A	0	[illegible]		$0	$0
.	Backfill raise #2	[illegible]		[illegible]	0	$0		$0	$0
.	Backfill open stopes	m3		#N/A	0	$0		$0	$0
.	Other			#N/A	0	$0		$0	$0
B	OBJECTIVE: STABILIZE GROUND SURFACE								
.	Backfill mine			#N/A	0	$0		$0	$0
.	Collapse crown pillar	m3		#N/A	0	$0		$0	$0
.	Contour, mat'l [illegible]	m3		#N/A	0	$0		$0	$0
.	, mat'l [illegible]	m3		#N/A	0	$0		$0	$0
.	Maintain de[illegible] "[illegible]ITO[illegible]G/MAINTENANCE" costing component)			#N/A	0	$0		$0	$0
.	Other			#N/A	0	$0		$0	$0
C	OBJECTIVE[illegible]LOO[illegible]INE								
.	Plug adits	m3		#N/A	0	$0		$0	$0
.	Plug drillholes to surface	each		#N/A	0	$0		$0	$0
.	Grouting	m3		#N/A	0	$0		$0	$0
.	LIme addition, kg/m3 of water	tonne		#N/A	0	$0		$0	$0
.	Truck waste from Milne Inlet Camp to Mary River Camp for landfilling	tonne		#N/A	0	$0		$0	$0
D	OBJECTIVE: HAZARDOUS MATERIALS								
.	remove hazardous materials	each		#N/A	0			$0	$0
.	remove/decontam. equipment	each		#N/A	0	$0		$0	$0
.	Other			#N/A	0	$0		$0	$0
E	SPECIALIZED ITEMS								
.				#N/A	0	$0		$0	$0
	Subtotal					$0	#DIV/0!	$0	$0
						Total U/G	Percent Land	Total Land	Total Water

1 **Tailings Impoundment Name:** ______ **Impoundment #** ***1***

NO TAILINGS FACILITY

	ACTIVITY/MATERIAL	Units	Quantity	Cost Code	Unit Cost	Cost	% Land	Land Cost	Water Cost
A	OBJECTIVE: CONTROL ACCESS								
	Fence	m		#N/A	0	$0		$0	$0
.	Signs	each		#N/A	0	$0		$0	$0
.	Ditch, mat'l A	m3		#N/A	0	$0		$0	$0
.	, mat'l B	m3		#N/A	0	$0		$0	$0
.	Berm	m3		#N/A	0	$0		$0	$0
.	Block roads	m3		#N/A	0	$0		$0	$0
.	Other			#N/A	0	$0		$0	$0
B	OBJECTIVE: STABILIZE EMBANKMENT								
.	Toe buttress, drain mat'l	m3		#N/A	0	$0		$0	$0
.	, fill mat'l A	m3		#N/A	0	$0		$0	$0
.	, fill mat'l B	m3		#N/A	0	$0		$0	$0
.	Rip rap	m3		#N/A	0	$0		$0	$0
.	Vegetate	ha		#N/A	0	$0		[illegible]	$0
.	Raise crest	m3		#N/A	0	$0		[illegible]	$0
.	Flatten slopes	m3		#N/A	0	[illegible]		[illegible]	$0
.	Other			#N/A	[illegible]	[illegible]		[illegible]	$0
C	OBJECTIVE: COVER TAILINGS								
.	Soil cover	m3		[illegible]	0	[illegible]		$0	$0
.	Rip rap	[illegible]		[illegible]	0	[illegible]		$0	$0
.	Vegetate			[illegible]		$0		$0	$0
.	Other			[illegible]	[illegible]	$0		$0	$0
D	OBJECTIVE: FLOOD TAILINGS								
.	Ditch, mat'l A	[illegible]		#N/A	0	$0		$0	$0
.	, mat'l B	[illegible]		#N/A	0	$0		$0	$0
.	Raise crest	m3		#N/A	0	$0		$0	$0
.	Other			#N/A	0	$0		$0	$0
E	OBJECTIV[illegible] SU[illegible]ERNAT[illegible]								
.	Truck wast[illegible] M[illegible]et Camp to Mary River Camp for landfilling	m3		#N/A	0	$0		$0	$0
.	Supply rea[illegible]	tonne		#N/A	0	$0		$0	$0
.	Operate tre[illegible]ment plant	m3		#N/A	0			$0	
.	Other			#N/A	0	$0		$0	$0
F	OBJECTIVE: UPGRADE SPILLWAY								
.	Excavate channel, mat'l A	m3		#N/A	0	$0		$0	$0
.	, mat'l B	m3		#N/A	0	$0		$0	$0
.	Concrete	m3		#N/A	0	$0		$0	$0
.	Rip rap	m3		#N/A	0	$0		$0	$0
.	Other			#N/A	0	$0		$0	$0
G	OBJECTIVE: STABILIZE DECANT SYSTEM								
.	Remove	m3		#N/A	0	$0		$0	$0
.	Plug/backfill	m3		#N/A	0	$0		$0	$0
.	Other			#N/A	0	$0		$0	$0
H	OBJECTIVE: REMOVE TAILINGS DISCHARGE								
.	Cyclones	m3		#N/A	0	$0		$0	$0
.	Pipe	m3		#N/A	0	$0		$0	$0
.	Other			#N/A	0	$0		$0	$0
I	SPECIALIZED ITEMS								
.				#N/A	0	$0			$0
	Subtotal					$0	#DIV/0!	$0	$0
						Total Tailings	Percent Land	Total Land	Total Water

1 **Rock Pile Name:** ________ **Rock Pile #:** ***1***

	ACTIVITY/MATERIAL	Units	Quantity	Cost Code	Unit Cost	Cost	% Land	Land Cost	Water Cost
A	OBJECTIVE: STABILIZE SLOPES								
	• The surficial weathered ore stockpiled at top of Deposit No. 1 (approximately 28,000 t) and the weathered ore roadbed between the stockpile and the pit has been progressively reclaimed and is expected to be physically stable in the long term.								
	• The approximately 6,000 t of representative (i.e. ore grade) material left in the bulk sample pit was contoured and left in a stable and free draining state at the end of the 2008 field season.								
	• The non-representative ore (approx. 25,000 t) stockpiled at the Mary River crusher site will be re-graded as required to ensure the area is physically stable.								
	• The stockpile of representative ore (approx. 6,000t) at Milne Inlet will be re-graded as required over the non-representative ore pad (approx. 24,000 t) to ensure the area is physically stable and covered in 0.3 m of locally available borrow material for aesthetics purposes and to prevent dusting of the beach head.								
.	Bulldoze/trim non-representative ore stockpiled at Mary River crusher site	m3	2000	DSl	0.78	$1,560	100%	$1,560	$0
.	Bulldoze/trim stockpile of representative ore and the non-representative ore pad at Milne Inlet	m3	2300	DSl	0.78	$1,794	100%	$1,794	$0
B	OBJECTIVE: COVER DUMP								
.	• It has been demonstrated from the 2008 environmental geochemical testing program that there is virtually no potential for enhanced release of acidity or metals in response to oxidative weathering of the material in the i) weathered ore stockpiled on the Deposit No. 1, ii) non-representative ore stockpiled at the Mary River crusher site and the stockpile pad at Milne Inlet, and iii) representative ore left exposed in the bench walls of the pit and stockpiled at Milne Inlet.								
	• The stockpile of representative ore (approx. 6,000t) at Milne Inlet will be re-graded as required over the non-representative ore pad (approx. 24,000 t) to ensure the area is physically stable and covered in 0.3 m of locally available borrow material for aesthetics purposes and to prevent dusting of the beach head.								
	Excavate, load, haul and place 0.3m borrow cover over representative and non-representative ore at Milne Inlet	m3	3200	SB4h	8.95	$28,640	100%	$28,640	$0
C	OBJECTIVE: RELOCATE DUMPS								
.	• Not applicaple. Stockpiles will not be relocated. It has been demonstrated from the 2008 environmental geochemical testing program that there is virtually no potential for enhanced release of acidity or metals in response to oxidative weathering of the material in the i) weathered ore stockpiled on the Deposit No. 1, ii) non-representative ore stockpiled at the Mary River crusher site and the stockpile pad at Milne Inlet, and iii) representative ore left exposed in the bench walls of the pit and stockpiled at Milne Inlet.								
D	OBJECTIVE: COLLECT AND TREAT								
.	• Not applicable. It has been demonstrated from the 2008 environmental geochemical testing program that there is virtually no potential for enhanced release of acidity or metals in response to oxidative weathering of the material in the i) weathered ore stockpiled on the Deposit No. 1, ii) non-representative ore stockpiled at the Mary River crusher site and the stockpile pad at Milne Inlet, and iii) representative ore left exposed in the bench walls of the pit and stockpiled at Milne Inlet. Any seepage observed below the weathered ore stockpile during follow-up monitoring will be sampled and tested for general chemistry and metals during the annual post-closure site visits.								
E	OBJECTIVE: DEVELOP WETLAND								
.	• Not applicable.								
F	SPECIALIZED ITEMS								
.	• Not applicable.								

	Total for Rock Pile	Percent Land	Total Land	Total Water
Subtotal	$31,994	100.0%	$31,994	$0

Truck waste from Milne Inlet Camp to Mary River Camp for landfilling. Backhaul from Milne to Mary River already accounted for.

Building / Equip Name: _______ Bldg / Equip #: 1

	ACTIVITY/MATERIAL	Units	Quantity	Cost Code	Unit Cost	Cost	% Land	Land Cost	Water Cost
A	OBJECTIVE: DISPOSE MOBILE EQUIPMENT (Decontaminate and ship)								
.	Demobilize mobile equipment to Milne Inlet - 100km by road (cost is included in Activity G)								
.	Demobilize mobile equipment at Rail Camp to Mary River - by helicopter	$/hr	3	MHEA	1500	$4,500	100%	$4,500	$0
B	OBJECTIVE: DISPOSE STATIONARY EQUIPMENT (Decontaminate and ship)								
.	Demobilize stationary equipment to Milne Inlet - 100km by road - generators, sewage treatment plant, etc. (cost is included in Activity G)								
.	Demobilize stationary equipment at Rail Camp to Mary River camp by helicpoter - generators, incinerator, etc.	$/hr	6	MHEA	1500	$9,000	100%	$9,000	$0
C	OBJECTIVE: DISPOSE ORE CONCENTRATION EQUIPMENT (Decontaminate and ship)								
.	• There will be no ore concentration equipment at site								
D	OBJECTIVE: DISPOSE WATER TREATMENT EQUIPMENT (Decontaminate and ship)								
.	Remove plumbing	m	1300	PPSI	0.5	$650	100%	$650	$0
E	OBJECTIVE: DECONTAMINATE BUILDINGS & TANKS (and transport to Milne Inlet)								
.	Camp (Mary River Camp, Milne Inlet, Mid-way, Rail Camp, Steensby Camp and temp. drill camps)	person-days	250	#N/A	600	$150,000	100%	$150,000	$0
.	Drain, fold, and containerize Mary River and Milne Inlet bulk fuel bladders	L.S.	1	#N/A	75,000	$75,000	100%	$75,000	$0
.	Remove and package geomembrane liners	m3	6000	SB2h	5.97	$35,820	100%	$35,820	$0
.	Decontaminate buried concrete sewage system tank in A-Lot	person-days	4	#N/A	600	$2,400	100%	$2,400	$0
F	OBJECTIVE: MOTHBALL BUILDINGS								
.	• No buildings (mothball) will remain								
.	Airstrips will remain (inspect and repair any erosion) and remove temporary airstrip lighting at Mary River	m3	6000	DSI	0.78	$4,680	100%	$4,680	$0
G	OBJECTIVE: REMOVE BUILDINGS (to Milne Inlet)								
.	Mary River camp	m2	10000	BRW1I	21.5	$215,000	100%	$215,000	$0
.	Truck approx. 160 containers to Milne Inlet	$/km/160 pcs	32000	MHERI	2.81	$89,920	100%	$89,920	$0
.	Milne Inlet camp	m2	5000	BRW1I	21.5	$107,500	100%	$107,500	$0
.	Truck waste from Milne Inlet Camp to Mary River Camp for landfilling. Backhaul from Milne to Mary River already accounted for.	$/km/50 pcs	0	MHERI	2.81	$0	100%	$0	$0
.	Refuge stations	m2	200	BRW1I	21.5	$4,300	100%	$4,300	$0
.	Decomission remote sites and mineral exploration areas (helicopter support included in mobilization costs)	m2	2750	BRS1h	52.8	$145,200	100%	$145,200	$0
.	Remove boneyard waste to landfill	m3	500	SB1h	4.85	$2,425	100%	$2,425	$0
.	Rail Camp	m2	1000	BRW1I	21.5	$21,500	100%	$21,500	$0
.	Transport material from Rail Camp to Mary River	$/hr	51	MHEA	1500	$76,500	100%	$76,500	$0
.	Steensby Camp	m2	1500	BRW1I	21.5	$32,250	100%	$32,250	$0
H	OBJECTIVE: BREAK BASEMENT SLABS								
.	• No concrete slabs are present. The camp structures are founded on wooden floor systems.								
I	OBJECTIVE: REMOVE BURIED TANKS								
.	Demolish buried concrete sewage system tank in A-Lot	m3	500	RB1I	9.35	$4,675	100%	$4,675	$0
.	Remove demolished concrete sewage system tank in A-Lot to landf	m3	500	SB1h	4.85	$2,425	100%	$2,425	$0

Building / Equip Name: ______ Bldg / Equip #: 1

	ACTIVITY/MATERIAL	Units	Quantity	Cost Code	Unit Cost	Cost	% Land	Land Cost	Water Cost
J	OBJECTIVE: LANDFILL FOR DEMOLITION WASTE								
.	Excavate, load, haul and place borrow material to construct landfill - including access road, berms, operations	m3	21,000	SB3h	5.31	$111,510	100%	$111,510	$0
.	Placement of waste materials into landfill	m3	15400	SB3h	5.31	$81,774	100%	$81,774	$0
.	Apply cover over landfill	m3	18000	SB3h	5.31	$95,580	100%	$95,580	$0
K	OBJECTIVE: GRADE AND CONTOUR								
.	Recontour camp site areas as required (using dozer)	m3	12500	DSh	3.11	$38,875	100%	$38,875	$0
L	OBJECTIVE: RECLAIM ROADS								
.	• There was an existing tote road and will remain at abandonment.								
.	Remove 10 navigatable water crossings - 30 days x crew of 6	person-days	180	#N/A	600	$108,000	0%	$0	$108,000
.	Excavate, load and haul to landfill/Milne Inlet	m3	1702	SB1l	3.2	$5,446	0%	$0	$5,446
.	Additional cost to haul sea containters, culverts, etc 60km to landfill/Milne Inlet	$/load/km	4440	MHERl	2.81	$12,476	0%	$0	$12,476
.	Grade and contour road surfaces using dozer	m3	40000	DSl	0.78	$31,200	100%	$31,200	$0
K	SPECIALIZED ITEMS								
.	Borrow material royalty fees from reclamation activities net of borrow material removed from existing bermed facilities	t	21244	#N/A	2.5	$53,110	100%	$53,110	$0

	Total Buildings	Percent Land	Total Land	Total Water
Subtotal	$1,521,717	91.7%	$1,395,794	$125,923

Chemicals and Soil Contamination: 1

	ACTIVITY/MATERIAL	Units	Quantity	Cost Code	Unit Cost	Cost	% Land	Land Cost	Water Cost
	Note: The procedures, equipment and packaging for clean up and removal of chemicals or contaminated soils are highly dependent on the nature of the chemicals and their existing state of containment. Government guidelines should be consulted on an individual chemical basis. Any estimate made here should be considered very rough unless specific evaluations have been conducted.								
.									
A	LABORATORY CHEMICALS								
.	Miscellaneous	pallet	2	LCRh	2320	$4,640	100%	$4,640	$0
B	PCB, hauling								
.	• No PCB's								
C	FUEL								
.	Fuel - Return excess fuel at Mary River to Milne (approx 300,000L) Road is 100km long.	$/km/10 loads	2000	MHERl	2.81	$5,620	100%	$5,620	$0
.	Transfer fuel from Milne Inlet fuel farm to tanker	L.S.	1	#N/A	18,000	$18,000	100%	$18,000	$0
D	WASTE OIL								
.	Prepare hazardous materials for shipping	L.S.	1	#N/A	67,000	$67,000	100%	$67,000	$0
.	Oils/lubricants - transported to Milne Inlet. Progressive reclamation in 2008 has reduced volume to dispose of at abandonment.	litre	592,000	ORl	0.35	$207,200	100%	$207,200	$0
E	PROCESS OR TREATMENT CHEMICALS								
.	• None								
F	EXPLOSIVES								
.	Transport explosives magazines to Milne Inlet	$/km/3 pcs	600	MHERH	8.42	$5,052	100%	$5,052	$0
G	CONTAMINATED SOILS								
.	Operate Oil water separation/activated carbon at Milne Inlets bermed/lined landfarm each year for 3 years	L.S.	1	#N/A	1E+05	$115,500	100%	$115,500	$0
.	Till hydrocarbon impacted soil each year for 3 years.	m3	3750	CSRl	38.5	$144,375	100%	$144,375	$0
.	Remove GM fuel lines and package for sealift backhaul (cost is included in Activity E of Bldgs & Equip worksheet)								
.	Recontour surface (included in Activity K of Bldgs & Equip worksheet)								
.	Freight community sealift backhaul in 2013 to remove liner, tilling equipment (i.e. loader with tiller drag), and trailer	L.S.	1	#N/A	30000	$30,000		$0	$30,000
.	MOB workers	person	24	MM<h	990	$23,760	90%	$21,384	$2,376
.	Operate 2-person trailer for 2 months each year for 3 years	month	6	ACCMl	1320	$7,920	100%	$7,920	$0
.	Third Party Consultant to verify site cleanup completion	L.S.	1	#N/A	7000	$7,000		$0	$7,000
	Truck waste from Milne Inlet Camp to Mary River Camp for landfilling. Backhaul from Milne to Mary River already accounted for.								
H	Haz. Mat. testing & assessment								
.	Technician and analyses	L.S.	1	#N/A	50000	$50,000	100%	$50,000	$0
.	OTHER								
.	Haz. Mat. waste disposal fee	L.S.	1	#N/A	51500	$51,500	100%	$51,500	$0
	Subtotal					$737,567 Total Chemical	94.7% Percent Land	$698,191 Total Land	$39,376 Total Water

1 **Water Management Project:** ________ **Project # *1***

	ACTIVITY/MATERIAL	Units	Quantity	Cost Code	Unit Cost	Cost	% Land	Land Cost	Water Cost
A	OBJECTIVE: STABILIZE EMBANKMENT								
.	• No embankment								
B	OBJECTIVE: UPGRADE SPILLWAY								
.	• No spillway								
C	OBJECTIVE: STABILIZE SEDIMENT CONTAINMENT PONDS								
.	Sludge removal	m3	150	SB1h	4.85	$728	0%	$0	$728
.	Regrade two sediment containment ponds with dozer	m3	1000	DSI	0.78	$780	0%	$0	$780
D	OBJECTIVE: BREACH EMBANKMENT								
.	• No embankment								
E	OBJECTIVE: STABILIZE DITCHES								
.	• No ditches								
F	OBJECTIVE: BREACH DITCHES								
.	• No ditches								
G	OBJECTIVE: REMOVE PIPELINES								
.	• Remove pipes - Included in Activity E of Bldgs & Equip worksheet								
H	OBJECTIVE: REMOVE STORAGE TANKS								
.	• Remove tanks & plumbing - Included in Activity D of Bldgs & Equip worksheet								
I	OBJECTIVE: COLLECT DRAINAGE FOR TREATMENT								
.	• No ongoing treatment required								
J	Truck waste from Milne Inlet Camp to Mary River Camp for landfilling. Backhaul from Milne to Mary River already accounted for.								
.	• No treatment plant necessary								
	Subtotal					$1,508	0.0%	$0	$1,508
						Total Water	Percent Land	Total Land	Total Water

1 **Mobilization Name:** ________ **Mob #** ***1***

	ACTIVITY/MATERIAL	Units	Quantity	Cost Code	Unit Cost	Cost	% Land	Land Cost	Water Cost
A	MOBILIZE HEAVY EQUIPMENT								
	Equipment to regional centre								
.	Community sealift for materials from Milne Inlet and Steensby Inlet to Montreal requiring off-site salvage or disposal.	L.S.	1	#N/A	2E+06	$1,550,000	100%	$1,550,000	$0
.	Bulk fuel backhaul sealift from Milne	L.S.	1	#N/A	260000	$260,000	100%	$260,000	$0
.	Land freight from regional centre	L.S.	1	#N/A	600000	$600,000	100%	$600,000	$0
	Equipment, regional centre to site								
.	• Sufficient equipment on site from bulk sample program for reclamation activities - NUNA/QC/BIM								
.	Standby costs for equipment (during decommissioning and shipment)	L.S.	1	#N/A	800000	$800,000	100%	$800,000	$0
B	MOBILIZE CAMP								
.	• Use existing camp for reclamation								
C	MOBILIZE WORKERS								
.	MOB workers (212 flights accounting for rotations)	person	212	MM>h	1320	$279,840	90%	$251,856	$27,984
D	MOBILIZE MISC. SUPPLIES								
.	• Sufficient supplies remain from bulk sample program for reclamation activities								
.	Helicopter Support	hours	450	#N/A	1500	$675,000	90%	$607,500	$67,500
E	MOBILIZE & HOUSE WORKERS person days								
.	Operate 40-person camp for 5 months	month	200	ACCMl	1320	$264,000	100%	$264,000	$0
.	WINTER ROAD								
.	Operate Milne Inlet Tote Road during reclamation	km	100	WRh	2620	$262,000	100%	$262,000	$0
F	BONDING								
.	2.5 basis points of total bond amount	0.00025	1	#N/A	1687.4	$1,687	100%	$1,687	$0
G	Truck waste from Milne Inlet Camp to Mary River Camp for landfilling. Backhaul from Milne to Mary River already accounted for.								
.		L.S.	1	#N/A	20000	$20,000	100%	$20,000	$0
H	INSURANCE lump sum								
.		L.S.	1	#N/A	100000	$100,000	100%	$100,000	$0
	Subtotal					$4,812,527	98.0%	$4,717,043	$95,484
						Total Mob.	Percent Land	Total Land	Total Water

Monitoring & Maintenance Mon / Mtce # *1*

	ACTIVITY/MATERIAL	Units	Quantity	Cost Code	Unit Cost	Cost	% Land	Land Cost	Water Cost
A	OBJECTIVE: INSPECTIONS								
.	Site supervision during final abandonment	L.S.	1	#N/A	495000	$495,000	100%	$495,000	$0
.	Water sampling	year	1	WSh	9000	$9,000	0%	$0	$9,000
.	Additional water sampling costs per year	year	1	WSh	9000	$9,000	0%	$0	$9,000
.	Reporting	report	1	RPTh	11000	$11,000	80%	$8,800	$2,200
B	OBJECTIVE: MAINTENANCE								
.	• Except for the landfarm (see Activity G in Chemicals worksheet) no items will remain that need to be maintained post-closure.								

Subtotal	$524,000	96.1%	$503,800	$20,200
	Total Pit	Percent Land	Total Land	Total Water

Truck waste from Milne Inlet Camp to Mary River Camp for landfilling. Backhaul from Milne to Mary River already accounted for.

Post-Closure Site Maintenance

	ACTIVITY/MATERIAL	Units	Quantity	Cost Code	Unit Cost	Cost	% Land	Land Cost	Water Cost
A	WATER TREATMENT								
	• Not Applicable. On-going water treatment will not occur. Shallow pit areas will remain free draining. The results from the 2008 environmental geochemical testing program and short term leach tests have demonstrated that there is virtually no potential for enhanced release of acidity or metals in response to								
.	oxidative weathering of the material sampled.								
B	Cover Maintenance								
	• Cover material on the site is not required except for the landfill. A cover (1.5m) will be placed on the landfill with gentle slopes. Ongoing problems with								
.	erosion and integrity is not anticipated. However, the cover will be inspected every year for 5 years post closure (SEE BELOW).								
C	Spillway Maintenance								
.	• Not applicable. No spillways to maintain.								
D	Other								
.	Annual site visits (4 years post closure)	visit	2	VIh	7100	$14,200	80%	$11,360	$2,840
.	Annual reporting (4 years post closure)	report	1	RPTh	11000	$11,000	80%	$8,800	$2,200
.	Annual water sampling (43 samples; 4 years post closure)	year	1	WSh	9000	$9,000	0%	$0	$9,000
.	Additional water sampling costs per year		1	WSh	9000	$9,000	0%	$0	$9,000
	Subtotal, Annual post-closure costs					$43,200		$20,160	$23,040
	Discount rate for calculation of net present value of post-closure cost, %			0.25%				$0	
	Number of years of post-closure activity			4	years			$0	
	Present Value of payment stream					$171,725	46.7%	$80,139	$91,587
						Total Post closure	Percent Land	Total Land	Total Water

Truck waste from Milne Inlet Camp to Mary River Camp for landfilling. Backhaul from Milne to Mary River already accounted for.

WATER TREATMENT COSTS

ANNUAL VOLUME OF WATER (m3)

Reagent addition rates

Reagent	**kg reagent/m3 water**		**cost in $/kg, FOB site**	**Annual reagent cost**
H2O2	0.1	kg/m3	1.5	$0
lime		kg/m3	0.45	$0
ferric sulphate		kg/m3		$0
ferrous sulphate		kg/m3		$0
flocculents		kg/m3		$0
			TOTAL	$0

Supplies and Labour

NO WATER TREATMENT

power, kW-hr	0	rate, $/kW-h	[illegible]	$0
misc. supplies, hoses, tools				$0
sampling equip.				$0
equip. maintenance and parts				$0
water analysis				$0
reporting				$0
truck rental				$0
annual mileage				$0
road maintenace & snowplowing				$0
electrician/mechanic for treatment plant & power supply				$0
		Annual cost		$0
labor hourly rate	35			
	men per day for water treatment work			1
	on site, days per year			0
	spring/fall maintenance, extra work			0
	hours worked per year			0
Truck waste from Milne Inlet	annual labor cost			$0
		Total, labour and suppli		$0
TOTAL ANNUAL COSTS, reagents plus labour and supplies				$0
Average treatment cost, $/m3				$0.00

Water analyses	
samples per month	10
analysis cost/sample	100
shipping	200
Total Water Sampling	1200

Site Access	
annual site access cost	
road	$0
air	$0
winter road	$0

Unit Cost Table

ITEM	Detail	COST CODE	UNITS	LOW $	HIGH $	SPECIFIED $	COMMENTS
1	**excavate Rock, Bulk**						
	drill, blast, load short haul (<500m) Dump	RB1	m3	9.35	14	#N/A	quarry operations for bulk fill
	RB1 + long haul, up to 1500 m	RB2	m3	9.9	14.6	#N/A	
	RB1 + spread and compact	RB3	m3	9.9	14.6	#N/A	
	RB1 + long haul + spread and compact	RB4	m3	10.45	25.25	#N/A	
	RB1 + Specified activity	RBS	m3	#N/A	#N/A	#N/A	
2	**excavate Rock, Controlled**						
	drill, blast, load short haul (<500m) Dump	RC1	m3	22	33	#N/A	spillway excavation
	RC1 + long haul, up to 1500 m	RC2	m3	10.45	15.1	#N/A	
	RC1 + spread and compact	RC3	m3	9.9	14.6	#N/A	
	RC1 + long haul + spread and compact	RC4	m3	11.1	15.73	#N/A	
	RC1 + Specified activity	RCS	m3	#N/A	#N/A	145	$145/M3-drift excavation
3	**excavate Soil, Bulk**						
	excavate, load short haul (<500m) dump	SB1	m3	3.2	4.85	#N/A	LOW cost: excavation of loose soil, high volume
	SB1 + long haul, up to 1500 m	SB2	m3	3.98	5.97	#N/A	LOW cost: excavation of loose soil, 1.5 km haul, high volume
	SB1 + spread and compact	SB3	m3	3.7	5.31	#N/A	
	SB1 + long haul + spread and compact	SB4	m3	4.5	8.95	#N/A	LOW cost: excavation of loose soil, 1.5 km haul, high volume, const. of simple soil cover
	SB1 + Specified activity	SBS	m3	2.31	6.38	10.95	LOW cost: rehandle waste rock dump into pit, >500,000 m3, 2 km haul SPECIFIED cost: rehandle waste rock, haul 3 km, place & compact on dam
	Soil, tailings	SBT	m3	3.03	7.15		LOW cost: doze tailings, HIGH cost: excavate & short haul
4	**excavate Soil, Controlled**						
	excavate, load short haul (<500 m), dump	SC1	m3	5.61	7.65	#N/A	
	SC1 + long haul, up to 1500 m	SC2	m3	6.95	9.64	#N/A	
	SC1 + spread and compact	SC3	m3	5.61	11.66	#N/A	HIGH cost: for simple soil covers
	SC1 + long haul + spread and compact	SC4	m3	6.3	19.05	#N/A	HIGH cost: for complex covers & dam construction, spillway repair, LOW volume
Truck w	SC1 + Specified activity	SCS	m3	#N/A	#N/A	15.75	SPECIFIED cost: backfill adit with waste rock
Geo-synthetics							
	geotextile, filter cloth	GST	M2	0.99	1.98	#N/A	FOB Edmonton, add shipping & installation
	geogrid	GSG	M2	4.73		#N/A	

Unit Cost Table

ITEM	Detail	COST CODE	UNITS	LOW $	HIGH $	SPECIFIED $	
	liner, HDPE	GSHDPE	M2	5.89		#N/A	
	liner, PVC	GSPVC	M2			#N/A	
	geosynthetic installation	GSI	m2	0.83	1	#N/A	
	bentonite soil ammendment	GSBA	tonne	253	286	#N/A	FOB Edmonton, add shipping & mixing
	Shaft, Raise & Portal Closures						
	Shaft & Raises	SR	m2	530	1750	#N/A	LOW cost: pre-cast concrete slabs, little site prep. HIGH cost: for hand construction, remote site
	Portals	POR	m3		205	1000	HIGH cost: for excavate & backfill collapsed portal SPECIFIED cost: installed pressure plug
5	**Concrete work**						
	Small pour, no forms	CS	m3	297	595	#N/A	
	Large pour, no forms	CL	m3	235	350	#N/A	
	Small pour, Formed	CSF	m3	350	1750	#N/A	
	Large pour, Formed	CLF	m3	290	410	#N/A	
6	**Vegetation**						
	Hydroseed, Flat	VHF	ha	1595	4950	#N/A	
	Hydroseed, Sloped	VHS	ha	1848	5555	#N/A	
	veg. Blanket/erosion mat	VB	ha	11000	13200	#N/A	
	Tree planting	VT	ha	11000	13200	#N/A	
	Wetland species	VW	ha	55000	82500	#N/A	
7	**Pumps**						
	Small, <	PS	each	3000	6000	#N/A	
	Large, >	PL	each	5000	100000	#N/A	large - 250 hp Gould w/diesel motor
8	**PiPes**						
	Small, < 6 inch diameter	PPS	m	0.5	5	#N/A	LOW cost: pipe removal, HIGH cost: supply new pipe SPECIFIED: small, heat traced & insulated pipe
	Large, > 6 inch diameter	PPL	m	1	180	#N/A	LOW cost: pipe removal, HIGH cost: supply 24" 100 psi HDPE pipe, FOB Edm. add shipping & installation

Unit Cost Table

ITEM	Detail	COST CODE	UNITS	LOW $	HIGH $	SPECIFIED $	
9	**pump sand BackFill**	BF	m3	5.5	16.5	#N/A	
10	**Fence**	F	m	11	165	#N/A	
11	**Signs**	S	each	11	33	#N/A	
12	**rock, Drill and Blast only**	DB	m3	11	22	#N/A	
	(flatten slope, collapse drift)						
13	**excavate Rip Rap**						
	drill, blast, load short haul (<500 m) dump and spread	RR1	m3	10.95	16.35	#N/A	
	RR1 + long haul	RR2	m3	11.1	16.95	#N/A	HIGH cost: quarry & place rip rap in channel
	excavate rock from waste dump, short haul, spread	RR3	m3	4.2	5.78	#N/A	LOW cost: removal of 18 in minus from dump, long haul and spread HIGH cost: removal of coarse rock from dump, long haul, armour spillway
	RR3 + long haul	RR4	m3	4.68	6.25	#N/A	
	specified rip rap source	RR5	m3	#N/A	#N/A	#N/A	
14	**Import LimeStone**	ILS	tonne	8.8	13.2	#N/A	
15	**Import LiMe**	ILM	tonne	165	495	#N/A	LOW cost: bulk shipping, high volume, FOB Vancouver/Edmonton HIGH cost: bags delivered to central Yukon, small volume
16	**Grouting**	G	m3	198	240	#N/A	HIGH cost: cement, FOB Yellowknife
17	**Dozing**						
	doze Rock piles	DR	m3	0.85	1.95	#N/A	LOW cost: doze crest off dump
	doze overburden/Soil piles	DS	m3	0.78	3.11	#N/A	HIGH cost: push up to 300 m
18							
	regrade	DRE	hr			300	
						#N/A	
19							
						#N/A	
						#N/A	
20							
			each	0	0	#N/A	
			each			#N/A	
21	**Buildings - Decontaminate**						

Unit Cost Table

ITEM	Detail	COST CODE	UNITS	LOW $	HIGH $	SPECIFIED $	
	Chemicals	BDC	m3	#N/A	#N/A	#N/A	
	Asbestos	BDA	m2	21	42	#N/A	LOW cost: removal of asbestos siding & flooring HIGH cost: removal of insulated pipes, friable asbestos
22	**Buildings - Remove**						
	areas are per floor on 3 m average height						LOW cost: removal and on-site disposal - small wooden structures
	Wood - teardown	BRW1	m2	21.5	33	#N/A	
	Wood - burn	BRW2	m2	5.5	11	#N/A	
	Masonry	BRM	m2	23.65	33	#N/A	
	Concrete	BRC	m	33	49.5	6	LOW cost: removal of building perimeter walls, HIGH cost: per m3 for bulk concrete SPECIFIED cost: $/m2 to break floor slab
	Steel - teardown	BRS1	m2	35.2	52.8	240	SPECIFIED cost: demolition shear $/hour operating
	Steel - salvage	BRS2	m2	55	82.5	#N/A	
23	**Power & Pipe Lines**						
	Power lines, remove	POWR	each	20.9	4620	#N/A	
						#N/A	
24	**Laboratory Chemicals**						
	Remove from site	LCR	pallet	1750	2320	#N/A	
	Dispose on site	LCD	each	#N/A	#N/A	#N/A	
25	**PCB - Remove from site**	PCBR	litre	33	38.5	#N/A	LOW cost: shipping, handling & disposal from Yellowknife
26	**Fuel**						
	Remove from site	FR	kg	0	1.02	#N/A	
	Burn on site	FB	kg	#N/A	#N/A	#N/A	
27	**Oil**						
	Remove from site	OR	litre	0.35	1.02	#N/A	
	Burn on site	OB	litre	0.35	0.55	#N/A	
28	**Process Chemicals**						
	Remove from site	PCR	kg	0.35	2.05	#N/A	
	Dispose on site	PCD	kg	#N/A	#N/A	#N/A	
29	**Explosives**						
	Remove from site	ER	kg	0	2.2	#N/A	
	Dispose on site	ED	kg	#N/A	#N/A	#N/A	

Unit Cost Table

ITEM	Detail	COST CODE	UNITS	LOW $	HIGH $	SPECIFIED $	
30	**Contaminated Soils**						
	Remediate on site	CSR	m3	38.5	120	#N/A	LOW cost: bio-remediate on-site. HIGH cost: ship off-site to landfil as haz. waste
	consolidate & cover	Use cost code items 1 - 4					
	cover in place	Use cost code items 1 - 4					
31	**Mobilize Heavy Equipment**						
	Road access	MHER	$/km	2.81	8.42	2.05	SPECIFIED cost: $/tonne/km in cargo plane
	Air access	MHEA	each	#N/A	#N/A	1375	SPECIFIED cost: helicopter cost, $/hr of operation
32	**Mobilize Camp**						
	<20 persons Road access	MC<R	each	#N/A	#N/A	#N/A	
	<20 persons Air access	MC<A	each	#N/A	#N/A	#N/A	
33	**Mobilize Workers**						
	mobilize	MM<	person	193	990	#N/A	LOW cost: road access. HIGH cost: transport by Twin Otter aircraft
	>20 persons	MM>	person	990	1320	#N/A	
34	**ACCoModation**	ACCM	month	1320	1980	#N/A	LOW cost, accom in existing camp, per man, HIGH cost: - supply new camp
35	**Mobilize Misc. Supplies**	MMS	each	#N/A	#N/A	#N/A	LOW cost: winter road - limited use, LOW snowfall
36	**Winter Road**	WR	km	1320	2620	#N/A	
37	**Visual site Inspection**	VI	each	3520	7100	10000	
38	**Survey site Inspection**	SI	each	#N/A	#N/A	#N/A	
39	**Water Sampling**	WS	each	5500	9000	#N/A	
40	**site inspection RePorT**	RPT	each	#N/A	11000	#N/A	
41	**Security Guard**	SG	pers/mc	5500	7700	#N/A	
42	**Maintain Pumping**	MP	month	3300	#N/A	#N/A	
43	**Clear SpillWay**	CSW	each	1870	5280	#N/A	
44	**Build Treatment Plant**						
	Small (< 1000 m3/d)	BTPS	lump su	1E+06	2E+06	#N/A	
	Large (> 1000 m3/d)	BTPL	lump su	2E+06	3.5E+6	#N/A	
45	**Operate Treatment Plant**	OTP	m3	0.29	1.65	#N/A	
46	**SCariFY road and install water breaks**	SCFY	km	3525	4950	#N/A	

Unit Cost Table

ITEM	Detail	COST CODE	UNITS	LOW $	HIGH $	SPECIFIED $
water treatment chemicals						
ferric sulphate		ferric	kg	0.67		
ferrous sulphate		ferrous	kg	0.44		
lime		lime	kg	0.3		
hydrogen peroxide, 50%		hperox	kg	1.43		
Sodium Metabisulfate		Nametab	kg	0.99		
Caustic soda, 50%		caustic	kg	0.62		
Sulfuric acid, 93%		sulfuric	kg	0.26		
flocculant		flocc	kg	5.39		
copper sulphate		copper	kg			
typical shipping, to Whitehorse or Yellowknife			kg	0.072		
Typical Labour & Equipment Rates						
	Site manager		$/hr	70	80	
	Mine superintenden		$/hr		60	
	Environmental coordinato		$/hr		60	
	Journeyman (mech, elec, weld)		$/hr	50	60	
	Equipment operato		$/hr	45	55	
	labour - skilled		$/hr	35	38	
	labour - unskillec		$/hr	32	35	
	Security / first aic		$/hr	38	48	
	Admin.		$/hr	42	49	
	Front end loader, ?, Cat99:		$/hr		330	
	excavator, Cat23!		$/hr		175	
	dump truck - tandem		$/hr			
	dump truck off road, Cat 777		$/hr	265		
	dozer, D8, D10		$/hr	170	300	

24 Hour Baffinland Contact:

Mary River - 403-450-8844

or

Milne Inlet – 647-723-2077

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SPILL CONTINGENCY PLAN

August 2007

Revision 1 (March 2008)
Revision 2 (March 2009)

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PREAMBLE

This Emergency and Spill Response Plan for the Mary River Project is in effect and applies to all licensed elements of the program.

The Plan will be updated and revised as necessary during the course of the Advanced Exploration Project.

Formal distribution of the Plan has been made to:

Department of Environment - Environmental Protection Division
PO Box 1000 Station 1300
Iqaluit, NU, Canada
X0A 0H0
Tel: (867) 975-7700, 1-866-222-9063
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Department of Fisheries and Oceans - Central and Arctic Region
501 University Crescent
Winnipeg, MN, Canada
R3T 2N6
Tel: (204) 983-5000
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Hamlet of Pond Inlet
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Tel: (867) 899-8934
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Indian and Northern Affairs Canada - Nunavut Regional Office
Land Administration Division
PO Box 2200
Iqaluit, NU, Canada
X0A 0H0
Tel: (867) 975-4280 (Land Administration Manager)

Indian and Northern Affairs Canada - Nunavut Regional Office
Water Resources Division
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Iqaluit, NU, Canada
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Mittimatalik Hunters and Trappers Organization
PO Box 189
Pond Inlet, NU, Canada
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Tel: (867) 899-8856
Fax: (867) 899-8095

Nunavut Impact Review Board
PO Box 1360
Cambridge Bay, NU, Canada
X0B 0C0
Tel: (867) 983-4600, 1-866-233-3033
Tax: (867) 983-2594

Nunavut Water Board
PO Box 119
Gjoa Haven, NU, Canada
X0B 1J0
Tel: (867) 360-6338
Fax: (867) 360-6369

Qikiqtani Inuit Association
PO Box 1340
Iqaluit, NU, Canada
X0A 0H0
Tel: (867) 979-5391, 1-800-6672742 (Land Administrator)
Fax: (867) 979-3238

Additional copies and updates of this Plan may be obtained from:

Baffinland Iron Mines Corporation
Suite 1016, 120 Adelaide Street West
Toronto, ON, Canada
M5H 1T1
Tel: (416) 364-8820
Fax: (416) 364-0193

TRACK CHANGES TABLE

An annual routine review and update of the Spill Contingency Plan has been undertaken, with the following salient revisions to the March 2008 Spill Contingency Plan:

Revision 2: March 2009

Modifications/Additions	Where they appear in the document	
	section	Page number
Description of the Mary River Project site was updated to reflect current configuration and site activities	1.0	1
Table 2.1 was updated to reflect the as-constructed capacity of the bulk fuel storage facilities and the approximate current drum fuel inventory.	2.1	5
Section 2.1 was updated to note that lined storage areas for large drum caches is in place at all four (4) exploration camps	2.1	4
Section 2.3 was updated noting that residual explosives remain on-site after completion of the bulk sample shipment in 2008	2.3	6
Table 3.1 was updated with the contact details for the project management team responsible for implementing the Spill Contingency Plan	3	8
Section 3 was updated to note that responsibilities for public and media contact is with the Corporate contact	3	9
Section 4 was changed to the current tense to reflect the ongoing nature of training and drills	4	11
Scenario 1 of Section 7 was removed as tug boat servicing was an activity undertaken as part of the bulk sample shipment, but is not currently ongoing	7	17
Scenarios 4 and 5 were added as potential spill scenarios	7	19-20
Section 8 was updated with current contact details for third party and regulatory authorities	8	21
Maps in appendix B have been modified and now show all existing fuel storage and spill kits locations.	B	B
Appendix D was updated to include most current versions of Material Safety Data Sheets	D	D

Baffinland Iron Mines Corporation

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1. GENERAL

This Spill Contingency Plan (Plan) was developed to assist in implementing measures to protect the environment and minimize impacts from potential spill events. It provides a framework and instructions to guide all personnel in emergency spill response situations. The Plan outlines procedures for responding to spills while minimizing potential health and safety hazards, environmental damage, and clean up costs.

The Mary River Project ("Project") is a proposed iron ore mine and associated facilities located on North Baffin Island, in the Qikiqtani Region of Nunavut. Baffinland commenced exploration at Mary River in 2004 and has since accomplished a number of field investigations in the region. Camp accommodations have been established at Mary River, Milne Inlet, Nivek Lake, and Steensby Inlet to support ongoing field investigations including exploration drilling and resource delineation, geotechnical drilling and engineering planning, and environmental and social data collection. A bulk sampling program has been undertaken with a resultant 113,000 tonnes of iron ore shipped to the European market during the summer of 2008.

Field programs and activities are ongoing in support of continued advancement of the Mary River Project. The 2009 field program currently focuses on infill exploration drilling on Deposit Nos. 2 and/or 3 to collect additional information on resources and will be conducted from the Mary River site. Depending on available financing, Baffinland may increase field activities accordingly. Equipment, infrastructure, consumables and regulatory permits are currently in place to support a substantially larger exploration drilling program, additional geotechnical drilling to support engineering planning and to undertake further environmental baseline work. This Spill Plan is commensurate with the full scope of activities for which appropriate regulatory permits and authorizations are in place.

The Mary River Iron Mine site is located in the northern part of Baffin Island, Nunavut (71° 18' 30" North, 79° 23' 30" West), approximately 160 km south of Pond Inlet. The mine site is approximately 85 km inland and accessible by road from the sealift supply site (i.e., Milne Inlet site) located where Phillips Creek discharges into Milne Inlet. The Milne Inlet site is located on the north-eastern coast of Baffin Island (71° 52' 57" North, 80° 53' 51" West), approximately 131 km south-west of Pond Inlet. The Steensby Inlet Camp (70° 17' 38" North, 78° 29' 13" West) is located to the south of Mary River and Mid-Rail camp (70° 58' 20" North, 78° 22' 15" West) is located mid way between Mary River and Steensby Inlet. Maps and locations of camps and fuel storage facilities are provided in Appendix B.

This spill emergency plan has been implemented to ensure that Baffinland respects all applicable laws, regulations and requirements from federal and territorial authorities. Baffinland obtained and complies with all required permits, approvals and authorizations required for the operations. The following applicable Regulations and documents constitute an integral part of the spill contingency plan:

The *Canadian Environmental Protection Act* controls hazardous substances from their production and/or import, their consumption, storage and/or disposal.

The federal *Fisheries Act* protects fish and their habitat from pollution and disturbances. Fisheries and Oceans Canada reviews permit applications and restoration plans submitted by other agencies.

The federal *Transportation of Dangerous Goods Act* and *Regulations* ensure the protection of public health and safety, and the environment during the handling and transport of dangerous goods. The Regulations apply to all modes of transportation, by road, by sea, and by air.

The federal *Territorial Land Use Regulations* define regulatory measures to maintain appropriate environmental practices for any land use activities on territorial lands that are under the control, management and administration of the Crown. These regulations require that land use permits be issued for operations such as mineral exploration and mining.

The *Guidelines for Preparation of Hazardous Material Spill Contingency Plans* describe parameters that should be considered in the development of hazardous material spill emergency plans. It also defines the information that should be incorporated into a comprehensive contingency plan.

The CCME *Code of Practice for Used Oil Management* defines appropriate environmental options for handling, storage, collection, recycling, transport, reuse and/or disposal of used oils in Canada. It helps regulatory authorities formulate provincial and/or regional strategies for used oil management.

The *Nunavut Environmental Protection Act* governs the protection of the environment from contaminants. The act defines offences and penalties as well as the powers of government inspectors.

The *Nunavut Spill Contingency Planning and Reporting Regulations* describe requirements for spill reporting and emergency planning.

The *Field Guide for Oil Spill Response in Arctic Waters* developed for the Emergency Prevention, Preparedness and Response Working Group, describes precise response methods and strategies for emergency response operations and provides technical support documentation.

The *Land Transportation Emergency Response Guideline for Petroleum Spills* developed by the Canadian Petroleum Products Institute outlines scope, emergency response code of practice, response time guidelines, response equipment and personnel capability requirements.

Links to *Baffinland Oil Handling Facility* – Oil Pollution Emergency Plan

The *Canada Shipping Act* (CSA), as amended by Chapter 36, stipulates that operators of designated Oil Handling Facilities must have an on-site Oil Pollution Emergency Plan.

Marine spills at the Milne Inlet port site are specifically addressed in *the Baffinland Oil Handling Facility – Oil Pollution Emergency Plan (OPEP)* which is a separate document. The Milne Inlet Fuel Storage Facility OPEP has been designed specifically to compliment this document. The OPEP is not to be construed as to supersede existing contingency plans, rather it is conceived to address the specifics of the Fuel Storage Facility, the bulk incoming transfer of fuel and spill scenarios directly relating to this operation.

The *Milne Inlet Fuel Storage Facility, Oil Pollution Emergency Plan* takes into account the requirements of the CSA 2001, Part 8, Subsections 168. (1), 168. (2) and 168. (3). Due to the facility's location (North of 60'), Subsections 168. (1) (a), 168. (1) (b) (ii), and 168. (1) (b) (iii) do not apply.

The *Canada Shipping Act Response Organizations and Oil Handling Facilities Regulations* (sor/95-405) apply. The oil handling facilities standards, tp12402 applies.

2. HAZARDOUS MATERIALS – TRANSPORT AND STORAGE

A variety of petroleum products and other hazardous materials are used as part of ongoing site activities. Large quantities of petroleum products are stored at various sites. Explosives are also stored on site. Other hazardous materials are also used but in smaller quantities. Nonetheless, all these products are considered as potential environmental and safety hazards. The material safety data sheets (MSDS) of all these products are presented in Appendix D. Regular monitoring and inspection of fuel and hazardous material storage areas and the use thereof is undertaken in accordance with the Baffinland's environmental management system and procedures.

2.1. Fuel

Table 2.1 presents the capacity of bulk fuel storage facilities and their location. Approximate volumes of the drummed fuel inventory on-site as of September 2008 and their locations are also provided.

In quantities required to support on-going site activities, fuel is delivered in bulk by sealift to the Milne Inlet site. From there, the fuel is hauled to the Mary River site by tanker trucks on a 100-km all-season road. Tanker trucks are equipped with emergency spill response kits. Drums at the Steensby Camp were supplied by sealift in the fall of 2008.

A map of the regional area and layouts of the four (4) main fuel storage locations (i.e., Milne Inlet, Mary River Camp, Mid-Rail Camp and Steensby Inlet) are presented in Appendix B. Appendix B also provides the location of all fuel containers and spill kits as of September 2008. The Milne Inlet tank farm is located approximately 500 m from the ocean, however, the fuel intake line is located at the high-water mark. The Mary River Camp tank farm is located approximately 400 m from the nearest lake.

Each bulk fuel storage facility consists of 113,560-litre fuel bladders inside a lined containment area. The fuel drum cache located at Steensby Inlet consists of drums inside lined containment areas. In addition, lined containment areas are situated at Milne Inlet, Mid-Rail and Mary River camps for the storage of fuel drum caches required for camp operations and field activities. All fuel caches are clearly identified, marked, and protected to prevent damage to drums from vehicles and heavy equipment especially during periods when the drums may be less visible (i.e., at night and during winter).

Refuelling stations at the Milne Inlet and Mary River sites are equipped with a lined and bermed area to contain minor spills or leaks during refuelling. The liner (40 mil hypolon liner) is protected by sand bedding and vehicles and equipment drive onto the lined area to refuel. Transfer of fuel from supply vehicles to tanks and from tanks to vehicular equipment is performed with the aid of fuel pumps.

Table 2.1: Fuel Storage Capacity (litres)

1) Milne Inlet Site		Type and number of containers
diesel fuel	6,814,000	60 x 113,560-L fuel bladders
jet A-1 fuel	1,363,000 61,500	12 x 113,560-L fuel bladders 300 x 205-L drums
2) Midway Camp (emergency use only)		
diesel fuel		No fuel at Midway camp
3) Mary River Site		
diesel fuel	1,250,000 77,000 75,000	11 x 113,560-L fuel bladders (bulk fuel facility) 1 x 77,000-L fuel bladder (Camp diesel generators supply) 1 Envirotank (75,000 liters) in lined containment
jet A-1 fuel	227,000 513,000	2 x 113,560-L fuel bladders 2500 x 205-L drums
4) Mid-Rail Camp		
diesel fuel	0	0 drums
jet A-1 fuel	0	0 drums
5) Steensby Inlet Camp		
diesel fuel	656,000	3200 x 205-L drums
jet A-1 fuel	861,000	4200 x 205-L drums

A variety of intermediate-sized fuel tanks are also used to supply generators (camps and operations) and furnaces. A bladder within lined containment adjacent to the generators at Mary River contains a maximum volume of 77, 000 liters. To the extent practicable, hazardous materials in drums are stored within lined areas.

Emergency spill response equipment (i.e., spill kits) is installed at each fuel storage location. All spill kits contain the appropriate type, size and quantity of equipment for the volume and type of product present at the storage location as well as the environment likely to be affected by a spill (i.e., ground, lake, river, or ocean).

2.2. Chemicals

Other chemicals and potentially hazardous materials associated with project operations include:

- Petroleum oils and lubricants for mining and heavy equipment;
- Drilling additives;
- Calcium chloride flakes for drill water;
- Lead acid batteries;
- Cleaning supplies at camp sites;
- Waste oil from equipment and generators.

Lubricants, oils, and batteries, are stored in containers at the work shop and at other work areas. Waste oils are stored in drums in lined containment, and may be used to fuel the camp incinerator. The calcium chloride storage area is located adjacent to the airstrip and camp at the Mary River site.

2.3. Explosives

Approximately 240 M.T. of pre-packaged emulsion and high explosives (Class A) was stored on site for use during the bulk sample program. Remaining explosives are stored in explosives magazines positioned in accordance with the Nunavut Mine Health and Safety Act and Regulations at the Mary River site. Detonators and explosives are stored in separate magazines, and inventory is strictly controlled with supervisory control. The explosives magazines are located at a minimum distance of 600 m away from other infrastructure (e.g., building or work area) in accordance with the requirements of the Explosives Use Act, and warning signs are prominently posted.

3. DUTIES AND RESPONSIBILITIES

As part of the spill emergency response plan, Baffinland is responsible for implementing, through its project management team, the following procedures:

- Train site personnel in spill response procedures and the proper use of response equipment and materials.
- In the event of a spill, mobilize required site personnel, equipment and tools.
- Implement required health and safety procedures at the site of the spill.
- Eliminate fire hazards and potential ignition sources near the spill area.
- Control the source of the spill (i.e., reduce or stop product discharge).
- Contain the spilled product using the most appropriate methods and equipment (i.e., dykes, ditches, sorbent materials, containment booms, and other barriers).
- Evaluate the possibilities of recovering spilled materials.
- Obtain, if required, assistance from government agencies such as Environment Canada, the Canadian Coast Guard and/or Fisheries and Oceans Canada.
- Obtain, if required, additional assistance by hiring local rangers or residents from the nearest communities and/or firms specialized in spill response operations.
- Comply with applicable guidelines and regulations.
- Conduct a preliminary assessment of environmental impacts to marine, freshwater and terrestrial ecosystems and natural resources.
- Report the spill to the Government of Nunavut Spill Report Line, to QIA, and to the water license inspector within 24 hours of the event, and submit a written spill report using the appropriate form (see below for the list of information required in the report).

Table 3.1 presents the management team responsible for overseeing emergency spill response operations and their contact information.

Baffinland
Iron Mines Corporation

Table 3.1: Project Management Team Members and Contact Information

Position	Contact
Cliff Pilgrim or Jeff Bush On-site Co-Coordinator	**Emergency After Hours Tel: 403-450-8844** Email: cliff.pilgrim@baffinland.com Mary River Site Tel: 403-450-7312 Email: jeff.bush@baffinland.com Mary River Site Tel: 403-450-7316 Milne Inlet Site Tel: 647-723-2077 (24 hours)
Dalton Head or Brian Larson On-site Co-Coordinator (alternates)	**Emergency After Hours Tel: 403-450-8844** Email: dalton.head@baffinland.com Mary River Site Tel: 403-450-8838 Email: brian.larson@baffinland.com **Mary River Site Tel: 403-450-1589**
Cheryl Wray and Jim Millard Environmental Superintendant	Mary River Site Tel: 403-450-**8843** Email: cheryl.wray@baffinland.com Email : jim.millard@baffinland.com
Al Gorman Operations Manager **Dave McCann** (alternate)	Office Tel: 416-814-3164 Cell: 416-818-9913 (Al Gorman) Email: al.gorman@baffinland.com Mary River Site Tel: 403-450-8843 Cell: 416-616-8860 (Dave McCann) Email: david.mccann@baffinland.com
Rod Cooper Corporate Contact – VP, Operations and COO **Derek Chubb** Corporate Contact – VP Sustainable Develop.	Office Tel: 416-814-3158 Cell: 416-8722-5660 (Rod Cooper) Email: rod.cooper@baffinland.com Office Tel: 416-814-3171 Cell: 416-844-0903 (Derek Chubb) Email: Derek.chubb@baffinland.com

As part of the spill response plan, the On-Site Co-Coordinator, acting as incident commander, is responsible for implementing the following procedures:

- Assume authority over the spill scene and personnel involved.
- Activate the Spill Response Plan.

- Evaluate the initial situation and assesses the magnitude of the spill.
- Develop an overall plan of action.
- Prepare a root cause analysis and an incident investigation for major spills.
- Report to the Operations Manager and provide recommendations on resource requirements (additional manpower, equipment, material, etc.) to complete the cleanup effort. The responsibility of the co-ordinator is to mobilise personnel and equipment to implement the cleanup.

The responsibilities of the Environmental Department on behalf of the Operations Manager include the following:

- Report the spill to NWT 24-hour Spill Report Line at (867) 920-8130, to Qikiqtani Inuit Association Lands Administrator at (867) 975-8422, and INAC Water License Inspector at (867) 975-4289.
- Provide liaison with Management to keep them informed of cleanup activities.
- Collect photographic records of the spill event and clean up efforts.
- Obtain additional required resources not available on-site for spill response and cleanup.
- Act as the spokesperson with government agencies as appropriate.
- Document the cause of the spill and effectiveness of the cleanup effort, and implement the appropriate measures to prevent a recurrence of the spill.
- Prepare and submit follow-up documentation required by appropriate regulators.
- Ensure that the spill is cleaned up and all follow-up communication and reports are filed with the INAC Water License Inspector, and QIA Land Administrator. Ensure that the spill reports submitted to QIA include photographic records and an updated map showing UTM coordinates, date, amount and the nature of spill.

The responsibilities of the Corporate Contact include the following:

- Work with the Environmental Department on regulatory follow-up as necessary.
- Act as the spokesperson with government agencies as well as the public and the media on any significant spill events.

Once a spill event is reported, the On-Site Co-Coordinator establishes a specific strategy for containing and controlling the spill and to initiate the clean up activities. Other site personnel such as the Fire chief, Health and Safety Officer, and Operations Manager may act as technical advisers prior to and during the intervention. The trained Spill Response Team will conduct all emergency spill response operations under the leadership of the On-Site Co-Coordinator. During the cleanup phase of the intervention other site personnel (e.g., heavy equipment operators, labourers, etc.) may be involved in the intervention. Figure 3.1 presents an organization chart of the Spill Response Team.

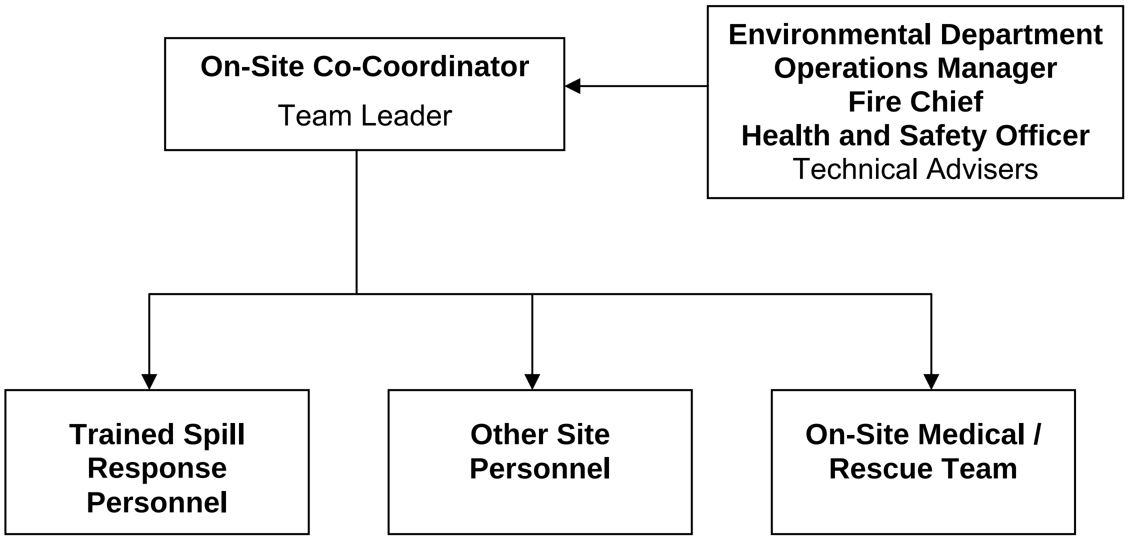


Figure 3.1: Spill Response Team Organization Chart

Baffinland ensures that all contracted shipping companies have their own spill contingency plan to respond to spill events during the course of their operations. When shipping hazardous materials to and from the site transport companies are required to carry out their operations in accordance with federal and international Transport of Dangerous Goods Regulations (i.e., TDGR – Clear Language, IMDG, IATA).

In the event of a spill of hazardous materials (exceeding the quantities listed in Part 8.1 (1) of the TDGR) during transport, the shipping company will immediately report the incident to the local police and the Nunavut Emergency Services at 1-800-693-1666 (as stated in Part 8.1 (5), TDGR). The immediate report must include as much of the information listed in Part 8.2, TDGR, as is known at the time of the report. A follow-up report must be made, in writing, to the Director General within 30 days after the occurrence of the accidental release, the "dangerous goods accident" or the "dangerous goods incident". The follow-up report must include the information listed in Part 8.3, TDGR.

If a spill occurs on water during transport or during the transfer of hazardous materials from ship to land, the shipping company is responsible to implement the appropriate spill response measures in accordance to their spill contingency plan. If needed, the Baffinland Spill Response Team can be available to assist the shipping company in their emergency response operations.

4. TRAINING AND DRILLS

As part of site orientation and ongoing awareness training, all site personnel are informed that any spill of fuel or other hazardous liquids or solids, whatever the extent, has to be reported immediately to the On-Site Co-Coordinator.

An appropriate number of site personnel are selected and appropriately trained to form the Spill Response Team. Crew members are trained in emergency spill response procedures and operations. Training includes knowledge in the:

- properties of hazardous materials used on site;
- common causes of spills;
- environmental effects of spills;
- worker health and safety during emergency interventions;
- personal protective equipment and clothing;
- spill response procedures and techniques on land, water, snow and ice, and during all four seasons;
- spill response equipment and materials.

Training also includes analysis of potential spill events that are more likely to occur during the Mary River Project operations. Fuel spills are more likely to be caused by:

- human error during fuel transfer operations (e.g., tank farm to tanker-trucks, drums to helicopters, etc.);
- rupture of tanks, supply lines, or valves from accidental damage, deterioration or equipment failure; or
- road accidents involving tanker-trucks.

Training includes spill response field drills and classroom training.

5. MATERIALS AND EQUIPMENT

In order to prevent spills and to provide adequate response in case of spill events, Baffinland maintains on-site the appropriate type and quantity of response equipment and materials.

Spill kits are strategically placed primarily in areas of fuel handling to facilitate immediate first response in the event of a hydrocarbon release to land. To facilitate response to fuel spills to water, two (2) sea-can containers will be positioned at Milne Inlet. Appendix C provides a list of the different spill kits and their contents (as purchased) that are available on-site. Note that over the course of operations, when materials in spill kits have been utilized, replacement materials may differ from that originally present in kits. Substituted spill kit materials will be of sufficient quality and quantity as appropriate to their locations and potential use.

In addition to the spill response material listed in Appendix C, a variety of mobile heavy equipment including excavators, front-end loaders, bull-dozers, haul trucks, a Zodiac boat for in-land water use, and an ocean support boat is available to aid in spill response and recovery efforts.

6. SPILL RESPONSE PROCEDURES

A spill is defined as the discharge of a hazardous product out of its containment and into the environment. Potential hazards to humans, vegetation, water resources, fish and wildlife vary in severity, depending on several factors including nature of the material, quantity spilled, location and season. Fuel is the main product that may be spilled and, therefore, spill response procedures focus on this hazardous material. Other chemicals that may be spilled include sewage water, calcium chloride flakes and small quantities of lubricants and oils.

All site personnel are briefed on the procedures to be followed to report a spill and initiate spill response. The first person to notice a spill takes the following steps:

1. Immediately warn other personnel working near the spill area;
2. Evacuate the area if the health and safety of personnel is threatened;
3. Notify the On-Site Co-Coordinator, who will initiate the spill response operations;
4. In the absence of danger, and before the spill response team arrives at the scene, take any safe and reasonable measure to stop, contain and identify the nature of the spill.

All spill response interventions carried out by the spill response team follow these general procedures:

Source Control - Reduce or stop the flow of product without endangering anyone. This may involve very simple actions such as turning off a pump, closing a valve, sealing a puncture hole with almost anything handy (e.g., a rag, a piece of wood, tape, etc.), raising a leaky or discharging hose at a level higher than the product level inside the tank, or transferring fuel from leaking containers.

Control of Free Product - Prevent or limit the spread of the spilled material. Accumulate/concentrate spilled product in an area to facilitate recovery. Barriers positioned down-gradient of the spill will slow or stop the progression of the spill. Barriers can consist of absorbent booms, dykes, berms, or trenches (dug in the ground or in ice).

Protection - Evaluate the potential dangers of the spill in order to protect sensitive ecosystems and natural resources. Block or divert the spilled material away from sensitive receptors. This can also be achieved by using various types of barriers.

Clean up the Spill – Recover and containerize as much free product as possible. Recover and containerize/treat contaminated soil, water, and snow. Pressure-wash contaminated bedrock surfaces, shorelines, ice and recover as much as possible oily water for containerization and/or treatment.

Report the Spill - Provide basic information such as date and time of the spill, type and amount of product discharged, photographic records, location and approximate size of the spill, actions already taken to stop and contain the spill, meteorological conditions and any perceived threat to human health or the environment. Reporting requirements are presented on Section 8.

Response procedures specific to spills on land, water, snow and ice are presented in the following sections. Procedures vary depending on the season. Spill response operations, techniques, equipment and materials are further detailed in the spill response training course manual.

6.1. Spills on Land

Response to spills on land will include the general procedures previously detailed. The main spill control techniques involve the use of two types of barriers: dykes and trenches. Barriers should be placed down-gradient (down-slope) from the source of the spill, and as close as possible to the source of the spill. Barriers slow the progression of the fuel and also serve as containment to allow recovery of the fuel.

Depending on the volume spilled, the site of the spill as well as available material, a dyke may be built with soil, booms, lumber, snow, etc. A plastic liner should be placed at the foot of and over the dykes to protect the underlying soil or other material and to facilitate recovery of the fuel. Construct dykes in such a way as to accumulate a thick layer of free product in a single area (V-shaped or U shaped).

Trenches are useful in the presence of permeable soil and when the spilled fuel is migrating below the ground surface. A plastic liner should be placed on the down-gradient edge of the trench to protect the underlying soil. Liners should not be placed at the bottom of the trench to allow water to continue flowing underneath the layer floating oil.

The use of large quantities of absorbent materials to recover important volumes of fuel should be avoided. Large volumes of free-product should be recovered, as much as possible, by using vacuums and pumps, and containerized. Mixtures of water and fuel may be processed through an oil-water separator. Absorbent sheets should be used to soak up residual fuel on water, on the ground (soil and rock), and on vegetation. Peat moss may also be sprinkled on vegetation to absorb films of petroleum products.

6.2. Spills on Water

Response to spills on water includes the general procedures previously detailed. Various containment, diversion and recovery techniques are discussed in the following sections. The following elements must be taken into consideration when conducting response operations:

- type of water body or water course (lake, ocean, stream, river)
- water depth and surface area
- wind speed and direction
- presence and range of tides
- type of shoreline
- seasonal considerations (open-water, freeze-up, break-up, frozen)

Containment of an oil slick on the **ocean** requires the deployment of mobile floating booms to intercept, control, contain and concentrate (i.e., increase thickness) the floating oil. One end of the booms is anchored to shore while the other is towed by a boat and use to circle the oil slick and return it close to shore for recovery using a skimmer. Reducing the surface area of the slick increases its thickness and thereby improves recovery. Mechanical recovery equipment (*i.e.,* skimmers and oil/water separators) will be mobilized to site if required.

If oil is spilled in a **lake** it may not be possible to deploy booms using a boat. In this case, measures are taken to protect sensitive and accessible shoreline. The oil slick is monitored to determine the direction of migration. In the absence of strong winds the oil will likely flow towards the discharge of the lake. Measures is taken to block and concentrate the oil slick at the lake discharge using booms where it will subsequently be recovered using a portable skimmer, a vacuum, or sorbent materials.

In small slowly-flowing rivers, **streams**, channels, inlets or ditches, inverted weirs (i.e., siphon dams) is used to stop and concentrate moving oil for collection while allowing water to continue to flow unimpeded. In the case of floating oil, in a **stream**, heading for a culvert (i.e., at a road crossing) a culvert block is used to stop and concentrate moving oil for collection while allowing water to continue to flow unimpeded. In both cases oil will then be recovered using a portable skimmer or sorbent materials.

In the case of spills in larger **rivers**, with fast moving currents, diversion booming is used to direct the oil slick ashore for recovery. Single or multiple booms (i.e., cascading) may be used for diversion. Typically, the booms are anchored across the river at an angle. The angle will depend on the current velocity. Choosing a section of a river that is both wider and shallower makes boom deployment easier. Diversion booming may also be used to direct an oil slick away from a sensitive area to be protected.

6.3. Spills on Snow and Ice

In general, snow and ice will slow the movement of hydrocarbons. The presence of snow may also hide the oil slick and make it more difficult to follow its progression. Snow is generally a good natural sorbent, as hydrocarbons have a tendency to be soaked up by snow through capillary action. However, the use of snow as a sorbent material is to be limited as much as possible. Snow and frozen ground also prevent hydrocarbons from migrating down into soil or at least slow the migration process. Ice prevents seepage of fuel into the water.

Response to spills on snow and ice includes the general procedures previously detailed. Most response procedures for spills on land may be used for spills on snow and ice. The use of dykes (i.e., compacted snow berms lined with plastic sheeting) or trenches (dug in ice) slow the progression of the fuel and also serve as containment to allow recovery of the fuel.

Free-product is recovered by using a vacuum, a pump, or sorbent materials. Contaminated snow and ice is scraped up manually or using heavy equipment depending on volumes. The contaminated snow and ice is placed in containers or within plastic lined berms on land. If required, a contaminated snow storage site is to be located in close proximity to one of the four (4) main work sites to facilitate inspection and monitoring, in an area which is still easily accessible once it is time to remove the snow (i.e., spring or summer), and at least 30 m away from any body of water or ditch. Once enough snow has melted, the oily water is removed from the storage and processed through an oil-water separator that would be mobilized to site. Hydrocarbons recovered will be burned in the camp incinerator or shipped off-site for processing.

6.4. Disposal of Spilled Material

Plastic ore sacks, steel drums, or other appropriate container as approved by the Environmental Superintendent are used to contain and transport contaminated soil for removal from site to a licensed southern disposal facility by either air or by road followed by sealift. Alternatively, a lined containment facility may be constructed on-site for the treatment of the contaminated soils. Such a facility requires regulatory approval and an amendment to Baffinland's water license. Temporary storage of contaminated materials is to be within plastic lined berms. Used sorbent material is burned in the site incinerators.

7. POTENTIAL SPILL ANALYSIS

In order to prepare for emergency spill response, potential spill analysis was conducted on various worst case scenarios. The exercise serves to identify potential risk areas, as well as to determine the fate of spilled products and their environmental effects. Five (5) potential spill scenarios were identified for the Mary River Project:

1. Mary River Camp Area - Spill of a fuel bladder to the ground
2. Road between Milne Inlet and Mary River – Spill of the contents of a tanker truck
3. Rotating Biological Contactor at Milne Inlet – Spill of sewage
4. Rotating Biological Contactor at Mary River – Spill of sewage
5. Refuelling of Float Plane

These five (5) spill scenarios are analysed in detail in the following pages.

Scenario #1: Mary River Camp Area Spill

Description of incident: Spill of the contents of one of the 13 fuel bladders (within the tank farm) to the ground during fuel transfer from a tanker truck. Spillage of fuel by gravity. Spill occurs at the south-western end of the tank farm.
Potential causes: equipment malfunction (valve, pump), human error, accident.
Hazardous products spilled: Diesel fuel, Jet-A Fuel.
Maximum volume spilled: 113,560 litres.
Estimated time to spill entire volume: 90 minutes.
Immediate receiving medium: soil.
Most probable direction of slick migration: west, towards the lake.
Distance and direction to nearest receiving body of water: approximately 400 m west of the tank farm.
Resources to protect: lake and shore.
Estimated emergency spill response time: 15 minutes after spill is noticed.
Spill response procedures: Contain and recover oil spill using dykes or trenches as described in section 6.1. Prevent the oil from reaching natural drainage paths leading to the lake. Collect free-product for temporary storage. Excavate contaminated soil and/or snow, store and manage appropriately.

Scenario #2: Road Accident Tanker Truck Spill

Description of incident: Spill of the contents of a tanker truck to a stream. Spill occurs in an isolated area between Milne Inlet and Mary River.
Potential causes: accident, human error.
Hazardous products spilled: Diesel fuel, Jet-A Fuel.
Maximum volume spilled: 50,000 litres.
Estimated time to spill entire volume: 45 minutes.
Immediate receiving medium: stream.
Most probable direction of slick migration: downstream and into a river named Phillips Creek; the road between Mary River and Milne Inlet follows Phillips Creek, and crosses many streams (that discharge into Phillips Creek) over a distance of approximately 50 km. Phillips Creek eventually discharges into the ocean at Milne Inlet.
Distance and direction to nearest receiving body of water: N/A.
Resources to protect: streams, Phillips Creek and the ocean.
Estimated emergency spill response time: 60 minutes after spill is reported to site personnel (assuming truck driver is injured and cannot commence spill response procedures).
Spill response procedures: Contain and recover oil slick downriver as described in section 6.2, protect shorelines using sorbent booms. Collect free-product for temporary storage. Clean-up soiled shorelines. If the response crew arrives before the complete spill, seal the leak where feasible, contain and recover oil spill on ground using dykes and trenches as described in 6.1. Also, if the truck driver is not injured, he will act as a first responder and immediately initiate the spill contingency plan as defined in section 6 using the spill kit kept in the fuel trucks.

Scenario #3: Milne Inlet sewage spill

Description of incident: Spill from the Rotating Biological Contactor reservoir. A pipe is accidently being dislodged and non treated wastewater escape the reservoir
Potential causes: pipe failure
Products spilled: sewage
Maximum volume spilled: 15,000 litres.
Estimated time to spill entire volume: 15 minutes.
Immediate receiving medium: soil
Most probable direction of slick migration: downstream and into a local depression east of the RBC wastewater treatment facility. That local depression dries in the summer and intercepts the maximum spilled volume.
Distance and direction to nearest receiving body of water: 150 m
Resources to protect: one stream and the ocean.
Estimated emergency spill response time: 15 minutes after spill is noticed.

Spill response procedures: Once the treatment is achieved, the content of the reservoir is normally pumped by a vacuum truck to be discharged elsewhere. Therefore a vacuum truck is available in the area. In case of a spill of non-treated wastewater (sewage), the slick would be pumped using the vacuum truck. The piping would be repaired and the content of the truck would be discharged back in the RBC treatment unit. Impacted soils (if any) would be excavated and placed within the landfill.

Scenario #4: Mary River sewage spill

Description of incident: Spill from the Rotating Biological Contactor reservoir. A pipe is accidently being dislodged and non treated wastewater escape the reservoir
Potential causes: pipe failure
Products spilled: sewage
Maximum volume spilled: 15,000 litres.
Estimated time to spill entire volume: 15 minutes.
Immediate receiving medium: soil
Most probable direction of slick migration: downstream and into a local depression east of the RBC wastewater treatment facility. That local depression dries in the summer and intercepts the maximum spilled volume.
Distance and direction to nearest receiving body of water: 200 m
Resources to protect: one stream and Camp Lake.
Estimated emergency spill response time: 15 minutes after spill is noticed.
Spill response procedures: Once the treatment is achieved, the content of the reservoir is normally pumped by a vacuum truck to be discharged elsewhere. Therefore a vacuum truck is available in the area. In case of a spill of non-treated wastewater (sewage), the slick would be pumped using the vacuum truck. The piping would be repaired and the content of the truck would be discharged back in the RBC treatment unit. Impacted soils (if any) would be excavated and placed within the landfill, once constructed.

Scenario #5: Refuelling of Float Plane

Description of incident: Spill from a 45 gallon drum while refuelling a float plane. The hose from the 45 gallon drum to the plane develops a leak or the nozzle malfunctions. The drum is accidentally knocked over causing the contents to spill.
Potential causes: equipment malfunction (valve, hose), human error
Products spilled: P-50 or Jet A
Maximum volume spilled: 205 liters.
Estimated time to spill entire volume: 15 minutes.
Immediate receiving medium: water
Most probable direction of slick migration: dependent on currents and wind velocities of water body.
Distance and direction to nearest receiving body of water: within 1 m

Resources to protect: Sheardown Lake, unnamed lake at Mid-Rail camp and 3km lake at Steensby Inlet camp.
Estimated emergency spill response time: immediately.
Spill response procedures: Contain and recover hydrocarbons or oil slicks using floating booms and/or pads deployed by boat as described in Section 6.2. Protect shoreline using floating or sorbent booms, if still possible. Collect free-product for temporary storage using sorbents and mobilize additional equipment as necessary. Clean-up soiled shoreline.

8. REPORTING REQUIREMENTS

Quantities of hazardous substances spilled which require reporting are listed in schedule B of the Nunavut Spill Contingency and Reporting Regulation.

After the initial field emergency response to the spill event, spills are reported to the 24-hour Spill Report Line:

24-Hour Spill Report Line
spills@gov.nt.ca
Tel. (867) 920-8130 or
Fax (867) 920-8127

Failure to report a spill can lead to fines. The Qikiqtani Inuit Association Lands Administrator will also be immediately notified at (867) 975-8422. Similarly, the INAC Water Resources Officer will be immediately notified of the spill event at (867) 975-4289. In the event of a spill on the ocean, the incident will be reported to the Canadian Coast Guard (Arctic region) 1-800-265-0237 (24-hour).

It is the responsibility of the Environmental Department on behalf of the Operations Manager to prepare the proper reports and transmit them to regulatory authorities. Table 8.1 presents an additional contact list for spill reporting. The Environmental Superintendent will determine who is to be contacted on the list on a spill by spill basis.

Table 8.1: Contact List for Spill Reporting

Department	Person	E-mail	Telephone
INAC-Waters (Iqaluit)	Kevin Buck	buckk@inac-ainc.gc.ca	(867) 975-4550
INAC-Inspector	Andrew Keim	keima@inac-ainc.gc.ca	(867) 975-4289
INAC-Qikiqtani	David Abernethy	abernethyd@inac-ainc.gc.ca	(867) 975-4555
INAC-Field Operations	Peter Kusugak	kusugakp@inac-ainc.gc.ca	(867) 975-4289
DFO-Iqaluit	Gary Cooper	Gary.cooper@dfo-mpo.gc.ca	(867) 979-8011
EC-Iqaluit	Jim Noble		(867) 975-4639
GN-DOE	Robert Eno	reno@gov.nu.ca	(867) 975-7748
Qikiqtani Inuit Association	Salamonie Shoo	landadmin@qia.ca	(867) 975-1643
Pond Inlet Health Clinic			(867) 899-7500 (867) 899-8431
Pond Inlet RCMP			(867) 899-1111 (867) 899-6055
Qikiqtani General Hospital (Iqaluit)			(867) 979-7300

Afterwards, the spill event is reported in writing using the standard Spill Report Form presented in Appendix A.

The written report includes the following information:

- date and time of the incident;
- location or map coordinates and direction of spill movement if not at steady-state;
- party responsible for the spill;
- type and estimated quantities of spilled contaminant(s);
- specific immediate cause of the incident;
- status of the spill indicating if spilled materials are still moving or now at steady-state;
- approximate surface of contaminated area;
- a photographic record of the spill event and clean up efforts;
- factors affecting spill or recovery such as temperature, wind, etc.;
- status on containment actions indicating whether a) naturally, b) booms, dykes or other, c) no containment has been implemented;
- corrective action taken or proposed, to clean, contain or dispose spilled material;
- whether assistance is required and in what form;
- whether the spill poses a hazard to persons or property (i.e., fire, drinking water);
- comments and recommendations;
- name, position and employer of the person reporting the spill; and,
- name, position department of the person to whom the spill is reported.

In addition, QIA requests Baffinland produce a site map(s) listing the location in UTM coordinates, date, amount and nature of the substance spilled. The map(s) should be updated and sent to QIA whenever a spill occurs. The map(s) will also detail major project components and all water bodies.

In the event of a spill involving the marine carrier delivering bulk fuel, Baffinland will ensure that the subcontractor reports any spill event under its responsibility.

Appendix A

Standard Nunavut Spill Report Form

NT-NU SPILL REPORT

OIL, GASOLINE, CHEMICALS AND OTHER HAZARDOUS MATERIALS

NT-NU 24-HOUR SPILL REPORT LINE
TEL: (867) 920-8130
FAX: (867) 873-6924
EMAIL: spills@gov.nt.ca

REPORT LINE USE ONLY

A	REPORT DATE: MONTH – DAY – YEAR	REPORT TIME	☐ ORIGINAL SPILL REPORT, OR ☐ UPDATE # ______ TO THE ORIGINAL SPILL REPORT	REPORT NUMBER ____-__________
B	OCCURRENCE DATE: MONTH – DAY – YEAR	OCCURRENCE TIME		
C	LAND USE PERMIT NUMBER (IF APPLICABLE)	WATER LICENCE NUMBER (IF APPLICABLE)		
D	GEOGRAPHIC PLACE NAME OR DISTANCE AND DIRECTION FROM NAMED LOCATION	REGION ☐ NWT ☐ NUNAVUT ☐ ADJACENT JURISDICTION OR OCEAN		
E	LATITUDE DEGREES MINUTES SECONDS	LONGITUDE DEGREES MINUTES SECONDS		
F	RESPONSIBLE PARTY OR VESSEL NAME	RESPONSIBLE PARTY ADDRESS OR OFFICE LOCATION		
G	ANY CONTRACTOR INVOLVED	CONTRACTOR ADDRESS OR OFFICE LOCATION		
H	PRODUCT SPILLED	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER	
	SECOND PRODUCT SPILLED (IF APPLICABLE)	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER	
I	SPILL SOURCE	SPILL CAUSE	AREA OF CONTAMINATION IN SQUARE METRES	
J	FACTORS AFFECTING SPILL OR RECOVERY	DESCRIBE ANY ASSISTANCE REQUIRED	HAZARDS TO PERSONS, PROPERTY OR ENVIRONMENT	
K	ADDITIONAL INFORMATION, COMMENTS, ACTIONS PROPOSED OR TAKEN TO CONTAIN, RECOVER OR DISPOSE OF SPILLED PRODUCT AND CONTAMINATED MATERIALS			

L	REPORTED TO SPILL LINE BY	POSITION	EMPLOYER	LOCATION CALLING FROM	TELEPHONE
M	ANY ALTERNATE CONTACT	POSITION	EMPLOYER	ALTERNATE CONTACT LOCATION	ALTERNATE TELEPHONE

REPORT LINE USE ONLY

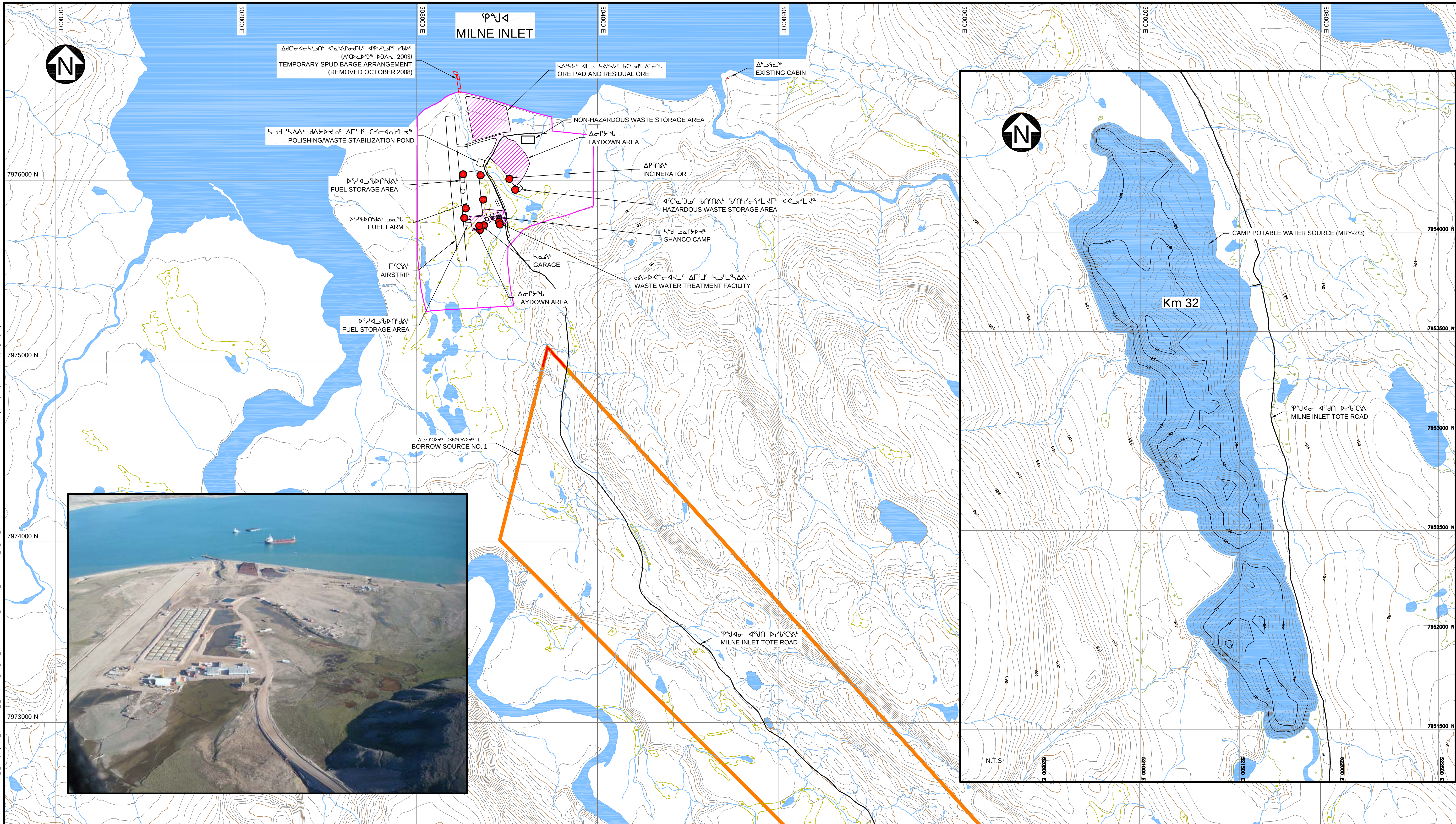
N	RECEIVED AT SPILL LINE BY	POSITION STATION OPERATOR	EMPLOYER	LOCATION CALLED YELLOWKNIFE, NT	REPORT LINE NUMBER (867) 920-8130

LEAD AGENCY ☐ EC ☐ CCG ☐ GNWT ☐ GN ☐ ILA ☐ INAC ☐ NEB ☐ TC	SIGNIFICANCE ☐ MINOR ☐ MAJOR ☐ UNKNOWN	FILE STATUS ☐ OPEN ☐ CLOSED

AGENCY	CONTACT NAME	CONTACT TIME	REMARKS
LEAD AGENCY			
FIRST SUPPORT AGENCY			
SECOND SUPPORT AGENCY			
THIRD SUPPORT AGENCY			

Appendix B

Layouts of main fuel storage and spill kit locations



LEGEND:

- WATER
- WETLAND
- LAYDOWN AREA
- BAFFINLAND'S COMMERCIAL LEASE ON INUIT OWNED LAND
- EXISTING BORROW AREA (IOL COMMERCIAL LEASE)
- RIVER/STREAM/DRAINAGE
- MILNE INLET TOTE ROAD
- ROAD
- APPROXIMATE SPILL KIT LOCATION

REFERENCE(S)

1. EAGLE MAPPING (2005)
2. UTM (NAD83) ZONE 17
3. 5 m

NOTE(S):

1. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 5 METRES.

SCALE 200 100 0 200 400 600 800 1000 m

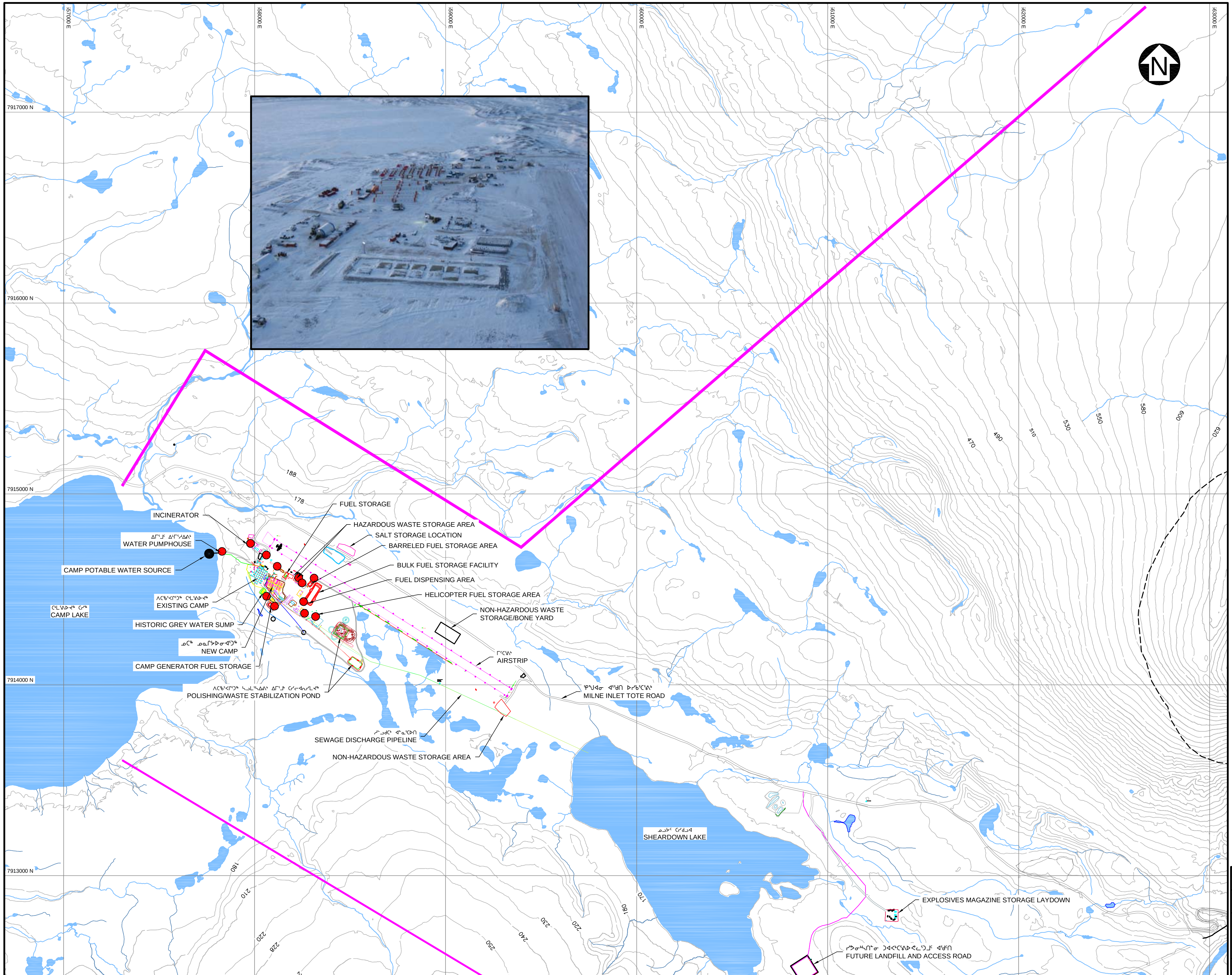
Baffinland Iron Mines Corporation

MARY RIVER PROJECT

MILNE INLET CAMP AND PORT LAYOUT
APPROXIMATE SPILL KIT LOCATION

REV. 0

FIGURE 1



LEGEND:

WATER

RIVER/STREAM/DRAINAGE

SURFACE RIGHTS AREA (IOL COMMERCIAL LEASE)

CAMP POTABLE WATER SOURCE

APPROXIMATE SPILL KIT LOCATION

NOTE(S):

1. COORDINATE GRID IS UTM (NAD83) ZONE 17 AND IS IN METRES.
2. CONTOUR INTERVAL IS 10 METRES.
3. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).

SCALE A 200 100 0 200 400 600 800 1000 m

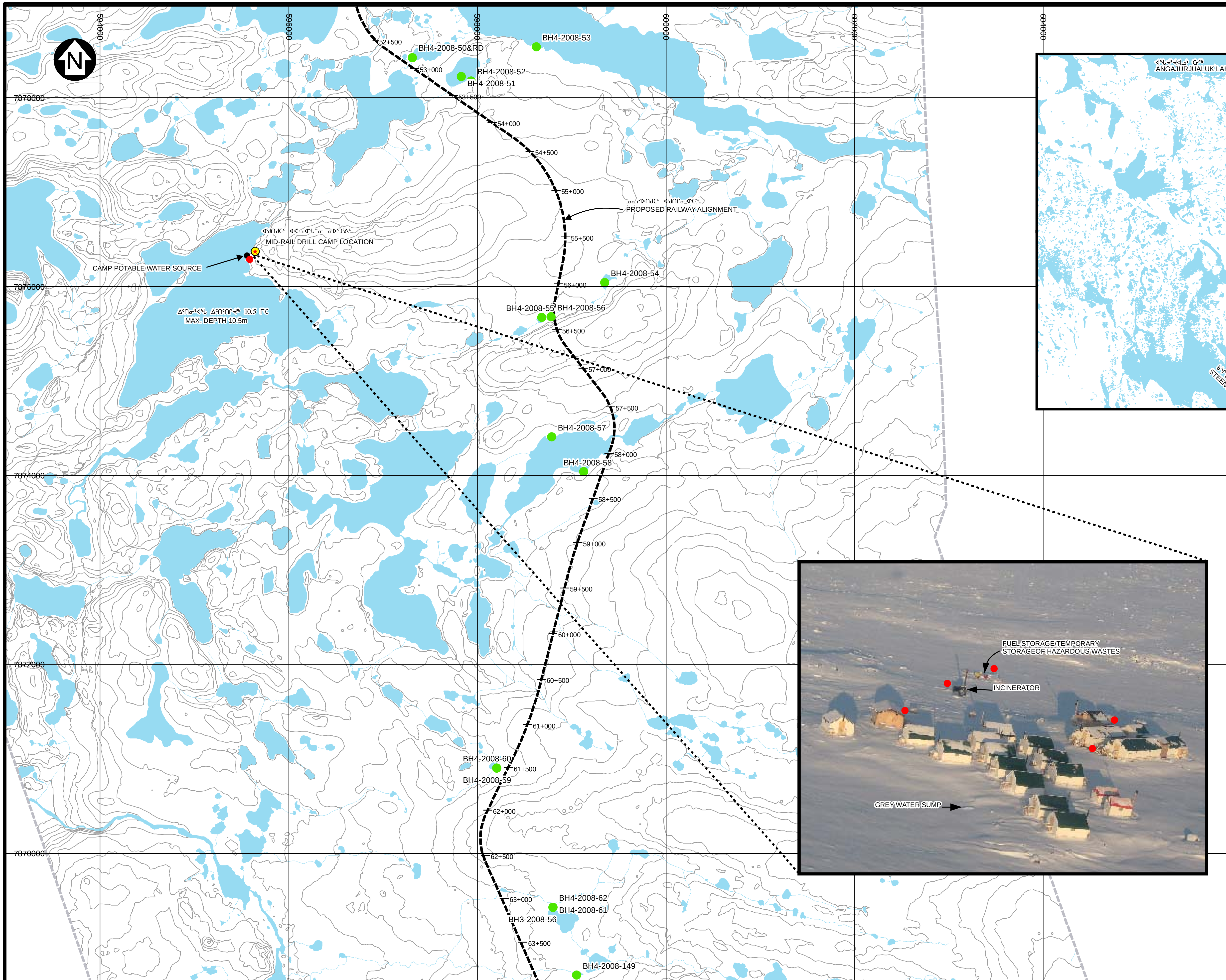
Baffinland Iron Mines Corporation

MARY RIVER PROJECT

MARY RIVER CAMP LAYOUT
APPROXIMATE SPILL KIT LOCATION

REV. 0

FIGURE: 2



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LEGEND:

- ᐃᒥᖅ WATER
- ᑯᒃᑐᖅ/ᑯᓗᓚᒃᑐᖅ/ᑯᕕᕕᐅᕙᖅ RIVER/STREAM/DRAINAGE
- ᓄᓇᓯᐅᑎᑯᑦ ᐊᕐᖁᑎᒋᓂᐊᕐᑕᖓ PROPOSED RAIL ALIGNMENT
- ᐱᑕᖃᕐᐸᒋᕐᑐᖅ ᑕᒪᕐᕕᐅᕙᖅ EXISTING CAMP
- WATER SOURCE LOCATIONS
- CAMP POTABLE WATER SOURCE
- APPROXIMATE SPILL KIT LOCATION

ᖃᐅᔨᒪᔭᒃᓴᐃᑦ
NOTES:

1. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
   ᓄᓇᖑᐊᓕᐅᕈᑦ EAGLE MAPPING (2005)
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
   ᓄᓇᖑᐊᕐ ᑎᑎᕐᓯᒪᓂᖓ ᒪᓕᒃᑐᖅ UTM (NAD83) ZONE 17
3. CONTOUR INVTERVAL IS IN METRES. CONTOUR INTERVAL IS 2.5 METRES.
   ᑎᑎᕐᓯᒪᔪᑦ ᒥᑕ: ᐊᕐᖁᓂᕐᒋᑦ ᐅᖓᓯᒃᑎᒋᒃᑐᑦ 2.5 ᒥᑕ
4. PROPOSED RAIL ALIGNMENT PROVIDED BY CAINARAIL CONSULTANTS INC.
   ᓄᓇᓯᐅᑎᑯᑦ ᐊᕐᕐᖁᑎᒃᓴᖓ CANARAIL CONSULTANTS INC

ᐊᖏᓂᖓ SCALE 500 250 0 500 1,000 1,500 2,000 ᒥᑕ m

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

MID RAIL CAMP LAYOUT
APPROXIMATE SPILL KIT LOCATIONS

REV 0

ᑎᑎᕋᐅᔭᕐᓯᒪᔪᖅ **FIGURE** **3**

NORTH BAY, ON SAVED: I:\102-00181-15\Assignment\GIS\ArcView\figures\B23.mxd , PRINTED: 25/03/2009 4:40:23 PM , rjohnson

ᑐᑭᓯᔾᔪᑎᑦ
LEGEND:

ᐃᒥᖅ
WATER

RIVER/STREAM/DRAINAGE

CAMP POTABLE WATER SOURCE

APPROXIMATE SPILL KIT LOCATION

NOTE(S):

1. COORDINATE GRID IS UTM (NAD83) ZONE 17 AND IS IN METRES.
2. CONTOUR INTERVAL IS 10 METRES.
3. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).

SCALE 250 12.5 0 250 500 750 1000 1250 m

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

STEENSBY CAMP LAYOUT
APPROXIMATE SPILL KIT LOCATION

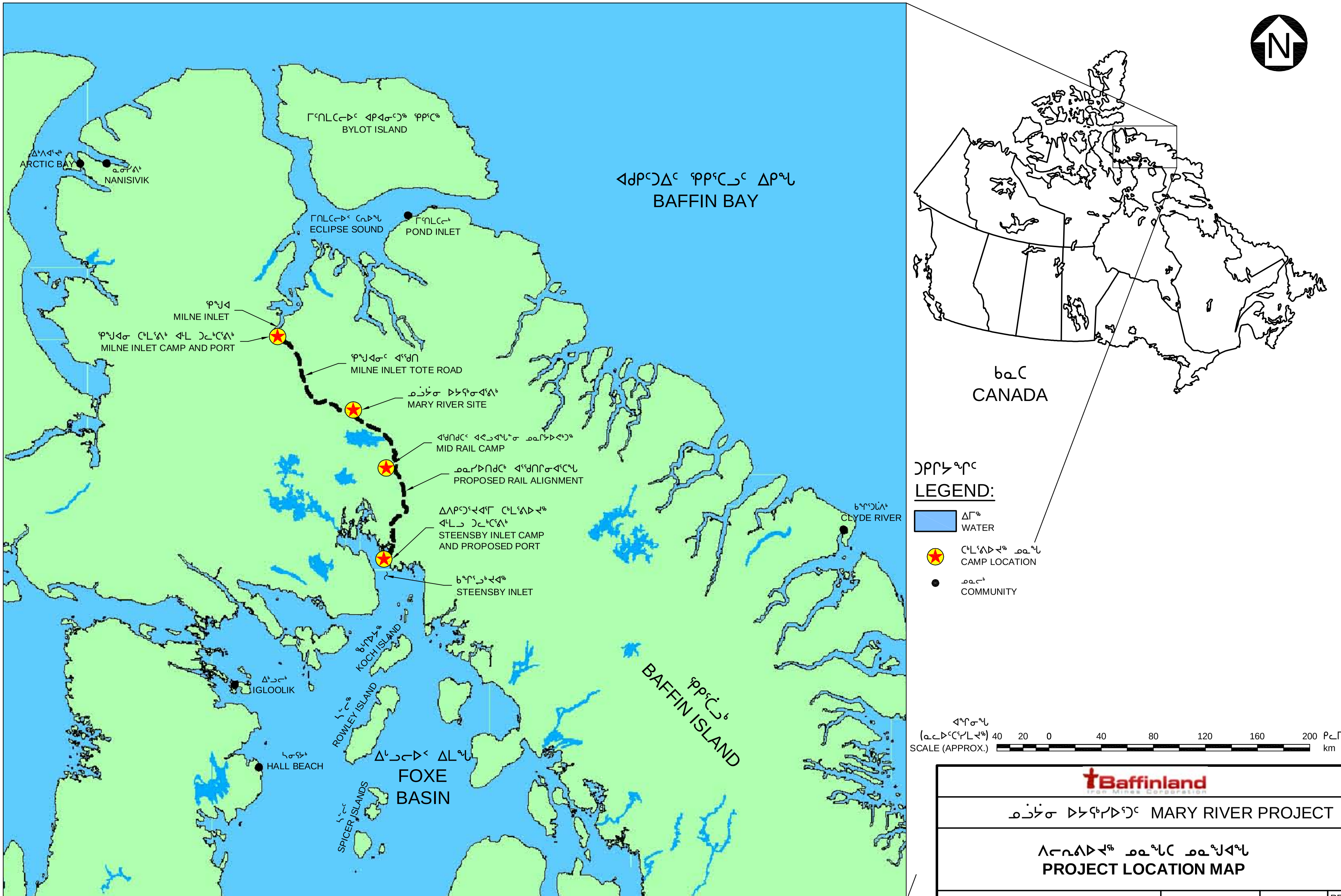
REV. 0

FIGURE: 4

NORTH BAY ON. SAVED: I:\102-00181-15\Assignment\Acad\Figs\B60 , 3/25/2009 4:59:43 PM PRINTED: 3/25/2009 5:00:11 PM , Layout1 , Bpark

XREF FILE(S): STEENSBY PORT AREA_01-APRIL 22 2008; steensby lakes; STEENSBY RAIL LOOP AND AIRSTRIP_03_ AUGUST 12 2008; Railway_Alignment-Mary_River-Steensby-03-Sep_23_2008; IMAGE FILE(S): Baffinland logo-big.corp Baffinland logo-big corp STEENSBY CAMP - OCT08

XREF FILE(S): IMAGE FILE(S): 4 Baffinland logo-big corp Baffinland logo_new logo-big corp NORTH BAFFINLAND



Baffinland Iron Mines Corporation

MARY RIVER PROJECT

PROJECT LOCATION MAP

FIGURE	1.1	REV. 0

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Appendix C

Spill Kits and Contents

VERSATECH SPILL KITS AT BAFFINLAND'S MARY RIVER PROJECT SITE:

Kit #4	six (6) kits
Kit #5	four (4) kits
Kit #6	four (4) kits
Kit #7	eighteen (18) kits
Kit #8	eight (8) kits

Kit No./Details	Contents	Quantity
4 **20 GALLON LAB PACK** Absorbs up to 18 Gallons Lab Pack Container	Sorbent Pads (19" x 17" x 3/8") Sorbent Socks (3" x 4ft.) Sorbent Pillows Nitrile Gloves (pair) Disposal Bag Epoxy Putty	20 5 4 2 3 1
5 **PORTABLE RESPONSE KIT** Absorbs up to 65 Gallons Durable Yellow Rollout Container 2 convenient sizes - 64 Gallon 96 Gallon	Sorbent Pads (19" x 17" x 3/8") Sorbent Socks (3" x 4ft.) Xsorb (6 quart) Hand broom/dust pan Nitrile Gloves (pair) Disposal Bag Disposable Coveralls Drain cover Splash resistant goggles	150 6 1 1 2 4 2 2 2
6 **SPILL CHEST** Absorbs up to 170 Gallons Heavy duty plastic Yellow Container Can be moved with a Forklift	Sorbent Pads (19" x 17" x 3/8") Sorbent Socks (3" x 4 ft) Sorbent Booms (5" x 10 ft) Sorbent Pillows (15" x 9 ft) Sorbent Roll (38" x 144 ft) Nitrile Gloves (pair) Disposal Bag Epoxy Putty Barricade tape (Roll)	100 8 4 16 1 2 4 1 1
7 **HEAVY DUTY DRUM KIT** Absorbs up to 75 Gallons Heavy duty plastic Yellow Container Drum sizes include 65 & 95 US gallons or an economy 45 gallon steel drum	Sorbent Pads (19" x 17" x 3/8") Sorbent Booms (5" x 10ft) Xsorb (6 quart) Nitrile Gloves (pair) Disposal Bag Disposable Coveralls Drain cover Splash resistant goggles	100 4 1 2 4 2 1 2

8 **EXTRA LARGE DRUM KIT** Absorbs up to 120 Gallons Heavy duty plastic Yellow Container	Sorbent Pads (19" x 17" x 3/8") Sorbent Socks (4ft) Sorbent Socks (8ft) Sorbent Pillows (large) Sorbent Pillows (small) Plug Putty Drain Cover Disposal Bags (roll) Disposable Coveralls Barrier Tape (roll) Granular Absorbant (12.5 kg)	300 8 8 12 8 2 7 1 2 1 1

SPILL RESPONSE EQUIPMENT TO BE STORED IN 2 SEA CONTAINERS AT MILNE INLET FOR BAFFINLAND'S MARY RIVER PROJECT:

Description
Oil containment boom, anchors and towing bridles (300m)
Multizorb granular absorbent (500 bags)
Custom pump skid for emergency fuel transfers from one tank to another
2" x 25' transfer hose for emergency transfer pump (8 sections)
18" x 18" x 6" Arctic mini berm for under fittings (12 units)
36" x 36" x 6" Arctic mini berm for under fittings (12 units)
Insta berm 10' x 10' x 15" Arctic (2 units)
Oil sheets for replenishing spill kits (300 bags)

Appendix D

MSDS of hazardous materials used on site

- Aviation Fuel (7p.)
- Calcium Chloride Flake (4p.)
- Cast Booster (3p.)
- CP-43 Diesel (6p.)
- Detonating Cord (3p.)
- DR-133 POLYMER (4p.)
- Electric Dentonators (4p.)
- EZ-MUD (6p.)
- Gasoline (6p.)
- Jet A (7p.)
- Lubtrac Rod Grease (4p.)
- Non-Electric Detonators (5p.)
- Packaged Emulsion Explosives (3p.)
- Packaged Dynamites and Explosive Gelatins (3p.)
- Potassium Chloride (Potash) (4p.)
- Shock Tube (3p.)
- Tellus T32 (4p.)
- W-OB POLYMER (4p.)
- Emulsion Explosives – Dyno AP (3p.)
- APS 706b Floc Log (2p.)
- APS 703d#3 Floc Log (2p.)
- 750 Silt Stop (2p.)
- Agricultural Lime (4p.)
- Aluminum Sulphate (1p.)

Shell Canada Limited
Material Safety Data Sheet

Effective Date: 2008-08-01
Supersedes: 2008-08-01

Class B2 Flammable Liquid

Class D2A Embryo/Fetotoxicity
Class D2B Skin Irritation

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT: **SHELL AVGAS 100 LL**
SYNONYMS: AVIATION GASOLINE
May contain anti-icing additive (Diethylene Glycol Monomethyl Ether)
PRODUCT USE: Fuel
PRODUCT CODE: **101-200**

SUPPLIER
Shell Canada Limited (SCL)
P.O. Box 100, Station M
400-4th Ave. S.W.
Calgary, AB Canada
T2P 2H5

TELEPHONE NUMBERS

Shell Emergency Number	1-800-661-7378
CANUTEC 24 HOUR EMERGENCY NUMBER	1-613-996-6666
For general information:	1-800-661-1600
	www.shell.ca

This MSDS was prepared by the Toxicology and Product Stewardship Section of Shell Canada Limited.
*An asterisk in the product name designates a trade-mark(s) of Shell Canada Limited, used under license by Shell Canada Products.

2. COMPOSITION/INFORMATION ON INGREDIENTS

Component Name	CAS Number	% Range	WHMIS Controlled
Naphtha (Petroleum), Light Alkylate	64741-66-8	80 - 90	Yes
Toluene	108-88-3	8 - 10	Yes
i-Pentane	78-78-4	5 - 10	Yes
Ethanol, 2-(2-methoxyethoxy)-	111-77-3	0 - 0.15	Yes

See Section 8 for Occupational Exposure Guidelines.

3. HAZARDS IDENTIFICATION

Physical Description: Volatile Liquid Blue Colour Clear Typical Gasoline Odour
Routes of Exposure: Exposure will most likely occur through skin contact or inhalation.
Hazards:

Vapour concentrations above the recommended exposure level are irritating to the eyes and respiratory tract, may cause headaches and dizziness, are anesthetic and may have other central nervous system effects.

	Flammable Liquid. Irritating to skin. May be absorbed by skin contact. Ingestion may result in vomiting. Avoid aspiration of vomitus into lungs as small quantities may result in aspiration pneumonitis. At very high concentrations this product can have an anesthetic (drowsiness, weakness) and asphyxiant effect. In rare cases may sensitize heart muscle causing heart arrythmia.
Handling:	Eliminate all ignition sources. Wear suitable gloves and eye protection. Bond and ground transfer containers and equipment to avoid static accumulation. Empty containers are hazardous, may contain flammable / explosive dusts, liquid residue or vapours. Keep away from sparks and open flames. Avoid prolonged exposure to vapours.

For further information on health effects, see Section 11.

4. FIRST AID MEASURES

Eyes:	Flush eyes with water for at least 15 minutes while holding eyelids open. If irritation occurs and persists, obtain medical attention.
Skin:	Wash contaminated skin with mild soap and water for at least 15 minutes. If irritation occurs and persists, obtain medical attention.
Ingestion:	DO NOT INDUCE VOMITING! OBTAIN MEDICAL ATTENTION IMMEDIATELY. Guard against aspiration into lungs by having the individual turn on to their left side. If vomiting occurs spontaneously, keep head below hips to prevent aspiration of liquid into the lungs. Do not give anything by mouth to an unconscious person.
Inhalation:	Remove victim from further exposure and restore breathing, if required. Obtain medical attention.
Notes to Physician:	The main hazard following accidental ingestion is aspiration of the liquid into the lungs producing chemical pneumonitis. If symptoms such as loss of gag reflex, convulsions or unconsciousness occur before vomiting, gastric lavage with a cuffed endotracheal tube should be considered. If more than 2.0 mL/kg has been ingested, vomiting should be induced with supervision.

5. FIRE FIGHTING MEASURES

Extinguishing Media:	Dry Chemical Carbon Dioxide Foam Water Fog
Firefighting Instructions:	Flammable. Clear area of unprotected personnel. Do not use water except as a spray. Do not enter confined fire space without adequate protective clothing and an approved positive pressure self-contained breathing apparatus. Avoid breathing vapours. Vapour forms a flammable/explosive mixture with air between upper and lower flammable limits. Vapours may travel along ground and flashback along vapour trail may occur. Product will float and can be reignited on surface of water. Delayed lung damage can be experienced after exposure to combustion products, sometimes hours after the exposure.

Hazardous Combustion Products: Carbon dioxide, carbon monoxide and unidentified organic compounds may be formed upon combustion.

6. ACCIDENTAL RELEASE MEASURES

Issue warning "Flammable". Eliminate all ignition sources. Isolate hazard area and restrict access. Wear appropriate breathing apparatus (if applicable) and protective clothing. Handling equipment must be grounded. Work upwind of spill if it is safe to do so. Avoid direct contact with material. Stop leak only if safe to do so. Dike and contain land spills; contain spills to water by booming. Use water fog to knock down vapours; contain runoff. Adsorb residue or small spills with adsorbent material and remove to non-leaking containers for disposal. Notify appropriate environmental agency(ies). After area has been cleaned up to the satisfaction of regulatory authorities, flush area with water to remove trace residue. Dispose of recovered material as noted under Disposal Considerations.

7. HANDLING AND STORAGE

Handling: Flammable. Fixed equipment as well as transfer containers and equipment should be grounded to prevent accumulation of static charge. Avoid breathing vapours and prolonged or repeated contact with skin. Vapours may accumulate and travel to distant ignition sources and flashback. Empty containers are hazardous, may contain flammable/explosive dusts, residues or vapours. Do not cut, drill, grind, weld or perform similar operations on or near containers. Provide adequate ventilation. Wash with soap and water prior to eating, drinking, smoking, applying cosmetics or using toilet facilities. Launder contaminated clothing prior to reuse.

Storage: Store in a cool, dry, well ventilated area, away from heat and ignition sources. Use explosion-proof ventilation to prevent vapour accumulation.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

The following information, while appropriate for this product, are general in nature. The selection of personal protective equipment will vary depending on the conditions of use.

OCCUPATIONAL EXPOSURE LIMITS (Current ACGIH TLV/TWA unless otherwise noted):

North American exposure limits have not been established for the product. Consult local and provincial authorities for acceptable values.
Gasoline: 300 ppm (STEL: 500 ppm)
Pentane: 600 ppm
Toluene: 20 ppm
Skin Notation: Absorption through skin, eyes and mucous membranes may contribute significantly to the total exposure.

Mechanical Ventilation: Concentrations in air should be maintained below the occupational exposure limit if unprotected personnel are involved. Use explosion-proof ventilation as required to control vapour concentrations. Local ventilation recommended where mechanical ventilation is ineffective in controlling airborne concentrations below the recommended occupational exposure limit. Make up air should always be supplied to balance air exhausted (either generally or locally). For personnel entry into confined spaces (i.e. bulk storage tanks) a proper confined space entry procedure must be followed including ventilation and testing of tank atmosphere.

PERSONAL PROTECTIVE EQUIPMENT:

Eye Protection: Chemical safety goggles and/or full face shield to protect eyes and face, if product is handled such that it could be splashed into eyes. Provide an eyewash station in the area.

Skin Protection: Avoid contact with skin. Use protective clothing and gloves manufactured from nitrile. Impervious gloves (viton, nitrile) should be worn at all times when handling this material. Safety showers should be available for emergency use.

Respiratory Protection: Avoid breathing vapour or mists. If exposure has the potential to exceed occupational exposure limits, use an appropriate NIOSH-approved respirator. For high airborne concentrations, use a NIOSH-approved supplied-air respirator, either self-contained or airline breathing apparatus, operated in positive pressure mode.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Volatile Liquid
Appearance:	Blue Colour Clear
Odour:	Typical Gasoline Odour
Odour Threshold:	Not available
Freezing/Pour Point:	Freeze Point < -58 °C
Boiling Point:	70 - 170 °C
Density:	Not available
Vapour Density (Air = 1):	Not available
Vapour Pressure (absolute):	38 - 49 kPa @ 38 °C
pH:	Not applicable
Flash Point:	TCC < 1 °C
Lower Flammable Limit:	1.4 % (vol.)
Upper Flammable Limit:	7.6 % (vol.)
Autoignition Temperature:	Not available
Viscosity:	Not available
Evaporation Rate (n-BuAc = 1):	Not available
Partition Coefficient (log K_{OW}):	Not available
Water Solubility:	Insoluble
Other Solvents:	Hydrocarbon Solvents

10. STABILITY AND REACTIVITY

Chemically Stable:	Yes
Hazardous Polymerization:	No
Sensitive to Mechanical Impact:	No
Sensitive to Static Discharge:	Yes
Incompatible Materials:	Avoid contact with strong oxidizing agents and acids.
Conditions of Reactivity:	Avoid excessive heat, open flames and all ignition sources.

11. TOXICOLOGICAL INFORMATION

Ingredient (or Product if not specified)	Toxicological Data
Naphtha (Petroleum), Light Alkylate	LC50 Inhalation Rat > 11000 mg/m3 for 4hours LD50 Dermal Rat > 4000 mg/kg LD50 Oral Rat > 8000 mg/kg

Toluene	LD50 Oral Rat = 5000 mg/kg LC50 Inhalation Rat = 8000 ppm for 4 hours LD50 Dermal Rabbit = 14000 mg/kg
i-Pentane	
Ethanol, 2-(2-methoxyethoxy)-	LD50 Oral Rat 4140 - 5180 mg/kg LD50 Dermal Rabbit > 2000 mg/kg

Routes of Exposure: Exposure will most likely occur through skin contact or inhalation.

Formulation: No data is specifically available for this product and therefore this toxicological information is based on testing completed with the ingredients.

Irritancy: Based on the ingredients, this product is expected to be irritating to skin.

Acute Toxicity: Vapour concentrations above the recommended exposure level are irritating to the eyes and respiratory tract, may cause headaches and dizziness, are anesthetic and may have other central nervous system effects.

Chronic Effects: Prolonged and repeated contact with skin can cause defatting and drying of the skin resulting in skin irritation and dermatitis. Prolonged exposure to high vapour concentration can cause headache, dizziness, nausea, blurred vision and central nervous system depression. This product contains low levels of lead. Chronic, low grade exposure to lead compounds could lead to insomnia, anorexia, nausea and vomiting, diarrhea, anemia, sensory loss and muscular weakness.

Feto/Teratogenicity: A component of this product has shown adverse effects on the growth and development of the fetus in some animal studies.

Pre-existing Conditions: Pre-existing eye, skin and respiratory disorders may be aggravated by exposure to this product.

12. ECOLOGICAL INFORMATION

Do not allow product or runoff from fire control to enter storm or sanitary sewers, lakes, rivers, streams, or public waterways. Block off drains and ditches. Provincial regulations require and federal regulations may require that environmental and/or other agencies be notified of a spill incident. Spill area must be cleaned and restored to original condition or to the satisfaction of authorities.

Biodegradability: Readily biodegradable.
Rapid volatilization.

Bioaccumulation: Not likely to bioaccumulate.

Partition Coefficient (log K_{OW}): Not available

Aquatic Toxicity: Product is expected to be toxic to aquatic organisms.

Ingredient:	**Toxicological Data**
Naphtha (Petroleum), Light Alkylate	LL50 (WAF method) Rainbow Trout (96hr) 1 - 10 mg/L. EL50 (WAF method) Daphnia Magna (48hr) 1 - 10 mg/L. EL50 - growth rate (WAF method) Algae (72hr) 1 - 10 mg/L.
Toluene	LL50 Rainbow Trout (96hr) 10 - 100 mg/L. EL50 Daphnia Magna (48hr) 10 - 100 mg/L. EL50 - growth rate Algae (72hr) 10 - 100 mg/L.
i-Pentane	
Ethanol, 2-(2-methoxyethoxy)-	

Definition(s): LL and EL are the lethal loading concentration and effective loading concentration

respectively. The concentration represents the amount of substance added to the system to obtain a toxic concentration. They replace the traditional LC and EC for low solubility substances.
WAF is the water accommodated fraction. A slightly soluble hydrocarbon is stirred into water and the insoluble portions are removed. The remaining solution is the water accommodated fraction.

13. DISPOSAL CONSIDERATIONS

Waste management priorities (depending on volumes and concentration of waste) are: 1. recycle (reprocess), 2. energy recovery 3. incineration, 4. disposal at a licenced waste disposal facility. Do not attempt to combust waste on-site. Incinerate at a licenced waste disposal site with approval of environmental authority.

14. TRANSPORT INFORMATION

Canadian Road and Rail Shipping Classification:

UN Number	UN1203
Proper Shipping Name	GASOLINE
Hazard Class	Class 3 Flammable Liquids
Packing Group	PG II
Additional Information	Marine Pollutant
Shipping Description	GASOLINE Class 3 UN1203 PG II Marine Pollutant

15. REGULATORY INFORMATION

This product has been classified in accordance with the hazard criteria of the *Controlled Products Regulations* (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Class:	Class B2 Flammable Liquid Class D2A Embryo/Fetotoxicity Class D2B Skin Irritation
DSL/NDSL Status:	This product, or all components, are listed on the Domestic Substances List, as required under the Canadian Environmental Protection Act.
Other Regulatory Status:	No Canadian federal standards. Provincial criteria are likely and should be requested when notifying provincial authorities.

16. OTHER INFORMATION

LABEL STATEMENTS

Hazard Statement :	Flammable Liquid. Irritating to skin. May be absorbed by skin contact.
Handling Statement:	Eliminate all ignition sources. Wear suitable gloves and eye protection. Bond and ground transfer containers and equipment to avoid static accumulation. Empty containers are hazardous, may contain flammable / explosive dusts, liquid

residue or vapours. Keep away from sparks and open flames.
Avoid prolonged exposure to vapours.

First Aid Statement : Wash contaminated skin with soap and water.
Flush eyes with water.
If overcome by vapours remove to fresh air.
Do not induce vomiting.
Obtain medical attention.

Revisions: This MSDS has been reviewed and updated. Changes have been made to: Section 1 Section 2 Section 3 Section 4 Section 5 Section 6 Section 7 Section 8 Section 9 Section 10 Section 11 Section 12 Section 15

General Chemical

Material Safety Data Sheet

CALCIUM CHLORIDE, FLAKE

A. GENERAL INFORMATION

TRADE NAME (COMMON NAME): FLAKE CALCIUM CHLORIDE	**CAS NUMBER:** 10043-52-4 (anhydrous)
CHEMICAL NAME AND/OR SYNONYM: Calcium Chloride, Dihydrate	
FORMULA: $CaCl_2 \cdot 2H_2O$	**MOLECULAR WEIGHT:** 147.02
MANUFACTURER/ADDRESS: GENERAL CHEMICAL CORPORATION, 90 East Halsey Road, Parsippany, NJ 07054	

CONTACT:	**PHONE NUMBER:**	**LAST ISSUE DATE:**	**CURRENT ISSUE DATE:**
Manager, Product Safety	(973) 515-1840	September, 1994	May, 2001

B. FIRST AID MEASURES

EMERGENCY PHONE NUMBER: (800) 631-8050

EYES: Flush promptly with plenty of water, continuing for at least 15 minutes. Get medical attention.

SKIN: Wash with plenty of water.

INHALATION: Remove to fresh air.

INGESTION: If conscious, immediately give 2 to 4 glasses of water, and induce vomiting by touching finger to back of throat.

Get medical attention for irritation, ingestion, or discomfort from inhalation.

C. HAZARDS INFORMATION

INHALATION:
Dust or mist inhalation may irritate nose, throat, and lungs.

INGESTION:
Low in toxicity. LD_{50} (rat): 1.4 g/kg.* - Reference (e)
May irritate gastrointestinal tract. *anhydrous basis.

SKIN:
May cause skin irritation. Under conditions of prolonged contact or when moisture is present, superficial burns may result. Contact with abraded skin or cuts can cause severe necrosis.

EYES:
May irritate or burn eyes.

PERMISSIBLE CONCENTRATION: AIR
(SEE SECTION J)
Also, no TLV established by ACGIH.

BIOLOGICAL
None

UNUSUAL CHRONIC TOXICITY:
None.

C. HAZARDS (Cont.)

FLASH POINT: Not flammable OPEN CUP ☐ CLOSED CUP ☐	AUTO IGNITION TEMPERATURE NA	FLAMMABLE LIMITS IN AIR (% BY VOL.) LOWER - NA UPPER - NA
UNUSUAL FIRE AND EXPLOSION HAZARDS See hazard of contact with zinc as in galvanized iron: Section G.		

D. PRECAUTIONS/PROCEDURES

FIRE EXTINGUISHING AGENTS RECOMMENDED:
NA

FIRE EXTINGUISHING AGENTS TO AVOID:
NA

SPECIAL FIREFIGHTING PRECAUTIONS:
None.

VENTILATION:
Local exhaust: In packaging and uploading areas, over open processing equipment, and any other places where dusty or misty condition prevails.
Natural ventilation: Adequate for other areas.

NORMAL HANDLING:
Avoid contact with eyes, skin or clothing. Avoid breathing mist. Use good personal hygiene and housekeeping.

STORAGE:
Store in a cool, dry area. Prolonged storage may cause product to cake and become wet from atmospheric moisture.

SPILL OR LEAK (ALWAYS WEAR PERSONAL PROTECTIVE QUIPMENT – SECTION E)
Shovel up dry chemical and place in metal drum with a cover. Cautiously spray residue with plenty of water.

SPECIAL: PRECAUTIONS/PROCEDURES/LABEL INSTRUCTIONS:

SIGNAL WORD
WARNING!

E. PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY PROTECTION:
For dusty or misty condition, wear NIOSH-approved mist respirator.

EYES AND FACE:
For dusty or misty condition, or when handling solution where there is reasonable probability of eye contact, wear chemical safety goggles and hat. Under these conditions, do not wear contact lenses.

HANDS, ARMS, AND BODY:
As a minimum, wear long-sleeve shirt and trousers, boots, and gloves for routine product use.
Cotton gloves permitted for dry product, impervious gloves when using solutions.

OTHER CLOTHING AND EQUIPMENT:
Eye-wash facility.

F. PHYSICAL DATA

MATERIAL IS AT NORMAL CONDITIONS: **LIQUID** ☐ **SOLID** ☒ **GAS** ☐ ☐ ____________		**APPEARANCE AND COLOR:** Small white flakes; odorless.
BOILING POINT: Unknown °C **MELTING POINT:** 176 °C	**SPECIFIC GRAVITY:** **(H_2O = 1)** 0.835 - Reference (b)	**VAPOR DENSITY:** **(AIR =1)** NA: water vapor only.
SOLUBILITY IN WATER: **(% BY WEIGHT)** 42 (anhydrous) @ 20°C	**pH:** Neutral or slightly alkaline - Reference (c).	**VAPOR PRESSURE:** (mm Hg @ 20°C) ☐ (PSIG) ☐ NA
EVAPORATION RATE: (Butyl acetate=1) ☐ (Ether = 1.0) ☐ NA	**% VOLATILES BY VOLUME:** **(AT 20°C)** NA	

G. REACTIVITY DATA

STABILITY: **UNSTABLE** ☐ **STABLE** ☒	**CONDITIONS TO AVOID:** NA

INCOMPATIBILITY (MATERIALS TO AVOID):
Sulfuric acid: yields hydrogen chloride gas, which is corrosive, irritating, and reactive. Water-reactive materials, such as sodium: cause an exothermic reaction. Methyl vinyl ether: starts runaway polymerization reaction – Reference (d). Zinc as in galvanized iron: yields hydrogen gas with solutions, which may explode under these conditions. – Reference (d).

HAZARDOUS DECOMPOSITION PRODUCTS:

None.

HAZARDOUS POLYMERIZATION: **MAY OCCUR** ☐ **WILL NOT OCCUR** ☒	**CONDITIONS TO AVOID:** NA

H. HAZARDOUS INGREDIENTS (MIXTURES ONLY)

MATERIAL OR COMPONENT/C.A.S. #	WT.%	HAZARD DATA (See Sect. J)
NA		

I. ENVIRONMENTAL

DEGRADABILITY/AQUATIC TOXICITY: Aquatic Toxicity: TLm96: over 1000 ppm (anhydrous) – Reference (a).	**OCTANOL/WATER PARTITION COEFFICIENT** NA

EPA HAZARDOUS SUBSTANCE? **(CLEAN WATER ACT SECT. 311)** **YES** ☐ **NO** ☒ **IF SO, REPORTABLE QUANTITY:**	**40 CFR 116-117**

WASTE DISPOSAL METHODS (DISPOSER MUST COMPLY WITH FEDERAL, STATE AND LOCAL DISPOSAL OR DISCHARGE LAWS):

Treatment or disposal of waste generated by use of this product should be reviewed in terms of applicable federal, state and local laws and regulations. Users are advised to consult with appropriate regulatory agencies before discharge, treatment or disposal.

RCRA STATUS OF UNUSED MATERIAL IF DISCARDERD: Not a "hazardous waste".	**HAZARDOUS WASTE NUMBER: (IF APPLICABLE)** --	**40 CFR 261**

J. REFERENCES

PERMISSIBLE CONCENTRATIONS REFERENCES:

None.

REGULATORY STANDARDS None.	**DOT CLASSIFICATION:** Not regulated	**49 CFR 173**

GENERAL:

(a) NIOSH, Registry of Toxic Effects of Chemical Substances, 1979, Accession No. EV 98 00 000.
(b) Weast, R.C. editor, CRC Handbook of Chemistry and Physics, 60th Edition, 1979-80, CRC Press, Inc., Boca Raton 33431.
(c) Hawley, G.N., editor, Condensed Chemical Dictionary, 9th Edition, 1977, Van Nostrand Reinhold, NYC.
(d) Brethwick, L., Handbook of Reactive Chemical Hazards, 2nd Edition, 1979, Butterworths, Boston.
(e) General Chemical Corporation tests, unpublished. (A solution of 25 g/100 ml water was used).

K. ADDITIONAL INFORMATION

None.

GC-1002

Material Safety Data Sheet

Dyno Nobel Inc.
2650 Decker Lake Boulevard, Suite 300
Salt Lake City, Utah 84119
Phone: 801-364-4800 Fax: 801-321-6703
E-Mail: dnna.hse@am.dynonobel.com
FOR 24 HOUR EMERGENCY, CALL CHEMTREC (USA) 800-424-9300
CANUTEC (CANADA) 613-996-6666

MSDS # 1108
Date 08/05/08

Supercedes
MSDS # 1108 01/23/06

SECTION I - PRODUCT IDENTIFICATION

Trade Name(s):

DYNO® CORD SENSITIVE BOOSTERS - CS35, CS45, CS90, CS135

TROJAN® SPARTAN®
TROJAN® SPARTAN® Slider
TROJAN® Stinger
TROJAN® NB
TROJAN® NB UNIVERSAL
TROJAN® Twinplex

Product Class: Cast Boosters

Product Appearance & Odor: Tan to brown solid with no odor. May also be silvery gray. Packaged in paper or plastic tube.

DOT Hazard Shipping Description: Booster 1.1D UN0042 II

NFPA Hazard Classification: Not Available (See Section IV - Special Fire Fighting Procedures)

SECTION II - HAZARDOUS INGREDIENTS

			Occupational Exposure Limits	
Ingredients:	**CAS#**	**% (Range)**	**ACGIH TLV-TWA**	**OSHA PEL-TWA**
Pentaerythritol Tetranitrate (PETN)	78-11-5	35-70	None Established	None Established
Trinitrotoluene	118-96-7	30-50	0.1 mg/m^3 (skin)	1.5 mg/m^3 (skin)
RDX	121-82-4	0-25	0.5 mg/m^3 (skin)	1.5 mg/m^3 (skin)
HMX	2691-41-0	0-5	None Established	None Established
Aluminum	7429-90-5	0-15	10 mg/m^3 (dust)	15 mg/m^3 (total)

Ingredients, other than those mentioned above, as used in this product are not hazardous as defined under current Department of Labor regulations, or are present in deminimus concentrations (less than 0.1% for carcinogens, less than 1.0% for other hazardous materials).

SECTION III - PHYSICAL DATA

Melting Point: 176° F (80° C) (TNT)
Vapor Density: Not applicable
Percent Volatile by Volume: Not applicable
Evaporation Rate (Butyl Acetate = 1): Not applicable

Vapor Pressure: 0.042mm Hg at 80° C (TNT)
Density: 1.55 - 1.65 g/cc
Solubility in Water: < 0.01%

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: Not applicable
Flammable Limits: Not applicable
Extinguishing Media: (See Special Fire Fighting Procedures section).
Special Fire Fighting Procedures: Do not attempt to fight fires involving explosive materials. Evacuate all personnel to a predetermined safe location, no less than 2,500 feet in all directions.
Unusual Fire and Explosion Hazards: Can explode or detonate under fire conditions. Burning material may produce toxic vapors.

SECTION V - HEALTH HAZARD DATA

Effects of Overexposure

Eyes: Particulates in the eye may cause irritation, redness, and tearing. Prolonged or repeated contact may cause cataracts, optic neuritis, blurred vision or amblyopia.
Skin: Prolonged contact may cause irritation, severe eczema and sensitization dermatitis. TNT may be absorbed through the skin, which may be indicated by orange staining on exposed skin. See systemic effects below.
Ingestion: Harmful if swallowed. See systemic effects below.
Inhalation: Inhalation of dusts may cause irritation, sneezing or coughing. See systemic effects below.
Systemic or Other Effects: TNT is an irritant, neurotoxin, hepatotoxin, nephrotoxin and bone marrow depressant. Although exposure is unlikely, acute or chronic exposure may cause sensitization dermatitis, headache, dizziness, jaundice, lethargy, or problems with the liver or blood such as toxic nephritis, aplastic anemia, hemolytic anemia or methemoglobin formation. **PETN** is a known coronary vasodilator, and ingestion or inhalation may result in a lowering of blood pressure, headache or faintness, and a decreased tolerance for grain alcohol. Repeated over-exposure may result in chest pains in the absence of exposure.

Emergency and First Aid Procedures

Eyes: Irrigate with running water for at least fifteen minutes. If irritation persists, seek medical attention.
Skin: Remove contaminated clothing. Wash skin thoroughly with soap and water.
Ingestion: Seek medical attention.
Inhalation: In case of irritation, remove to fresh air. Seek medical attention if chronic symptoms occur.
Special Considerations: None.

SECTION VI - REACTIVITY DATA

Stability: Stable under normal conditions, may explode when subjected to fire, supersonic shock or high-energy projectile impact, especially when confined or in large quantities.
Conditions to Avoid: Keep away from heat, flame, friction, impact, ignition sources and strong shock.
Materials to Avoid (Incompatibility): Corrosives (strong acids and bases or alkalis).
Hazardous Decomposition Products: Nitrogen Oxides (NO_X), Carbon Monoxide (CO)
Hazardous Polymerization: Will not occur.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in Case Material is Released or Spilled: Protect from all ignition sources. In case of fire evacuate area not less than 2,500 feet in all directions. Notify authorities in accordance with emergency response procedures. Only personnel trained in emergency response should respond. If no fire danger is present, and product is undamaged and/or uncontaminated, repackage product in original packaging or other clean DOT approved container. Ensure that a complete account of product has been made and is verified. Follow applicable Federal, State and local spill reporting requirements.
Waste Disposal Method: Disposal must comply with Federal, State and local regulations. If product becomes a waste, it is potentially regulated as a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR, part 261. Review disposal requirements with a person knowledgeable with applicable environmental law (RCRA) before disposing of any explosive material.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation: Not required for normal handling.
Respiratory Protection: None normally required.
Protective Clothing: Non-permeable gloves and work clothing that reduce skin contact are recommended.
Eye Protection: Safety glasses are recommended.
Other Precautions Required: None.

SECTION IX - SPECIAL PRECAUTIONS

Precautions to be taken in handling and storage: Store in cool, dry location. Store in compliance with all Federal, State and local regulations. Keep away from heat, flame, ignition sources or strong shock.
Precautions to be taken during use: Avoid breathing the fumes or gases from detonation of explosives. Use accepted safe industry practices when using explosive materials. Unintended detonation of explosives or explosive devices can cause serious injury or death.
Other Precautions: It is recommended that users of explosives material be familiar with the Institute of Makers of Explosives Safety Library publications.

SECTION X - SPECIAL INFORMATION

This product contains the following substances that are subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

Chemical Name	CAS Number	% By Weight
None Applicable		

Disclaimer

Shell Canada Limited
Material Safety Data Sheet
Effective Date: 2008-10-30
Supersedes: 2005-11-07

Class B3 Combustible Liquid Class D2B Skin Irritation

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT: **ULTRA LOW SUL. DIESEL FUEL MARKED CP -43 - GEN. ELECTRICITY**
PRODUCT USE: Fuel
PRODUCT CODE: **329-143**

SUPPLIER	TELEPHONE NUMBERS	
Shell Canada Limited (SCL)	**Shell Emergency Number**	1-800-661-7378
P.O. Box 100, Station M	**CANUTEC 24 HOUR EMERGENCY NUMBER**	1-613-996-6666
400-4th Ave. S.W.	For general information:	1-800-661-1600
Calgary, AB Canada		www.shell.ca
T2P 2H5		

This MSDS was prepared by the Toxicology and Product Stewardship Section of Shell Canada Limited.
*An asterisk in the product name designates a trade-mark(s) of Shell Canada Limited, used under license by Shell Canada Products.

2. COMPOSITION/INFORMATION ON INGREDIENTS

Component Name	CAS Number	% Range	WHMIS Controlled
Fuels, Diesel, No. 2	68476-34-6	> 99	Yes

See Section 8 for Occupational Exposure Guidelines.

3. HAZARDS IDENTIFICATION

Physical Description: Liquid Red Colour Dyed for tax purposes Hydrocarbon Odour
Routes of Exposure: Exposure will most likely occur through skin contact or inhalation.
Hazards:
Vapour concentrations above the recommended exposure level are irritating to the eyes and respiratory tract, may cause headaches and dizziness, are anesthetic and may have other central nervous system effects.
Combustible Liquid.
Irritating to skin.
Ingestion may result in vomiting. Avoid aspiration of vomitus into lungs as small quantities may result in aspiration pneumonitis.

Handling: Eliminate all ignition sources.
Wear suitable gloves and eye protection.

Bond and ground transfer containers and equipment to avoid static accumulation.
Empty containers are hazardous, may contain flammable / explosive dusts, liquid residue or vapours. Keep away from sparks and open flames.
Avoid prolonged exposure to vapours.

For further information on health effects, see Section 11.

4. FIRST AID MEASURES

Eyes: Flush eyes with water for at least 15 minutes while holding eyelids open. If irritation occurs and persists, obtain medical attention.

Skin: Wipe excess from skin. Wash contaminated skin with mild soap and water for at least 15 minutes. If irritation occurs and persists, obtain medical attention.

Ingestion: DO NOT INDUCE VOMITING! OBTAIN MEDICAL ATTENTION IMMEDIATELY. Guard against aspiration into lungs by having the individual turn on to their left side. If vomiting occurs spontaneously, keep head below hips to prevent aspiration of liquid into the lungs. Do not give anything by mouth to an unconscious person.

Inhalation: Remove victim from further exposure and restore breathing, if required. Obtain medical attention.

Notes to Physician: The main hazard following accidental ingestion is aspiration of the liquid into the lungs producing chemical pneumonitis. If more than 2.0 mL/kg has been ingested, vomiting should be induced with supervision. If symptoms such as loss of gag reflex, convulsions or unconsciousness occur before vomiting, gastric lavage with a cuffed endotracheal tube should be considered.

5. FIRE FIGHTING MEASURES

Extinguishing Media: Dry Chemical
Carbon Dioxide
Foam
Water Fog

Firefighting Instructions: Caution - Combustible. Do not use a direct stream of water as it may spread fire. Do not enter confined fire space without adequate protective clothing and an approved positive pressure self-contained breathing apparatus. Avoid inhalation of smoke. Vapour forms a flammable/explosive mixture with air between upper and lower flammable limits. Vapours may travel along ground and flashback along vapour trail may occur. Product will float and can be reignited on surface of water. Containers exposed to intense heat may rupture. Use water to cool fire exposed containers. Delayed lung damage can be experienced after exposure to combustion products, sometimes hours after the exposure.

Hazardous Combustion Products: A complex mixture of airborne solid, liquid, particulates and gases will evolve when this material undergoes pyrolysis or combustion. Carbon dioxide, carbon monoxide and unidentified organic compounds may be formed upon combustion.

6. ACCIDENTAL RELEASE MEASURES

Issue warning "Combustible". Eliminate all ignition sources. Isolate hazard area and restrict access. Wear appropriate breathing apparatus (if applicable) and protective clothing. Handling equipment must be grounded. Work upwind of spill if it is safe to do so. Avoid direct contact with material. Stop leak only if safe to do so. Dike and contain land spills; contain spills to water by booming. Use water fog to knock down vapours; contain runoff. Adsorb residue or small spills with adsorbent material and remove to non-leaking containers for disposal. Notify appropriate environmental agency(ies). After area has been cleaned up to the satisfaction of regulatory authorities, flush area with water to remove trace residue. Dispose of recovered material as noted under Disposal Considerations.

7. HANDLING AND STORAGE

Handling: Combustible. Avoid excessive heat, sparks, open flames and all other sources of ignition. Fixed equipment as well as transfer containers and equipment should be grounded to prevent accumulation of static charge. Vapours are heavier than air and will settle and collect in low areas and pits, displacing breathing air. Extinguish pilot lights, cigarettes and turn off other sources of ignition prior to use and until all vapours are gone. Vapours may accumulate and travel to distant ignition sources and flashback. Do not cut, drill, grind, weld or perform similar operations on or near containers. Empty containers are hazardous, may contain flammable/explosive dusts, residues or vapours. Do not pressurize drum containers to empty them. Wash with soap and water prior to eating, drinking, smoking, applying cosmetics or using toilet facilities. Launder contaminated clothing prior to reuse. Use good personal hygiene.

Storage: Store in a cool, dry, well ventilated area, away from heat and ignition sources. Keep container tightly closed.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

The following information, while appropriate for this product, are general in nature. The selection of personal protective equipment will vary depending on the conditions of use.

OCCUPATIONAL EXPOSURE LIMITS (Current ACGIH TLV/TWA unless otherwise noted):

Diesel fuel, as total hydrocarbons (skin): 100 mg/m3
Skin Notation: Absorption through skin, eyes and mucous membranes may contribute significantly to the total exposure.

Mechanical Ventilation: Concentrations in air should be maintained below the occupational exposure limit if unprotected personnel are involved. Use explosion-proof ventilation as required to control vapour concentrations. Local ventilation recommended where mechanical ventilation is ineffective in controlling airborne concentrations below the recommended occupational exposure limit. Make up air should always be supplied to balance air exhausted (either generally or locally). For personnel entry into confined spaces (i.e. bulk storage tanks) a proper confined space entry procedure must be followed including ventilation and testing of tank atmosphere.

PERSONAL PROTECTIVE EQUIPMENT:

Eye Protection: Chemical safety goggles and/or full face shield to protect eyes and face, if product is handled such that it could be splashed into eyes. Provide an eyewash station in the area.

Skin Protection: Impervious gloves (viton, nitrile) should be worn at all times when handling this material. In confined spaces or where the risk of skin exposure is much higher, impervious clothing should be worn. Safety showers should be available for emergency use.

Respiratory Protection: If exposure exceeds occupational exposure limits, use an appropriate NIOSH-approved respirator. Use a NIOSH-approved chemical cartridge respirator with organic vapour cartridges or use a NIOSH-approved supplied-air respirator. For high airborne concentrations, use a NIOSH-approved supplied-air respirator, either self-contained or airline breathing apparatus, operated in positive pressure mode.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Liquid
Appearance: Red Colour Dyed for tax purposes
Odour: Hydrocarbon Odour
Odour Threshold: Not available
Freezing/Pour Point: Varies with region and season
Boiling Point: 150 - 330 °C
Density: < 876 kg/m3 @ 15 °C
Vapour Density (Air = 1): Not available
Vapour Pressure (absolute): Not available
pH: Not available
Flash Point: PMCC > 40 °C
Lower Flammable Limit: 1 % (vol.)
Upper Flammable Limit: 6 % (vol.)
Autoignition Temperature: 250 °C
Viscosity: 1.4 - 4.1 cSt @ 40 °C
Evaporation Rate (n-BuAc = 1): Not available
Partition Coefficient (log K_{OW}): Not available
Water Solubility: Insoluble

10. STABILITY AND REACTIVITY

Chemically Stable: Yes
Hazardous Polymerization: No
Sensitive to Mechanical Impact: No
Sensitive to Static Discharge: Yes
Hazardous Decomposition Products: Thermal decomposition products are highly dependent on combustion conditions.
Incompatible Materials: Avoid strong oxidizing agents.
Conditions of Reactivity: Avoid excessive heat, open flames and all ignition sources.

11. TOXICOLOGICAL INFORMATION

Ingredient (or Product if not specified)	Toxicological Data
Fuels, Diesel, No. 2	LD50 Oral Rat = 9000 mg/kg LD50 Dermal Rabbit > 5000 mg/kg

Routes of Exposure: Exposure will most likely occur through skin contact or inhalation.
Irritancy: This product is expected to be irritating to skin but is not predicted to be a skin sensitizer.
Acute Toxicity: Vapour concentrations above the recommended exposure level are irritating to the eyes and respiratory tract, may cause headaches and dizziness, are anesthetic and

may have other central nervous system effects.

Chronic Effects: Prolonged and repeated contact with skin can cause defatting and drying of the skin resulting in skin irritation and dermatitis. Prolonged exposure to high vapour concentration can cause headache, dizziness, nausea, blurred vision and central nervous system depression.

Pre-existing Conditions: Pre-existing eye, skin and respiratory disorders may be aggravated by exposure to this product.

Carcinogenicity and Mutagenicity: The International Agency for Research on Cancer (IARC) considers that this product is not classifiable as to its carcinogenicity to humans. Middle distillates have caused skin cancers in laboratory animals when applied repeatedly and left in place between applications. This effect is believed to be caused by the continuous irritation of the skin. Good personal hygiene should be maintained to avoid this risk. The American Conference of Governmental Industrial Hygienists (ACGIH) has classified this product as A3 - confirmed animal carcinogen with unknown relevance to humans.

12. ECOLOGICAL INFORMATION

Do not allow product or runoff from fire control to enter storm or sanitary sewers, lakes, rivers, streams, or public waterways. Block off drains and ditches. Provincial regulations require and federal regulations may require that environmental and/or other agencies be notified of a spill incident. Spill area must be cleaned and restored to original condition or to the satisfaction of authorities. May cause physical fouling of aquatic organisms. The immediate effect of a release is the physical impairment of the environment from the coating of surfaces, resulting in the disruption of oxygen, water and light to flora and fauna. Prolonged exposure may result in the partitioning of light-end hydrocarbon fractions into the water and gas phases of the subsurface soil environment, adversely affecting the soil quality.

Biodegradability: Not readily biodegradable.

Bioaccumulation: Potential for bioaccumulation.
Potential for bioconcentration.

Partition Coefficient (log K_{OW}): Not available

Aquatic Toxicity: Product is expected to be toxic to aquatic organisms.

Ingredient:	Toxicological Data
Fuels, Diesel, No. 2	LL50 (WAF method) Rainbow Trout (96hr) 10 - 100 mg/L. EL50 Daphnia Magna (48hr) 10 - 100 mg/L. EL50 - growth rate Algae (72hr) 10 - 100 mg/L.

Definition(s): LL and EL are the lethal loading concentration and effective loading concentration respectively. The concentration represents the amount of substance added to the system to obtain a toxic concentration. They replace the traditional LC and EC for low solubility substances.
WAF is the water accommodated fraction. A slightly soluble hydrocarbon is stirred into water and the insoluble portions are removed. The remaining solution is the water accommodated fraction.

13. DISPOSAL CONSIDERATIONS

Waste management priorities (depending on volumes and concentration of waste) are: 1. recycle (reprocess), 2. energy recovery 3. incineration, 4. disposal at a licenced waste disposal facility. Do not attempt to combust waste on-site. Incinerate at a licenced waste disposal site with approval of environmental authority.

14. TRANSPORT INFORMATION

Canadian Road and Rail Shipping Classification:

UN Number	UN1202
Proper Shipping Name	DIESEL FUEL
Hazard Class	Class 3 Flammable Liquids
Packing Group	PG III
Additional Information	Not Regulated in Containers Less Than or Equal to 450 Litres.
Shipping Description	DIESEL FUEL Class 3 UN1202 PG III Not Regulated in Containers Less Than or Equal to 450 Litres.

15. REGULATORY INFORMATION

This product has been classified in accordance with the hazard criteria of the *Controlled Products Regulations* (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Class:	Class B3 Combustible Liquid Class D2B Skin Irritation
DSL/NDSL Status:	This product, or all components, are listed on the Domestic Substances List, as required under the Canadian Environmental Protection Act. This product and/or all components are listed on the U.S. EPA TSCA Inventory.
Other Regulatory Status:	Provincial criteria are likely and should be requested when notifying provincial authorities. The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

16. OTHER INFORMATION

LABEL STATEMENTS

Hazard Statement :	Combustible Liquid. Irritating to skin.
Handling Statement:	Eliminate all ignition sources. Wear suitable gloves and eye protection. Bond and ground transfer containers and equipment to avoid static accumulation. Empty containers are hazardous, may contain flammable / explosive dusts, liquid residue or vapours. Keep away from sparks and open flames. Avoid prolonged exposure to vapours.
First Aid Statement :	Wash contaminated skin with soap and water. Flush eyes with water. If overcome by vapours remove to fresh air. Do not induce vomiting. Obtain medical attention.
Revisions:	This MSDS has been reviewed and updated. Changes have been made to: Section 1 Section 3 Section 4 Section 5 Section 6 Section 12 Section 15

Material Safety Data Sheet

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CANUTEC (CANADA) 613-996-6666

MSDS # 1126
Date 08/13/08

Supercedes
MSDS # 1126 01/24/05

SECTION I - PRODUCT IDENTIFICATION

Trade Name(s): PRIMALINE®
PRIMACORD®
PRIMASHEAR™
OPTICORD®
GEOSEIS®
LOW FLEX™
FIRELINE CORD

Product Class: Detonating Cord

Product Appearance & Odor: Flexible cord of woven textile with a protected explosive core of PETN (white crystalline powder) and covered by a white or colored plastic or textile jacket. May have a waxed finish. No odor.

DOT Hazard Shipping Description: UN0065 Cord, Detonating 1.1D II

NFPA Hazard Classification: Not Applicable (See Section IV - Special Fire Fighting Procedures)

SECTION II - HAZARDOUS INGREDIENTS

Ingredients	CAS#	%	Occupational Exposure Limits OSHA PEL-TWA	ACGIH TLV-TWA
Pentaerythritol tetranitrate (PETN)	78-11-5	-----*	None[1]	None[2]

[1] Use limit for particulates not otherwise regulated (PNOR): Total dust, 15 mg/m^3 ; respirable fraction, 5 mg/m^3.
[2] Use limit for particulates not otherwise classified (PNOC): Inhalable particulate, 10 mg/m^3 ; respirable part., 3 mg/m^3.
Ingredients, other than those mentioned above, as used in this product are not hazardous as defined under current Department of Labor regulations, or are present in deminimus concentrations (less than 0.1% for carcinogens, less than 1.0% for other hazardous materials).
* Core powder is 100% PETN. The approximate amount of PETN in a given grade of cord is expressed as that number of grams of PETN per linear meter of cord. Range is from 1 to 280 gram/meter. Example: PRIMALINE® 5 contains approximately 5 grams PETN per meter of cord. (1 gram/meter = 4.7 grains/foot)

SECTION III - PHYSICAL DATA

Boiling Point: Not Applicable (PETN decomposes at melting point, about 141°C)
Vapor Pressure: Not Applicable
Vapor Density: (Air = 1) Not Applicable
Percent Volatile by Volume: Not Applicable
Solubility in Water: Insoluble.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Extinguishing Media: (See Special Fire Fighting Procedures section.)
Special Fire Fighting Procedures: Do not attempt to fight fires involving explosive materials. Evacuate all personnel to a predetermined safe, distant location. Allow fire to burn unless it can be fought remotely or with fixed extinguishing systems (sprinklers). For transportation fires involving large quantities of detonating cord, such as a trailer load, evacuate no less than 2,500 feet in all directions.
Unusual Fire and Explosion Hazards: Can explode or detonate under fire conditions. Burning or detonating material may produce toxic vapors.

SECTION V - HEALTH HAZARD DATA

Effects of Overexposure
This is a packaged product that will not result in exposure to the explosive core material under normal conditions of use.

Eyes: May cause irritation, redness and tearing.
Skin: PETN is not known as a skin irritant or sensitizer.
Ingestion: PETN is moderately toxic if ingested. See systemic effects below.
Inhalation: See systemic effects below.
Systemic or Other Effects: PETN is a known coronary vasodilator, and ingestion or inhalation may result in a lowering of blood pressure, headache or faintness, and a decreased tolerance for grain alcohol. Repeated over-exposure may result in chest pains in the absence of exposure. Systemic effects by ingestion include dermatitis.
Carcinogenicity: No constituents are listed by NTP, IARC or OSHA.

Emergency and First Aid Procedures

Eye: Irrigate with running water for at least fifteen minutes. If irritation persists, seek medical attention.
Skin: Wash with soap and water.
Ingestion: Seek medical attention.
Inhalation: Remove to fresh air. If symptoms persist, seek medical attention.
Special Considerations: None.

SECTION VI - REACTIVITY DATA

Stability: Stable under normal conditions, may explode when subjected to fire, supersonic shock or high-energy projectile impact, especially when confined or in large quantities.
Conditions to Avoid: Keep away from heat, flame, ignition sources, impact, friction, electrostatic discharge and strong shock.
Materials to Avoid (Incompatibility): Corrosives (strong acids and strong bases or alkalis).
Hazardous Decomposition Products: Nitrogen Oxides (NO_X), Carbon Monoxide (CO)
Hazardous Polymerization: Will not occur.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in Case Material is Released or Spilled: Protect from all ignition sources. In case of fire evacuate all personnel to a safe distant area and allow to burn or fight fire remotely. Notify authorities in accordance with emergency response procedures. Only personnel trained in emergency response should respond. If explosive powder is spilled from damaged detonating cord, remove all other explosives from the spill area. Wet down and clean spilled powder using a damp sponge or rag, avoid applying friction or pressure to the explosive, and place in a (Velostat) electrically conductive bag. Contamination of this material with sand, grit or dirt will render the material more sensitive to detonation. If no fire danger is present, and product is undamaged and/or uncontaminated, repackage product in original packaging or other

clean DOT approved container. Ensure that a complete account of product has been made and is verified. Follow applicable Federal, State, and local spill reporting requirements.
Waste Disposal Method: Disposal must comply with Federal, State and local regulations. If product becomes a waste, it is potentially regulated as a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR, part 261. Review disposal requirements with a person knowledgeable with applicable environmental law (RCRA) before disposing of any explosive material.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation: Not required for normal handling.
Respiratory Protection: None normally required.
Protective Clothing: Work gloves and work clothing that reduce the possibility of skin abrasion and that would prevent contact with spilled explosive powder is suggested.
Eye Protection: Safety glasses or goggles are recommended.
Other Precautions Required: None.

SECTION IX - SPECIAL PRECAUTIONS

Precautions to be taken in handling and storage: Store in cool, dry, well-ventilated location. Store in compliance with Federal, State and local regulations. Only properly qualified and authorized personnel should handle and use explosives. Keep away from heat, flame, ignition sources, impact, friction, electrostatic discharge and strong shock.
Precautions to be taken during use: Use accepted safe industry practices when using explosive materials. Unintended detonation of explosives or explosive devices can cause serious injury or death. Avoid breathing the fumes or gases from detonation of explosives. Detonation in confined or unventilated areas may result in exposure to hazardous fumes or oxygen deficiency.
Other Precautions: It is recommended that users of explosive materials be familiar with the Institute of Makers of Explosives Safety Library Publications.

SECTION X - SPECIAL INFORMATION

This product contains the following substances that are subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

Chemical Name	CAS Number	% By Weight
None		

Disclaimer

MATERIAL SAFETY DATA SHEET

SECTION I: IDENTIFICATION OF PRODUCT

COMPANY:	**Diversity Technologies Corp.**	DATE:	Jan. 3, 2006
	8750 – 53rd Ave.	PHONE:	604-940-6050
	Edmonton, AB T6E 5G2	FAX:	604-940-6080

PRODUCT NAME: **DR-133 POLYMER**

PRODUCT USE: Drilling mud additive.
CHEMICAL FAMILY: Anionic polyacrylamides in oil-water emulsion   CAS#: Mixture

WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS)

WHMIS CLASSIFICATION: B3; D2B
WORKPLACE HAZARD: Combustible liquid; skin and eye irritant

TRANSPORTATION OF DANGEROUS GOODS (TDG)

PROPER SHIPPING NAME: Not regulated under TDG
TDG CLASSIFICATION: Not applicable
UN NUMBER (PIN): Not applicable
PACKING GROUP: Not applicable

SECTION II: HAZARDOUS INGREDIENTS

INGREDIENT	% (v/v)	CAS NUMBER	LD_{50}Oral-Rat	LC_{50}Inhal-Rat	ACGIH-TLV
Mineral spirits	30-60	64742-47-8	>5000 mg/kg	Not available	Not established
Alkylphenol ethoxylate	3-7	68412-54-4	3000 mg/kg	Not available	Not established
Ethoxylated C_{12-15} alcohol	0.5-1.5	68131-39-5	>3200 mg/kg	Not available	Not established

SECTION III: HEALTH HAZARDS

ROUTE OF ENTRY: [XX]EYE CONTACT [XX]SKIN [ ]INHALATION [XX]INGESTION
EYE CONTACT: Severe irritant. Can cause redness, tissue destruction, and irritation.
SKIN CONTACT: Irritant. Low acute dermal toxicity. Can cause redness, inflammation and irritation on prolonged contact.
INGESTION: Low acute oral toxicity. May cause nausea, diarrhea and abdominal cramps.
INHALATION: Not a likely source of exposure.

CARCINOGENICITY:	No information available.
TERATOGENICITY:	No information available.
REPRODUCTIVE TOXICITY:	No information available.
MUTAGENICITY:	No information available.
SYNERGISTIC PRODUCTS:	No information available.

SECTION IV: FIRST AID MEASURES

SKIN CONTACT:	Wash thoroughly with soap and water. If irritation develops or persists, obtain medical attention. Wash contaminated clothing prior to re-use.
EYE CONTACT:	Flush with gently flowing warm water for 15 minutes or until irritation subsides. Obtain medical attention when flushing period is complete.
INGESTION:	Do not induce vomiting. Give 1-2 glasses of water. Obtain immediate medical attention. Do not give anything by mouth if patient is unconscious, rapidly losing consciousness or convulsing.
INHALATION:	Move to fresh air. Apply oxygen or artificial respiration as required. If breathing difficulties or distress continues obtain medical attention.

SECTION V: PHYSICAL DATA

APPEARANCE AND ODOUR:	Liquid emulsion; petroleum odour	
SPECIFIC GRAVITY:	Not available	
BOILING POINT (°C):	Not available	
MELTING POINT (°C):	Not available	
SOLUBILITY IN WATER:	Forms gel	pH: 7-9 (@ 0.6%)
PERCENT VOLATILE BY VOLUME:	Not available	
EVAPORATION RATE:	Not available	
VAPOUR PRESSURE (mmHg):	Not available	
VAPOUR DENSITY (air = 1):	Not available	
BULK DENSITY:	Not applicable	

SECTION VI: FIRE AND EXPLOSION HAZARD DATA

FLASH POINT:	65°C (TCC)
FLAMMABLE LIMITS:	Not applicable
EXTINGUISHING MEDIA:	Carbon dioxide, dry chemical, foam, in preference to a water spray.
SPECIAL FIRE FIGHTING PROCEDURES:	Self contained breathing apparatus required for fire fighting personnel. Move containers from fire area, or cool with water spray, if possible.

UNUSUAL FIRE AND EXPLOSION HAZARDS:	Vapours may travel to ignition source and flash back.

SECTION VII: REACTIVITY DATA

STABILITY:	STABLE [XX] UNSTABLE [ ]
INCOMPATIBILITY (CONDITIONS TO AVOID):	Avoid contact with strong oxidizers and strong reducing agents. Avoid ignition sources.
HAZARDOUS DECOMPOSITION PRODUCTS:	Oxides of carbon and nitrogen upon combustion
HAZARDOUS POLYMERIZATION:	WILL NOT OCCUR [XX] MAY OCCUR [ ]

SECTION VIII: PREVENTATIVE MEASURES

SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:	Use approved respirators with organic vapour cartridges if TLV is exceeded.
VENTILATION:	Use in well-ventilated area, or use local exhaust ventilation, process enclosure or other engineering controls to maintain vapour/mist level below TLV.
PROTECTIVE GLOVES:	Neoprene or viton recommended.
EYE PROTECTION:	Wear chemical goggles when handling.
OTHER PROTECTIVE EQUIPMENT (Specify):	As necessary to prevent contact. Ensure eyewash station and emergency shower are available.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Avoid all contact with material. Remove contaminated clothing; launder or dry-clean before re-use. Cleanse skin thoroughly after contact, before breaks and meals and at end of work period. Product is readily removed from skin by washing thoroughly with soap and water. Store in a cool, dry location away from incompatibles. Store in original container. Empty packages contain residual hazardous material; handle and store as if full.

STEPS TO BE TAKEN IN CASE THE MATERIAL IS SPILLED OR RELEASED

Use appropriate safety equipment. Eliminate ignition sources. Stop leak if possible to do so without risk. Dike spill to prevent spread. Use vacuum to pick up large spills. Soak up residual and small spills with absorbent materials. Collect uncontaminated material for repackaging. Collect contaminated material and absorbents in appropriate container for disposal.

WASTE DISPOSAL METHOD

Dispose in accordance with federal, provincial and local regulations. It is the responsibility of the end-user to determine if material meets the criteria of hazardous waste at the time of disposal.

SECTION IX: PREPARATION

THE INFORMATION CONTAINED HEREIN IS GIVEN IN GOOD FAITH,
BUT NO WARRANTY, EXPRESSED OR IMPLIED, IS MADE.

DATE ISSUED:	January 3, 2006	BY:	Product safety committee
SUPERSEDES:	March 31, 2003	PHONE:	780-440-4923

Material Safety Data Sheet

Dyno Nobel Inc.
2650 Decker Lake Boulevard, Suite 300
Salt Lake City, Utah 84119
Phone: 801-364-4800 Fax: 801-321-6703
E-Mail: dnna.hse@am.dynonobel.com
FOR 24 HOUR EMERGENCY, CALL CHEMTREC (USA) 800-424-9300
CANUTEC (CANADA) 613-996-6666

MSDS # 1076
Date 08/13/08

Supercedes
MSDS # 1076 10/25/07

SECTION I - PRODUCT IDENTIFICATION

Trade Name(s): ELECTRIC SUPER™ COAL
ELECTRIC SUPER™ LP
ELECTRIC SUPER™ SP
ELECTRIC SUPER™ SEISMIC
ELECTRIC SUPER™ INSTANT
ELECTRIC SUPER™ DiPED™

Product Class: Detonators, Electric

Product Appearance & Odor: Metal cylinder with varying length of attached plastic coated wires.

DOT Hazard Shipping Description: UN0030 Detonators, Electric 1.1B II
Or
UN0255 Detonators, Electric 1.4B II
Or
UN0456 Detonators, Electric 1.4S II

NFPA Hazard Classification: Not Applicable (See Section IV - Special Fire Fighting Procedures)

SECTION II - HAZARDOUS INGREDIENTS

		EXPOSURE LIMITS	
Ingredients	**CAS#**	**OSHA PEL-TWA**	**ACGIH TLV-TWA**
Tungsten	7440-33-7	None[1]	5 mg/m^3 (TWA) 10 mg/m^3 (STEL)
Barium Chromate	10294-40-3	1 mg (CrO_3)/10m^3 (ceiling) 0.5 mg (Ba)/m^3	0.01 mg (Cr)/m^3 0.5 mg (Ba)/m^3
Lead Compounds	------------	0.5 mg (Pb)/m^3	0.5 mg (Pb)/m^3
Pentaerythritol Tetranitrate (PETN)	78-11-5	None[1]	None[2]
Boron	7440-42-8	No Value Established	No Value Established
Potassium Perchlorate[3]	7778-74-7	None[1]	None[2]
Diazodinitrophenol (DDNP)	4682-03-5	No Value Established	No Value Established
Nitrocellulose	9004-70-0	No Value Established	No Value Established

[1] Use limit for particulates not otherwise regulated (PNOR): Total dust, 15 mg/m^3 ; respirable fraction, 5 mg/m^3 .
[2] Use limit for particulates not otherwise classified (PNOC): Inhalable particulate, 10 mg/m^3 ; respirable part., 3 mg/m^3 .
[3] Not all delay periods contain perchlorate. Those that do contain between from about 4 to a maximum of about 25 mg perchlorate per detonator.

Ingredients, other than those mentioned above, as used in this product are not hazardous as defined under current Department of Labor regulations, or are present in deminimus concentrations (less than 0.1% for carcinogens, less than 1.0% for other hazardous materials).

SECTION III - PHYSICAL DATA

Boiling Point: Not Applicable
Vapor Density: Not Applicable
Percent Volatile by Volume: Not Applicable
Vapor Pressure: Not Applicable
Density: Not Applicable
Solubility in Water: Not Applicable

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: Not Applicable
Flammable Limits: Not Applicable
Extinguishing Media: None
Special Fire Fighting Procedures: Do not attempt to fight fires involving explosive materials. Evacuate all personnel to a predetermined safe location, no less than 2,500 feet in all directions.
Unusual Fire and Explosion Hazards: Can explode or detonate under fire conditions. Burning material may produce toxic vapors.

SECTION V - HEALTH HAZARD DATA

Effects of Overexposure

This is a packaged product that will not result in exposure to the explosive material under normal conditions of use. Exposure concerns are primarily with post-detonation reaction products, particularly heavy metal compounds.

Eyes: No exposure to chemical hazards anticipated with normal handling procedures. Particulates in the eye may cause irritation, redness and tearing.
Skin: No exposure to chemical hazards anticipated with normal handling procedures.
Ingestion: No exposure to chemical hazards anticipated with normal handling procedures.
Inhalation: Not a likely route of exposure.
Systemic or Other Effects: None anticipated with normal handling procedures. Repeated inhalation or ingestion of post-detonation reaction products may lead to systemic effects such as respiratory tract irritation, ringing of the ears, dizziness, elevated blood pressure, blurred vision and tremors. Heavy metal (lead) poisoning can occur.
Carcinogenicity: ACGIH classifies Lead as a "Suspected Human Carcinogen" and insoluble Chromium VI as "Confirmed Human Carcinogen". NTP, OSHA, and IARC consider components contained in this detonator carcinogenic.
Perchlorate: Perchlorate can potentially inhibit iodide uptake by the thyroid and result in a decrease in thyroid hormone. The National Academy of Sciences (NAS) has reviewed the toxicity of perchlorate and has concluded that even the most sensitive populations could ingest up to 0.7 microgram perchlorate per kilogram of body weight per day without adversely affecting health. The USEPA must establish a maximum contaminant level (MCL) for perchlorate in drinking water by 2007, and this study by NAS may result in a recommendation of about 20 ppb for the MCL.

Emergency and First Aid Procedures

Eyes: Irrigate with running water for at least fifteen minutes. If irritation persists, seek medical attention.
Skin: Wash with soap and water.
Ingestion: Seek medical attention.
Inhalation: Not applicable.
Special Considerations: None

SECTION VI - REACTIVITY DATA

Stability: Stable under normal conditions, may explode when subjected to fire, supersonic shock or high-energy projectile impact, especially when confined or in large quantities.
Conditions to Avoid: Keep away from heat, flame, ignition sources, strong shock and electrical impulse. Do not attempt to disassemble.
Materials to Avoid (Incompatibility): Corrosives (acids and bases)
Hazardous Decomposition Products: Carbon Monoxide (CO), Nitrous Oxides (NO_x), Lead (Pb) and various oxides and complex oxides of metals.
Hazardous Polymerization: Will not occur.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in Case Material is Released or Spilled: Protect from all ignition sources. In case of fire evacuate area not less than 2,500 feet in all directions. Notify authorities in accordance with emergency response procedures. Only personnel trained in emergency response should respond. If no fire danger is present, and product is undamaged and/or uncontaminated, repackage product in original packaging or other clean DOT approved container. Ensure that a complete account of product has been made and is verified. Follow applicable Federal, State, and local spill reporting requirements.
Waste Disposal Method: Disposal must comply with Federal, State and local regulations. If product becomes a waste, it is potentially regulated as a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR, part 261. Review disposal requirements with a person knowledgeable with applicable environmental law (RCRA) before disposing of any explosive material.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation: Not required for normal handling.
Respiratory Protection: None normally required.
Protective Clothing: Cotton clothing is suggested.
Eye Protection: Safety glasses are recommended.
Other Precautions Required: None.

SECTION IX - SPECIAL PRECAUTIONS

Precautions to be taken in handling and storage: Store in cool, dry, well-ventilated location. Store in compliance with Federal, State, and local regulations. Keep away from heat, flame, ignition sources, strong shock, and electrical impulses.
Precautions to be taken during use: Avoid breathing the fumes or gases from detonation of explosives. Use accepted safe industry practices when using explosive materials. Unintended detonation of explosives or explosive devices can cause serious injury or death.
Other Precautions: It is recommended that users of explosive materials be familiar with the Institute of Makers of Explosives Safety Library Publications.

SECTION X - SPECIAL INFORMATION

This product contains the following substances that are subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

Chemical Name	CAS Number	Max. lbs/1000 units
Lead	7439-92-1	0.016
	(Use Toxic Chemical Category Code)	
Barium Compounds	N040	0.093*
Chromium Compounds	N090	0.093*
Lead Compounds	N420	0.091

Amount of Lead in Detonator Product Line *		
Product	**lb Pb compounds per 1000 detonators**	**lb Pb per 1000 detonators**
Electric Super SP	**0.0908**	**0.0000**
Electric Super LP	**0.0908**	**0.0000**
Electric Super Coal	**0.0908**	**0.0000**
Electric Instant	**0.0908**	**0.0000**
Electric Super Seismic	**0.0000**	**0.0000**
Electric Super DiPED	**0.0000**	**0.0157**

*** No barium or chromium compounds are present in the Electric Super Instant, Seismic or DiPED detonators. The exact quantity and weight percent of Section 313 Chemicals in each delay period and wire length for each product is available upon request.**

Disclaimer

Dyno Nobel Inc. and its subsidiaries disclaim any warranties with respect to this product, the safety or suitability thereof, the information contained herein, or the results to be obtained, whether express or implied, INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND/OR OTHER WARRANTY. The information contained herein is provided for reference purposes only and is intended only for persons having relevant technical skills. Because conditions and manner of use are outside of our control, the user is responsible for determining the conditions of safe use of the product. Buyers and users assume all risk, responsibility and liability whatsoever from any and all injuries (including death), losses, or damages to persons or property arising from the use of this product or information. Under no circumstances shall either Dyno Nobel Inc. or any of its subsidiaries be liable for special, consequential or incidental damages or for anticipated loss of profits.

MATERIAL SAFETY DATA SHEET

Product Trade Name: **EZ-MUD®**

Revision Date: 02-Jan-2007

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: EZ-MUD®
Synonyms: None
Chemical Family: Blend
Application: Shale Inhibitor

Manufacturer/Supplier
Baroid Drilling Fluids
a Product Service Line of Halliburton Energy Services, Inc.
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Hydrotreated light petroleum distillate	64742-47-8	10 - 30%	200 mg/m^3	Not applicable

3. HAZARDS IDENTIFICATION

Hazard Overview
May cause eye, skin, and respiratory irritation. May cause headache, dizziness, and other central nervous system effects. May be harmful if swallowed.

4. FIRST AID MEASURES

Inhalation
If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin
Wash with soap and water. Get medical attention if irritation persists. Remove contaminated shoes and discard.

Eyes
In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion
Get medical attention! If vomiting occurs, keep head lower than hips to prevent aspiration.

Notes to Physician
Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	> 200**Min:** > 200
Flash Point/Range (C):	Not Determined**Min:** > 93
Flash Point Method:	PMCC
Autoignition Temperature (F):	> 392
Autoignition Temperature (C):	> 200
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Special Exposure Hazards	Decomposition in fire may produce toxic gases. Use water spray to cool fire exposed surfaces.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.
NFPA Ratings:	Health 2, Flammability 1, Reactivity 0
HMIS Ratings:	Flammability 1, Reactivity 0, Health 2

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.
Storage Information	Store away from oxidizers. Keep container closed when not in use.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Organic vapor respirator with a dust/mist filter. In high concentrations, supplied air respirator or a self-contained breathing apparatus.
Hand Protection	Impervious rubber gloves.
Skin Protection	Rubber apron.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	White to gray
Odor:	Mild hydrocarbon
pH:	6-8

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity @ 20 C (Water=1):	1.0
Density @ 20 C (lbs./gallon):	8.3
Bulk Density @ 20 C (lbs/ft3):	Not Determined
Boiling Point/Range (F):	347
Boiling Point/Range (C):	175
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	0.002
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	70
Evaporation Rate (Butyl Acetate=1):	< 1
Solubility in Water (g/100ml):	Partially soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	Keep away from heat, sparks and flame.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Ammonia. Oxides of nitrogen. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
Skin Contact	May cause skin irritation.
Eye Contact	May cause severe eye irritation.
Ingestion	Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal. May cause central nervous system depression including headache, dizziness, drowsiness, muscular weakness, incoordination, slowed reaction time, fatigue blurred vision, slurred speech, giddiness, tremors and convulsions.
Aggravated Medical Conditions	Lung disorders.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.

Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	BOD(28 Day): 40% of COD
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: >1000 mg/l (Pimephales promelas)
Acute Crustaceans Toxicity:	TLM48: 98 mg/l (Acartia tonsa)
Acute Algae Toxicity:	EC50: 16.70 mg/l (Skeletonema costatum)

Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels:	None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	Acute Health Hazard
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity For This Product	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	All components listed do not apply to the California Proposition 65 Regulation.
MA Right-to-Know Law	Does not apply.
NJ Right-to-Know Law	Does not apply.
PA Right-to-Know Law	Does not apply.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.
WHMIS Hazard Class	D2B Toxic Materials

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

Shell Canada Limited
Material Safety Data Sheet

Effective Date: 2007-05-25
Supersedes: 2005-07-29

Class B2 Flammable Liquid   Class D2A Carcinogenicity

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT: **REGULAR UNLEADED GASOLINE MARKED**
SYNONYMS: Automotive Fuel
Petrol
PRODUCT USE: Fuel
PRODUCT CODE: **215-002**

SUPPLIER	**TELEPHONE NUMBERS**	
Shell Canada Limited (SCL)	**Shell Emergency Number**	1-800-661-7378
P.O. Box 100, Station M	**CANUTEC 24 HOUR EMERGENCY NUMBER**	1-613-996-6666
400-4th Ave. S.W.	For general information:	1-800-661-1600
Calgary, AB Canada		www.shell.ca
T2P 2H5		

This MSDS was prepared by the Toxicology and Product Stewardship Section of Shell Canada Limited.
*An asterisk in the product name designates a trade-mark(s) of Shell Canada Limited, used under license by Shell Canada Products.

2. COMPOSITION/INFORMATION ON INGREDIENTS

Component Name	CAS Number	% Range	WHMIS Controlled
Gasoline	86290-81-5	> 90	Yes
Benzene	71-43-2	< 1.5	Yes

See Section 8 for Occupational Exposure Guidelines.

3. HAZARDS IDENTIFICATION

Physical Description: Volatile Liquid   Dyed for tax purposes   Typical Gasoline Odour
Routes of Exposure: Exposure will most likely occur through skin contact or inhalation.
Hazards:

Vapour concentrations above the recommended exposure level are irritating to the eyes and respiratory tract, may cause headaches and dizziness, are anesthetic and may have other central nervous system effects.
Flammable Liquid.
Contains Benzene.
May cause cancer.

	Ingestion may result in vomiting. Avoid aspiration of vomitus into lungs as small quantities may result in aspiration pneumonitis. May be absorbed by skin contact. In rare cases may sensitize heart muscle causing heart arrythmia.
Handling:	Eliminate all ignition sources. Wear suitable gloves and eye protection. Bond and ground transfer containers and equipment to avoid static accumulation. Avoid prolonged exposure to vapours. Empty containers are hazardous, may contain flammable / explosive dusts, liquid residue or vapours. Keep away from sparks and open flames.

For further information on health effects, see Section 11.

4. FIRST AID MEASURES

Eyes:	Flush eyes with water for at least 15 minutes while holding eyelids open. If irritation occurs and persists, obtain medical attention.
Skin:	Wash contaminated skin with mild soap and water for at least 15 minutes. If irritation occurs and persists, obtain medical attention.
Ingestion:	DO NOT INDUCE VOMITING! OBTAIN MEDICAL ATTENTION IMMEDIATELY. Guard against aspiration into lungs by having the individual turn on to their left side. If vomiting occurs spontaneously, keep head below hips to prevent aspiration of liquid into the lungs. Do not give anything by mouth to an unconscious person.
Inhalation:	Remove victim from further exposure and restore breathing, if required. Obtain medical attention.
Notes to Physician:	The main hazard following accidental ingestion is aspiration of the liquid into the lungs producing chemical pneumonitis. If more than 2.0 mL/kg has been ingested, vomiting should be induced with supervision. If symptoms such as loss of gag reflex, convulsions or unconsciousness occur before vomiting, gastric lavage with a cuffed endotracheal tube should be considered.

5. FIRE FIGHTING MEASURES

Extinguishing Media:	Dry Chemical Carbon Dioxide Foam Water Fog
Firefighting Instructions:	Flammable. Clear area of unprotected personnel. Do not use a direct stream of water as it may spread fire. Product will float and can be reignited on surface of water. Vapour forms a flammable/explosive mixture with air between upper and lower flammable limits. Avoid breathing vapours. Avoid inhalation of smoke. Vapours may travel along ground and flashback along vapour trail may occur. Do not enter confined fire space without adequate protective clothing and an approved positive pressure self-contained breathing apparatus. Delayed lung damage can be experienced after exposure to combustion products, sometimes hours after the exposure.
Hazardous Combustion Products:	Carbon dioxide, carbon monoxide and unidentified organic compounds may be formed upon combustion.

6. ACCIDENTAL RELEASE MEASURES

Issue warning "Flammable". Eliminate all ignition sources. Isolate hazard area and restrict access. Handling equipment must be grounded. Work upwind of spill if it is safe to do so. Avoid direct contact with material. Wear appropriate breathing apparatus (if applicable) and protective clothing. Stop leak only if safe to do so. Dike and contain land spills; contain spills to water by booming. Use water fog to knock down vapours; contain runoff. Adsorb residue or small spills with adsorbent material and remove to non-leaking containers for disposal. Notify appropriate environmental agency(ies). After area has been cleaned up to the satisfaction of regulatory authorities, flush area with water to remove trace residue. Dispose of recovered material as noted under Disposal Considerations.

7. HANDLING AND STORAGE

Handling: Flammable. Fixed equipment as well as transfer containers and equipment should be grounded to prevent accumulation of static charge. Vapours may accumulate and travel to distant ignition sources and flashback. Avoid breathing vapours and prolonged or repeated contact with skin. Empty containers are hazardous, may contain flammable/explosive dusts, residues or vapours. Do not cut, drill, grind, weld or perform similar operations on or near containers. Provide adequate ventilation. Launder contaminated clothing prior to reuse. Wash with soap and water prior to eating, drinking, smoking, applying cosmetics or using toilet facilities.

Storage: Store in a cool, dry, well ventilated area, away from heat and ignition sources. Use explosion-proof ventilation to prevent vapour accumulation.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

The following information, while appropriate for this product, are general in nature. The selection of personal protective equipment will vary depending on the conditions of use.

OCCUPATIONAL EXPOSURE LIMITS (Current ACGIH TLV/TWA unless otherwise noted):

Gasoline: 300 ppm (STEL: 500 ppm)
Benzene (skin) : 0.5 ppm (STEL: 2.5 ppm)
Skin Notation: Absorption through skin, eyes and mucous membranes may contribute significantly to the total exposure.

Mechanical Ventilation: Concentrations in air should be maintained below the occupational exposure limit if unprotected personnel are involved. Use explosion-proof ventilation as required to control vapour concentrations. Local ventilation recommended where mechanical ventilation is ineffective in controlling airborne concentrations below the recommended occupational exposure limit. Make up air should always be supplied to balance air exhausted (either generally or locally). For personnel entry into confined spaces (i.e. bulk storage tanks) a proper confined space entry procedure must be followed including ventilation and testing of tank atmosphere.

PERSONAL PROTECTIVE EQUIPMENT:

Eye Protection: Chemical safety goggles and/or full face shield to protect eyes and face, if product is handled such that it could be splashed into eyes. Provide an eyewash station in the area.

Skin Protection: Avoid contact with skin. Use protective clothing and gloves manufactured from nitrile.

Safety showers should be available for emergency use.

Respiratory Protection: Avoid breathing vapour or mists. If exposure has the potential to exceed occupational exposure limits, use an appropriate NIOSH-approved respirator. For high airborne concentrations, use a NIOSH-approved supplied-air respirator, either self-contained or airline breathing apparatus, operated in positive pressure mode.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Volatile Liquid
Appearance:	Dyed for tax purposes
Odour:	Typical Gasoline Odour
Odour Threshold:	> 0.25 ppm
Freezing/Pour Point:	Not available
Boiling Point:	35 - 220 °C
Density:	720 - 760 kg/m3 @ 15 °C
Vapour Density (Air = 1):	3.5
Vapour Pressure (absolute):	< 107 kPa @ 38 °C
Specific Gravity (Water = 1):	0.74
pH:	Not applicable
Flash Point:	TCC -30 °C
Lower Flammable Limit:	1.4 % (vol.)
Upper Flammable Limit:	7.6 % (vol.)
Autoignition Temperature:	280 °C
Viscosity:	< 1 cSt @ 38 °C
Evaporation Rate (n-BuAc = 1):	Not available
Partition Coefficient (log K_{OW}):	2.3
Water Solubility:	Insoluble
Formula:	C4 - C11

10. STABILITY AND REACTIVITY

Chemically Stable:	Yes
Hazardous Polymerization:	No
Sensitive to Mechanical Impact:	No
Sensitive to Static Discharge:	Yes
Incompatible Materials:	Avoid strong oxidizing agents.
Conditions of Reactivity:	Avoid excessive heat, open flames and all ignition sources.

11. TOXICOLOGICAL INFORMATION

Ingredient (or Product if not specified)	Toxicological Data
Gasoline	LD50 Oral Rat > 18 mL/kg LD50 Dermal Rabbit > 5 mL/kg
Benzene	LD50 Oral Rat 690 - 3400 mg/kg LC50 Inhalation Rat 13700 ppm for 4 hours LD50 Dermal Rabbit > 8260 mg/kg

Routes of Exposure: Exposure will most likely occur through skin contact or inhalation.

Formulation: No data is specifically available for this product and therefore this toxicological information is based on testing completed with the ingredients.

Irritancy: Based on testing with similar materials, this product is not expected to be a primary skin irritant after exposure of short duration, would not be a skin sensitizer and would not be irritating to the eye.

Acute Toxicity: Vapour concentrations above the recommended exposure level are irritating to the eyes and respiratory tract, may cause headaches and dizziness, are anesthetic and may have other central nervous system effects.

Chronic Effects: Prolonged and repeated contact with skin can cause defatting and drying of the skin resulting in skin irritation and dermatitis. Prolonged exposure to high vapour concentration can cause headache, dizziness, nausea, blurred vision and central nervous system depression. Prolonged and repeated exposure may cause serious injury to blood forming organs, resulting in anemia and similar conditions. Myelodysplastic syndrome (MDS) has been observed in people exposed to very high levels (50 to 300 ppm) of benzene over a long period of time in the workplace. The relevance of these results to lower levels of exposure is not known.

Carcinogenicity and Mutagenicity: According to the International Agency for Research on Cancer (IARC) this product is considered to be possibly carcinogenic to humans. This product contains benzene. Carcinogenic hazard. Repeated exposure to benzene concentrations greater than the recommended TLV/TWA may reduce the cellular components of peripheral blood and bone marrow. Epidemiological studies indicate that long term inhalation of benzene vapour can cause leukaemia in man. Benzene has also produced chromosomal aberrations in peripheral blood lymphocytes.

12. ECOLOGICAL INFORMATION

Do not allow product or runoff from fire control to enter storm or sanitary sewers, lakes, rivers, streams, or public waterways. Block off drains and ditches. Provincial regulations require and federal regulations may require that environmental and/or other agencies be notified of a spill incident. Spill area must be cleaned and restored to original condition or to the satisfaction of authorities.

Biodegradability: Inherently biodegradable.
Rapid volatilization.

Bioaccumulation: Potential for bioaccumulation.

Partition Coefficient (log K_{OW}): 2.3

Aquatic Toxicity: Product is expected to be toxic to aquatic organisms.

Ingredient:	Toxicological Data
Gasoline	LL50 (WAF method) Rainbow Trout (96hr) 1 - 10 mg/L. EL50 (WAF method) Daphnia Magna (48hr) 1 - 10 mg/L. EL50 - growth rate (WAF method) Algae (72hr) 1 - 10 mg/L.
Benzene	LL50 Rainbow Trout (96hr) 1 - 10 mg/L. EL50 Daphnia Magna (48hr) 10 - 100 mg/L. EL50 - growth rate Algae (72hr) 10 - 100 mg/L.

13. DISPOSAL CONSIDERATIONS

Waste management priorities (depending on volumes and concentration of waste) are: 1. recycle (reprocess), 2. energy recovery 3. incineration, 4. disposal at a licenced waste disposal facility. Do not attempt to combust waste on-site. Incinerate at a licenced waste disposal site with approval of environmental authority.

14. TRANSPORT INFORMATION

Canadian Road and Rail Shipping Classification:

UN Number	UN1203
Proper Shipping Name	GASOLINE
Hazard Class	Class 3 Flammable Liquids
Packing Group	PG II
Additional Information	Marine Pollutant
Shipping Description	GASOLINE Class 3 UN1203 PG II Marine Pollutant

15. REGULATORY INFORMATION

This product has been classified in accordance with the hazard criteria of the *Controlled Products Regulations* (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Class:	Class B2 Flammable Liquid Class D2A Carcinogenicity
DSL/NDSL Status:	This product, or all components, are listed on the Domestic Substances List, as required under the Canadian Environmental Protection Act. This product and/or all components are listed on the U.S. EPA TSCA Inventory.
Other Regulatory Status:	No Canadian federal standards.

16. OTHER INFORMATION

LABEL STATEMENTS

Hazard Statement :	Flammable Liquid. Contains Benzene. May cause cancer.
Handling Statement:	Eliminate all ignition sources. Wear suitable gloves and eye protection. Bond and ground transfer containers and equipment to avoid static accumulation. Avoid prolonged exposure to vapours. Empty containers are hazardous, may contain flammable / explosive dusts, liquid residue or vapours. Keep away from sparks and open flames.
First Aid Statement :	Wash contaminated skin with soap and water. Flush eyes with water. If overcome by vapours remove to fresh air. Do not induce vomiting. Obtain medical attention.

Revisions:	This MSDS has been reviewed and updated. Section 1 Section 2 Section 3 Section 4 Section 5 Section 6 Section 7 Section 8 Section 11 Section 12

Shell Canada Limited
Material Safety Data Sheet

Effective Date: 2008-08-01
Supersedes: 2005-08-15

Class B3 Combustible Liquid

Class D2A Embryo/Fetotoxicity
Class D2B Skin Irritation

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT: **SHELL* JET A-1**
SYNONYMS: Aviation Turbine Fuel (Kerosene Type)
May contain anti-icing additive (Diethylene Glycol Monomethyl Ether)
PRODUCT USE: Fuel Solvent
PRODUCT CODE: **142-011**

SUPPLIER
Shell Canada Limited (SCL)
P.O. Box 100, Station M
400-4th Ave. S.W.
Calgary, AB Canada
T2P 2H5

TELEPHONE NUMBERS

Shell Emergency Number	1-800-661-7378
CANUTEC 24 HOUR EMERGENCY NUMBER	1-613-996-6666
For general information:	1-800-661-1600
	www.shell.ca

This MSDS was prepared by the Toxicology and Product Stewardship Section of Shell Canada Limited.
*An asterisk in the product name designates a trade-mark(s) of Shell Canada Limited, used under license by Shell Canada Products.

2. COMPOSITION/INFORMATION ON INGREDIENTS

Component Name	CAS Number	% Range	WHMIS Controlled
Kerosene (Petroleum), Hydrodesulfurized	64742-81-0	60 - 100	Yes
Ethanol, 2-(2-methoxyethoxy)-	111-77-3	0 - 0.15	Yes

See Section 8 for Occupational Exposure Guidelines.

3. HAZARDS IDENTIFICATION

Physical Description: Liquid Bright Clear Hydrocarbon Odour
Routes of Exposure: Exposure will most likely occur through skin contact or inhalation.
Hazards:

Vapour concentrations above the recommended exposure level are irritating to the eyes and respiratory tract, may cause headaches and dizziness, are anesthetic and may have other central nervous system effects.
Combustible Liquid.

	Irritating to skin. Ingestion may result in vomiting. Avoid aspiration of vomitus into lungs as small quantities may result in aspiration pneumonitis.
Handling:	Eliminate all ignition sources. Wear suitable gloves and eye protection. Bond and ground transfer containers and equipment to avoid static accumulation. Empty containers are hazardous, may contain flammable / explosive dusts, liquid residue or vapours. Keep away from sparks and open flames. Avoid prolonged exposure to vapours.

For further information on health effects, see Section 11.

4. FIRST AID MEASURES

Eyes:	Flush eyes with water for at least 15 minutes while holding eyelids open. If irritation occurs and persists, obtain medical attention.
Skin:	Wash contaminated skin with mild soap and water for at least 15 minutes. If irritation occurs and persists, obtain medical attention.
Ingestion:	DO NOT INDUCE VOMITING! OBTAIN MEDICAL ATTENTION IMMEDIATELY. Guard against aspiration into lungs by having the individual turn on to their left side. If vomiting occurs spontaneously, keep head below hips to prevent aspiration of liquid into the lungs. Do not give anything by mouth to an unconscious person.
Inhalation:	Remove victim from further exposure and restore breathing, if required. Obtain medical attention.
Notes to Physician:	The main hazard following accidental ingestion is aspiration of the liquid into the lungs producing chemical pneumonitis. If more than 2.0 mL/kg has been ingested, vomiting should be induced with supervision. If symptoms such as loss of gag reflex, convulsions or unconsciousness occur before vomiting, gastric lavage with a cuffed endotracheal tube should be considered.

5. FIRE FIGHTING MEASURES

Extinguishing Media:	Carbon Dioxide Foam Dry Chemical Water Fog
Firefighting Instructions:	Caution - Combustible. Do not use a direct stream of water as it may spread fire. Do not enter confined fire space without adequate protective clothing and an approved positive pressure self-contained breathing apparatus. Avoid inhalation of smoke. Vapour forms a flammable/explosive mixture with air between upper and lower flammable limits. Vapours may travel along ground and flashback along vapour trail may occur. Product will float and can be reignited on surface of water. Delayed lung damage can be experienced after exposure to combustion products, sometimes hours after the exposure.
Hazardous Combustion Products:	A complex mixture of airborne solid, liquid, particulates and gases will evolve when this material undergoes pyrolysis or combustion. Carbon dioxide, carbon monoxide and unidentified organic compounds may be formed upon combustion.

6. ACCIDENTAL RELEASE MEASURES

Issue warning "Combustible". Eliminate all ignition sources. Isolate hazard area and restrict access. Wear appropriate breathing apparatus (if applicable) and protective clothing. Handling equipment must be grounded. Work upwind of spill if it is safe to do so. Avoid direct contact with material. Stop leak only if safe to do so. Dike and contain land spills; contain spills to water by booming. Use water fog to knock down vapours; contain runoff. Adsorb residue or small spills with adsorbent material and remove to non-leaking containers for disposal. Notify appropriate environmental agency(ies). After area has been cleaned up to the satisfaction of regulatory authorities, flush area with water to remove trace residue. Dispose of recovered material as noted under Disposal Considerations.

7. HANDLING AND STORAGE

Handling: Combustible. Avoid excessive heat, sparks, open flames and all other sources of ignition. Fixed equipment as well as transfer containers and equipment should be grounded to prevent accumulation of static charge. Vapours are heavier than air and will settle and collect in low areas and pits, displacing breathing air. Extinguish pilot lights, cigarettes and turn off other sources of ignition prior to use and until all vapours are gone. Vapours may accumulate and travel to distant ignition sources and flashback. Do not cut, drill, grind, weld or perform similar operations on or near containers. Empty containers are hazardous, may contain flammable/explosive dusts, residues or vapours. Do not pressurize drum containers to empty them. Wash with soap and water prior to eating, drinking, smoking, applying cosmetics or using toilet facilities. Launder contaminated clothing prior to reuse. Use good personal hygiene.

Storage: Store in a cool, dry, well ventilated area, away from heat and ignition sources. Keep container tightly closed.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

The following information, while appropriate for this product, are general in nature. The selection of personal protective equipment will vary depending on the conditions of use.

OCCUPATIONAL EXPOSURE LIMITS (Current ACGIH TLV/TWA unless otherwise noted):

Kerosene/Jet fuels, as total hydrocarbon vapour (skin) : 200 mg/m3 (Application restricted to conditions in which there are negligible aerosol exposures.)
Skin Notation: Absorption through skin, eyes and mucous membranes may contribute significantly to the total exposure.

Mechanical Ventilation: Concentrations in air should be maintained below the occupational exposure limit if unprotected personnel are involved. Use explosion-proof ventilation as required to control vapour concentrations. Local ventilation recommended where mechanical ventilation is ineffective in controlling airborne concentrations below the recommended occupational exposure limit. Make up air should always be supplied to balance air exhausted (either generally or locally). For personnel entry into confined spaces (i.e. bulk storage tanks) a proper confined space entry procedure must be followed including ventilation and testing of tank atmosphere.

PERSONAL PROTECTIVE EQUIPMENT:

Eye Protection: Chemical safety goggles and/or full face shield to protect eyes and face, if product is handled such that it could be splashed into eyes. Provide an eyewash station in the area.

Skin Protection: Impervious gloves (viton, nitrile) should be worn at all times when handling this material. In confined spaces or where the risk of skin exposure is much higher, impervious clothing should be worn. Safety showers should be available for emergency use.

Respiratory Protection: If exposure exceeds occupational exposure limits, use an appropriate NIOSH-approved respirator. Use a NIOSH-approved chemical cartridge respirator with organic vapour cartridges or use a NIOSH-approved supplied-air respirator. For high airborne concentrations, use a NIOSH-approved supplied-air respirator, either self-contained or airline breathing apparatus, operated in positive pressure mode.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Appearance:	Bright Clear
Odour:	Hydrocarbon Odour
Odour Threshold:	Not available
Freezing/Pour Point:	< -47 °C
Boiling Point:	145 - 300 °C
Density:	775 - 840 kg/m3 @ 15 °C
Vapour Density (Air = 1):	Not available
Vapour Pressure (absolute):	1 - 1.4 kPa @ 37.8 °C
pH:	Not available
Flash Point:	TCC > 43 °C
Lower Flammable Limit:	0.7 % (vol.)
Upper Flammable Limit:	5 % (vol.)
Autoignition Temperature:	210 °C
Viscosity:	< 8 cSt @ -20 °C
Evaporation Rate (n-BuAc = 1):	Not available
Partition Coefficient (log K_{OW}):	3.3 - 6
Water Solubility:	Insoluble
Other Solvents:	Hydrocarbon Solvents

10. STABILITY AND REACTIVITY

Chemically Stable:	Yes
Hazardous Polymerization:	No
Sensitive to Mechanical Impact:	No
Sensitive to Static Discharge:	Yes
Hazardous Decomposition Products:	Thermal decomposition products are highly dependent on combustion conditions.
Incompatible Materials:	Avoid strong oxidizing agents.
Conditions of Reactivity:	Avoid excessive heat, open flames and all ignition sources.

11. TOXICOLOGICAL INFORMATION

Ingredient (or Product if not specified)	Toxicological Data
Kerosene (Petroleum), Hydrodesulfurized	LD50 Oral Rat > 5000 mg/kg LD50 Dermal Rabbit > 2000 mg/kg

Ethanol, 2-(2-methoxyethoxy)-	LD50 Oral Rat 4140 - 5180 mg/kg LD50 Dermal Rabbit > 2000 mg/kg

Routes of Exposure: Exposure will most likely occur through skin contact or inhalation.

Irritancy: This product is expected to be irritating to skin but is not predicted to be a skin sensitizer.

Acute Toxicity: Vapour concentrations above the recommended exposure level are irritating to the eyes and respiratory tract, may cause headaches and dizziness, are anesthetic and may have other central nervous system effects.

Chronic Effects: Prolonged and repeated contact with skin can cause defatting and drying of the skin resulting in skin irritation and dermatitis. Prolonged exposure to high vapour concentration can cause headache, dizziness, nausea, blurred vision and central nervous system depression.

Feto/Teratogenicity: A component of this product has shown adverse effects on the growth and development of the fetus in some animal studies.

Pre-existing Conditions: Pre-existing eye, skin and respiratory disorders may be aggravated by exposure to this product.

Carcinogenicity and Mutagenicity: The International Agency for Research on Cancer (IARC) considers that this product is not classifiable as to its carcinogenicity to humans. Middle distillates have caused skin cancers in laboratory animals when applied repeatedly and left in place between applications. This effect is believed to be caused by the continuous irritation of the skin. Good personal hygiene should be maintained to avoid this risk. The American Conference of Governmental Industrial Hygienists (ACGIH) has classified this product as A3 - confirmed animal carcinogen with unknown relevance to humans.

12. ECOLOGICAL INFORMATION

Do not allow product or runoff from fire control to enter storm or sanitary sewers, lakes, rivers, streams, or public waterways. Block off drains and ditches. Provincial regulations require and federal regulations may require that environmental and/or other agencies be notified of a spill incident. Spill area must be cleaned and restored to original condition or to the satisfaction of authorities. May cause physical fouling of aquatic organisms. The immediate effect of a release is the physical impairment of the environment from the coating of surfaces, resulting in the disruption of oxygen, water and light to flora and fauna. Prolonged exposure may result in the partitioning of light-end hydrocarbon fractions into the water and gas phases of the subsurface soil environment, adversely affecting the soil quality.

Biodegradability: Not readily biodegradable.

Bioaccumulation: Potential for bioaccumulation.
Potential for bioconcentration.

Partition Coefficient (log K_{OW}): 3.3 - 6

Aquatic Toxicity: Product is expected to be toxic to aquatic organisms.

Ingredient:	Toxicological Data
Kerosene (Petroleum), Hydrodesulfurized	LL50 (WAF method) Rainbow Trout (96hr) 1 - 10 mg/L. EL50 (WAF method) Daphnia Magna (48hr) 1 - 10 mg/L. EL50 - growth rate (WAF method) Algae (72hr) 1 - 10 mg/L.
Ethanol, 2-(2-methoxyethoxy)-	

Definition(s): LL and EL are the lethal loading concentration and effective loading concentration

respectively. The concentration represents the amount of substance added to the system to obtain a toxic concentration. They replace the traditional LC and EC for low solubility substances.
WAF is the water accommodated fraction. A slightly soluble hydrocarbon is stirred into water and the insoluble portions are removed. The remaining solution is the water accommodated fraction.

13. DISPOSAL CONSIDERATIONS

Waste management priorities (depending on volumes and concentration of waste) are: 1. recycle (reprocess), 2. energy recovery 3. incineration, 4. disposal at a licenced waste disposal facility. Do not attempt to combust waste on-site. Incinerate at a licenced waste disposal site with approval of environmental authority.

14. TRANSPORT INFORMATION

Canadian Road and Rail Shipping Classification:

UN Number	UN1863
Proper Shipping Name	FUEL, AVIATION, TURBINE ENGINE
Hazard Class	Class 3 Flammable Liquids
Packing Group	PG III
Additional Information	Not Regulated in Containers Less Than or Equal to 450 Litres.
Shipping Description	FUEL, AVIATION, TURBINE ENGINE Class 3 UN1863 PG III Not Regulated in Containers Less Than or Equal to 450 Litres.

15. REGULATORY INFORMATION

This product has been classified in accordance with the hazard criteria of the *Controlled Products Regulations* (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Class:	Class B3 Combustible Liquid Class D2A Embryo/Fetotoxicity Class D2B Skin Irritation
DSL/NDSL Status:	This product, or all components, are listed on the Domestic Substances List, as required under the Canadian Environmental Protection Act.
Other Regulatory Status:	No Canadian federal standards. Provincial criteria are likely and should be requested when notifying provincial authorities.

16. OTHER INFORMATION

LABEL STATEMENTS

Hazard Statement :	Combustible Liquid. Irritating to skin.
Handling Statement:	Eliminate all ignition sources. Wear suitable gloves and eye protection. Bond and ground transfer containers and equipment to avoid static accumulation. Empty containers are hazardous, may contain flammable / explosive dusts, liquid residue or vapours. Keep away from sparks and open flames.

Avoid prolonged exposure to vapours.

First Aid Statement : Wash contaminated skin with soap and water.
Flush eyes with water.
If overcome by vapours remove to fresh air.
Do not induce vomiting.
Obtain medical attention.

Revisions: This MSDS has been reviewed and updated. Changes have been made to: Section 2 Section 3 Section 6 Section 8 Section 11 Section 15

ADG Technology

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Tel (03) 9545 1277
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INTERNATIONAL
Tel +61 (8) 9249 7599
Fax +61 (8) 9249 7699

PO Box 148,
Kingsway WA 6065

Material Safety Data Sheet

Lubtac Rod Grease

HDD
MINING & WATERWELL

Driltech Mission SANDVIK

Down hole hammers & bits
Top hole hammer equipment

BOART LONGYEAR

Diamond drilling
Three cone rotary drill bits
(TCI or Mill Tooth)
Geological supplies
Radio communications
Drag & blade bits
Drilling fluids
Drilling rigs - all types
Elgi air compressors
Augers, teeth,
ground engaging tools
Drill pipe & subs
Geotechnical drilling supplies
International procurement
Machinery parts & equipment

A Smith/Schlumberger Company

M-I Australia Pty Ltd, 11/251 Adelaide Tce, Perth, WA, 6000
Tel: 08 9325 4822 Fax: 08 9325 1897

HEALTH SAFETY HSE ENVIRONMENTAL

ENVIRONMENTAL AND SAFETY DATA SHEET

1. PRODUCT IDENTIFICATION

TRADE NAME: **LUBTAC ROD GREASE**

GENERIC DESCRIPTION: **A MIXTURE OF INORGANIC INERT VISCOSIFIERS, TACKIFIERS, HYDROCARBON OILS AND VEGETABLE OILS.**

2. HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT	%	DATA
NONE		

3. PHYSICAL DATA

BOILING POINT : **120 °C**

MELTING POINT : **NA**

FREEZING POINT : **< 0 °C**

pH : **7-8**

SPECIFIC GRAVITY : **0.99**

APPEARANCE AND : **DARK BROWN STRINGY GREASE**

4. FIRE AND EXPLOSION DATA

FLASH POINT °C: (AUTO IGNITION TEMPERATURE) **> 200 °C**

EXTINGUISING MEDIA : **USE EXTINGUISHER USED FOR EXTINGUISHING HYDROPHOBIC MATERIALS**

BIO-2

5. HEALTH HAZARD INFORMATION

ROUTES OF EXPOSURE AND EFFECTS

EYES : **MODERATE TO SEVERE IRRITATION**

INHALATION : **NO IRRITATING FUMES ARE PRODUCED AT NORMAL TEMPERTURES**

INGESTION : **MAY CAUSE NAUSEA**

SKIN : **MAY BE IRRITATING TO SENSITIVE SKINS ON PROLONGED EXPOSURE**

6. EMERGENCY AND FIRST AID PROCEDURES

EYES : **WIPE OUT WITH DRY CLOTH. USE EYE DROPS IF NECESSARY. OBTAIN MEDICAL ATTENTION IF NECESSARY**

INHALATION : **NO IRRITATING FUMES ARE PRODUCED AT NORMAL TEMPERATURES**

INGESTION : **WASH MOUTH WITH WATER. INDUCE VOMITING. OBTAIN MEDICAL ADVICE AS SOON AS POSSIBLE**

SKIN : **WASH WITH SOAPY WATER. IF DEGREASING OF SKIN HAS OCCURED, APPLY MOISTURISING CREAM**

7. REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY: **EXTREME HEAT**

INCOMPATABILITY: **NONE**

HAZARDOUS DECOMPOSITION PRODUCTS: **CAN PRODUCE HYDROCARBON DECOMPOSITION PRODUCT ON BURNING.**

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERISATION: **WILL NOT OCCUR**

BIO-3

8. SPILL OR LEAK PROCEDURES

CONTAIN SPILL. SCRAPE UP EXCESS PRODUCTS WITH A SPADE. THROW SAND OR WOOD SHAVINGS OVER CONTAMINATED AREA AND SCRAPE UP WITH ASPADE. CONTAMINATED WOOD SHAVINGS OR SAND CAN BE DISCARDED IN ANY RUBBISH STORAGE AREA.

9. INDUSTRIAL HYGEINE CONTROL MEASURES

VENTILATION: **NORMAL**

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY	:	**NONE**
EYES	:	**NONE**
GLOVES	:	**YES**
OTHER	:	**CLOTHING PROTECTOR AS REQUIRED TO PROTECT CLOTHES FROM GREASE WHICH IS DIFFICULT TO REMOVE.**

10. SPECIAL PRECAUTIONS

NONE

11. OTHER HANDLING AND STORAGE REQUIREMENTS

NONE

Material Safety Data Sheet

Dyno Nobel Inc.
2650 Decker Lake Boulevard, Suite 300
Salt Lake City, Utah 84119
Phone: 801-364-4800 Fax: 801-321-6703
E-Mail: dnna.hse@am.dynonobel.com
FOR 24 HOUR EMERGENCY, CALL CHEMTREC (USA) 800-424-9300
CANUTEC (CANADA) 613-996-6666

MSDS # 1122
Date 01/22/09

Supercedes
MSDS # 1122 08/13/08

SECTION I - PRODUCT IDENTIFICATION

Trade Name(s): NONEL® MS
NONEL® MS ARCTIC
NONEL® LP
NONEL® SL
NONEL® TD
NONEL® MS CONNECTOR
NONEL® TWINPLEX™
NONEL® STARTER
NONEL® EZ DET®
NONEL® EZTL™
NONEL® EZ DRIFTER ®

Product Class: NONEL® Non-electric Delay Detonators

Product Appearance & Odor: Aluminum cylindrical shell with varying length and diameter of attached colored plastic tubing. The detonator may be enclosed in a plastic housing, and an assembly may contain two detonators. Odorless.

DOT Hazard Shipping Description: UN0029 Detonators, non-electric 1.1B II
-or- UN0360 Detonator assemblies, non-electric 1.1B II
-or- UN0361 Detonator assemblies, non-electric 1.4B II

NFPA Hazard Classification: Not Applicable (See Section IV - Special Fire Fighting Procedures)

SECTION II - HAZARDOUS INGREDIENTS

		Occupational Exposure Limits	
Ingredients	**CAS#**	**OSHA PEL-TWA**	**ACGIH TLV-TWA**
Pentaerythritol Tetranitrate (PETN)	78-11-5	None[1]	None[2]
Lead Azide	13424-46-9	0.05 mg (Pb)/m^3	0.05 mg (Pb)/m^3
Lead	7439-92-1	0.05 mg (Pb)/m^3	0.05 mg (Pb)/m^3
Silicon	7440-21-3	15 mg / m^3 (total dust) 5 mg / m^3 (respirable fraction)	10 mg / m^3
Selenium	7782-49-2	0.2 mg/m^3	0.2 mg/m^3
Red Lead (Lead tetroxide)	1314-41-6	0.05 mg (Pb)/m^3	0.05 mg (Pb)/m^3
Titanium dioxide	13463-67-7	15 mg/m^3	10 mg/m^3
Barium Chromate	10294-40-3	1 mg (CrO_3)/10m^3 (ceiling) 0.5 mg (Ba)/m^3	0.01 mg (Cr)/m^3 0.5 mg (Ba)/m^3
Lead Chromate	7758-97-6	0.05 mg (Pb)/m^3 1 mg (CrO_3)/10m^3 (ceiling)	0.15 mg (Pb)/m^3 0.012 mg (Cr)/m^3
Barium Sulfate	7727-43-7	0.5 mg (Ba)/m^3	10 mg/m^3
Potassium Perchlorate[3]	7778-74-7	None[1]	None[2]
Silica (crystalline)	61790-53-2	See Note Below	0.05 mg/m^3 (resp frac)

Molybdenum	7439-98-7	None[1]	None[2]
Tungsten	7440-33-7	None[1]	5 mg/m^3 (TWA) 10 mg/m^3 (STEL)
Aluminum	7429-90-5	15 mg/m^3 (total dust) 5 mg/m^3 (respirable fraction)	5 mg/m^3
Antimony	7440-36-0	0.5 mg/m^3	0.5 mg/m^3
Cyclotetramethylene Tetranitramine (HMX)	2691-41-0	None[1]	None[2]

[1] Use limit for particulates not otherwise regulated (PNOR): Total dust, 15 mg/m^3 ; respirable fraction, 5 mg/m^3 .
[2] Use limit for particulates not otherwise classified (PNOC): Inhalable particulate, 10 mg/m^3 ; respirable part., 3 mg/m^3 .
Note: The OSHA PEL for crystalline silica is calculated as follows:
Quartz, respirable: 10 mg/m$^{3\ e}$ / % SiO_2 + 2 Quartz, total dust: 30 mg/m^3 / % SiO_2 + 2
[3] Not all delay periods contain perchlorate. Those that do contain between from about 4 to a maximum of about 60 mg perchlorate per detonator.

Ingredients, other than those mentioned above, as used in this product are not hazardous as defined under current Department of Labor regulations, or are present in deminimus concentrations (less than 0.1% for carcinogens, less than 1.0% for other hazardous materials).

SECTION III - PHYSICAL DATA

Boiling Point: Not Applicable
Vapor Density: Not Applicable
Percent Volatile by Volume: Not Applicable
Evaporation Rate (Butyl Acetate = 1): Not Applicable
Vapor Pressure: Not Applicable
Density: Not Applicable
Solubility in Water: Not Applicable

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: Not Applicable
Flammable Limits: Not Applicable
Extinguishing Media: (See Special Fire Fighting Procedures section.)
Special Fire Fighting Procedures: Do not attempt to fight fires involving explosive materials. Evacuate all personnel to a predetermined safe, distant location. Allow fire to burn unless it can be fought remotely or with fixed extinguishing systems (sprinklers).
Unusual Fire and Explosion Hazards: Can explode or detonate under fire conditions. Burning material may produce toxic vapors.

SECTION V - HEALTH HAZARD DATA

Effects of Overexposure

This is a packaged product that will not result in exposure to the explosive material under normal conditions of use. Exposure concerns are primarily with post-detonation reaction products, particularly heavy metal compounds.

Eyes: No exposure to chemical hazards anticipated with normal handling procedures. Particulates in the eye may cause irritation, redness, swelling, itching, pain and tearing.
Skin: No exposure to chemical hazards anticipated with normal handling procedures. Exposure to post-detonation reaction products may cause irritation.
Ingestion: No exposure to chemical hazards anticipated with normal handling procedures. Post-detonation reaction product residue is toxic by ingestion. Symptoms may include gastroenteritis with abdominal pain, nausea, vomiting and diarrhea. See systemic effects below.

Inhalation: Not a likely route of exposure. See systemic effects below.
Systemic or Other Effects: None anticipated with normal handling procedures. Repeated inhalation or ingestion of post-detonation reaction products may lead to systemic effects such as respiratory tract irritation, ringing of the ears, dizziness, elevated blood pressure, blurred vision and tremors. Heavy metal (lead) poisoning can occur.
Carcinogenicity: ACGIH classifies Lead as a "Suspected Human Carcinogen" and insoluble Chromium VI as "Confirmed Human Carcinogen". NTP, OSHA, and IARC consider components contained in this detonator carcinogenic.

Perchlorate: Perchlorate can potentially inhibit iodide uptake by the thyroid and result in a decrease in thyroid hormone. The National Academy of Sciences (NAS) has reviewed the toxicity of perchlorate and has concluded that even the most sensitive populations could ingest up to 0.7 microgram perchlorate per kilogram of body weight per day without adversely affecting health. The USEPA must establish a maximum contaminant level (MCL) for perchlorate in drinking water by 2007, and this study by NAS may result in a recommendation of about 20 ppb for the MCL.

Emergency and First Aid Procedures

Eyes: Irrigate with running water for at least fifteen minutes. If irritation persists, seek medical attention.
Skin: Wash with soap and water.
Ingestion: Seek medical attention.
Inhalation: Not applicable.
Special Considerations: None

SECTION VI - REACTIVITY DATA

Stability: Stable under normal conditions, may explode when subjected to fire, supersonic shock or high-energy projectile impact.
Conditions to Avoid: Keep away from heat, flame, ignition sources, impact, friction, electrostatic discharge and strong shock. Do not attempt to disassemble.
Materials to Avoid (Incompatibility): Corrosives (acids and bases or alkalis).
Hazardous Decomposition Products: Carbon Monoxide (CO), Nitrous Oxides (NO_X), Sulfides, Chromates, Lead (Pb), Antimony (Sb) and various oxides and complex oxides of metals.
Hazardous Polymerization: Will not occur.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in Case Material is Released or Spilled: Protect from all ignition sources. In case of fire evacuate all personnel to a safe distant area and allow to burn or fight fire remotely. Notify authorities in accordance with emergency response procedures. Only personnel trained in emergency response should respond. If no fire danger is present, and product is undamaged and/or uncontaminated, repackage product in original packaging or other clean DOT approved container. Ensure that a complete account of product has been made and is verified. If loose explosive powder is spilled, such as from a broken detonator, only properly qualified and authorized personnel should be involved with handling and clean-up activities. Spilled explosive powder is extremely sensitive to initiation and may detonate. Follow applicable Federal, State, and local spill reporting requirements.

Waste Disposal Method: Disposal must comply with Federal, State and local regulations. If product becomes a waste, it is potentially regulated as a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR, part 261. Review disposal requirements with a person knowledgeable with applicable environmental law (RCRA) before disposing of any explosive material.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation: None required for normal handling. Provide enhanced ventilation after use if in underground mines or other enclosed areas.

Respiratory Protection: None required for normal handling.

Protective Clothing: Cotton gloves are recommended.

Eye Protection: Safety glasses are recommended.

Other Precautions Required: None.

SECTION IX - SPECIAL PRECAUTIONS

Precautions to be taken in handling and storage: Store in cool, dry, well-ventilated location. Store in compliance with Federal, State, and local regulations. Only properly qualified and authorized personnel should handle and use explosives. Keep away from heat, flame, ignition sources, impact, friction, electrostatic discharge and strong shock.

Precautions to be taken during use: Use accepted safe industry practices when using explosive materials. Unintended detonation of explosives or explosive devices can cause serious injury or death. Avoid breathing the fumes or gases from detonation of explosives. Detonation in confined or unventilated areas may result in exposure to hazardous fumes or oxygen deficiency.

Other Precautions: It is recommended that users of explosive materials be familiar with the Institute of Makers of Explosives Safety Library Publications.

ECTION X - SPECIAL INFORMATION

These products contain the following substances that are subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

Chemical Name	CAS Number	Max. lbs/1000 units
Lead	7439-92-1	39.4
	(Use Toxic Chemical Category Code)	
Lead Compounds	N420	2.0
Barium Compounds	N040	1.8
Chromium Compounds	N090	1.9

Range* of Section 313 Chemicals in each product

Product	lb Pb per 1000 detonators	lb Pb compounds per 1000 detonators	lb Ba compounds per 1000 detonators	lb Cr compounds per 1000 detonators
NONEL® MS	0 - 27	0.3 – 1.5	0 – 0.9	0 – 0.9
NONEL® LP	0 - 30	0.3 – 2.0	0 - 1.8	0 - 1.9
NONEL® SL	7 - 27	0.3 – 1.5	0	0
NONEL® TD	0 - 18	0.3 – 0.7	0	0
NONEL® MS Connector	5 - 16	0.3 – 0.4	0	0
NONEL® TWINPLEX™	5 - 15	0.3 – 0.7	0	0
NONEL® STARTER	0	0.3	0	0
NONEL® EZ DET®	22 - 36	2.0	0	0
NONEL® EZTL™	5 - 15	0.5 – 0.7	0	0
NONEL® EZ DRIFTER	39.4	1.3	1.2	1.3

*** The exact quantity and weight percent of Section 313 Chemicals in each delay period and tubing length for each product is available upon request.**

Disclaimer

Material Safety Data Sheet

Dyno Nobel Inc.
2650 Decker Lake Boulevard, Suite 300
Salt Lake City, Utah 84119
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E-Mail: dnna.hse@am.dynonobel.com
FOR 24 HOUR EMERGENCY, CALL CHEMTREC (USA) 800-424-9300
CANUTEC (CANADA) 613-996-6666

MSDS # 1063
Date 10/30/08

Supercedes
MSDS # 1063 07/02/07

SECTION I - PRODUCT IDENTIFICATION

Trade Name(s):

BLASTEX®	DYNO® 1.5 SB
BLASTEX® PLUS	DYNO® 1.5 SBC
BLASTEX® PLUS HD	DYNO® 1.5 SB30
BLASTEX® TX	DYNO® 900
BLASTEX® TX PLUS	DYNO® 1300
BLASTGEL® 1000	DYNO® 1500
BLASTGEL® 1070	DYNO® 1520
SUPER BLASTEX®	DYNO® 1540
SUPER BLASTEX® TX	DYNOTEX
SUPER BLASTEX® TX	DX-2011
	DX-2012

Product Class: Emulsion Explosives, Packaged

Product Appearance & Odor: White or pink opaque semi-solid, which will appear gray if product contains aluminum. Little or no odor. Packaged in cylindrical cartridges of paper or plastic film.

DOT Hazard Shipping Description: **UN0332** Explosive, blasting, type E 1.5D II

NFPA Hazard Classification: Not Applicable (See Section IV - Special Fire Fighting Procedures)

SECTION II - HAZARDOUS INGREDIENTS

			Occupational Exposure Limits	
Ingredients:	**CAS#**	**% (Range)**	**ACGIH TLV-TWA**	**OSHA PEL-TWA**
Ammonium Nitrate	6484-52-2	60-85	None	None
Sodium Nitrate	7631-99-4	0-12	None	None
Methylamine Nitrate*	22133-87-7	0-3	None	None
Aluminum	7429-90-5	0-10	10 mg/m^3 (dust)	15 mg/m^3 (total)
Mineral Oil	64742-35-4	0-6	5 mg/m^3 (mist)	None
Kerosene	8008-20-6	0-6	None	None

* This ingredient may be used only in products produced at the Paige Plant.

Ingredients, other than those mentioned above, as used in this product are not hazardous as defined under current Department of Labor regulations, or are present in deminimus concentrations (less than 0.1% for carcinogens, less than 1.0% for other hazardous materials).

SECTION III - PHYSICAL DATA

Boiling Point: Not Applicable
Vapor Density: (Air = 1) Not Applicable
Percent Volatile by Volume: <20 (water)

Evaporation Rate (Butyl Acetate = 1): <1

Vapor Pressure: Not Applicable
Density: 1.15-1.35 g/cc
Solubility in Water: Product partially dissolves very slowly in water.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: >100°C
Flammable Limits: Not Applicable
Extinguishing Media: (See Special Fire Fighting Procedures section.)
Special Fire Fighting Procedures: Do not attempt to fight fires involving explosive materials. Evacuate all personnel to a predetermined safe location, no less than 2,500 feet in all directions.
Unusual Fire and Explosion Hazards: Can explode or detonate under fire conditions. Burning material may produce toxic vapors.

SECTION V - HEALTH HAZARD DATA

Effects of Overexposure

Eyes: May cause irritation, redness and tearing.
Skin: Prolonged contact may cause irritation.
Ingestion: Large amounts may be harmful if swallowed.
Inhalation: Not a likely route of exposure.
Systemic or Other Effects: None known.

Emergency and First Aid Procedures

Eyes: Irrigate with running water for at least 15 minutes. If irritation persists seek medical attention.
Skin: Remove contaminated clothing. Wash with soap and water.
Ingestion: Seek medical attention.
Inhalation: If irritation occurs, remove to fresh air.
Special Considerations: None.

SECTION VI - REACTIVITY DATA

Stability: Stable under normal conditions, may explode when subjected to fire, supersonic shock or high-energy projectile impact, especially when confined or in large quantities.
Conditions to Avoid: Keep away from heat, flame, ignition sources and strong shock.
Materials to Avoid (Incompatibility): Corrosives (strong acids and strong bases or alkalis).
Hazardous Decomposition Products: Nitrogen Oxides (NO_X), Carbon Monoxide (CO)
Hazardous Polymerization: Will not occur

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in Case Material is Released or Spilled: Protect from all ignition sources. In case of fire evacuate area not less than 2,500 feet in all directions. Notify authorities in accordance with emergency response procedures. Only personnel trained in emergency response should respond. If no fire danger is present, and product is undamaged and/or uncontaminated, repackage product in original packaging or other clean DOT approved container. Ensure that a complete account of product has been made and is verified. Follow applicable Federal, State, and local spill reporting requirements.
Waste Disposal Method: Disposal must comply with Federal, State and local regulations. If product becomes a waste, it is potentially regulated as a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR, part 261. Review disposal requirements with a person knowledgeable with applicable environmental law (RCRA) before disposing of any explosive material.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation: Not required for normal handling.
Respiratory Protection: None normally required.
Protective Clothing: Gloves and work clothing that reduce skin contact are suggested.
Eye Protection: Safety glasses are recommended.
Other Precautions Required: None.

SECTION IX - SPECIAL PRECAUTIONS

Precautions to be taken in handling and storage: Store in cool, dry, well-ventilated location. Store in compliance with Federal, State and local regulations. Keep away from heat, flame, ignition sources and strong shock.
Precautions to be taken during use: Avoid breathing the fumes or gases from detonation of explosives. Use accepted safe industry practices when using explosive materials. Unintended detonation of explosives or explosive devices can cause serious injury or death.
Other Precautions: It is recommended that users of explosive materials be familiar with the Institute of Makers of Explosives Safety Library Publications.

SECTION X - SPECIAL INFORMATION

The reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR 372 may become applicable if the physical state of this product is changed to an aqueous solution. If an aqueous solution of this product is manufactured, processed, or otherwise used, the nitrate compounds category and ammonia listing of the previously referenced regulation should be reviewed.

Material Safety Data Sheet

Dyno Nobel Inc.
2650 Decker Lake Boulevard, Suite 300
Salt Lake City, Utah 84119
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FOR 24 HOUR EMERGENCY, CALL CHEMTREC (USA) 800-424-9300
CANUTEC (CANADA) 613-996-6666

MSDS # 1019
Date 03/27/07

Supercedes
MSDS # 1019 01/24/05

SECTION I - PRODUCT IDENTIFICATION

Trade Name(s):

D-GEL™ 1000	Oil Well Explosive 80%
DYNOSPLIT®: D1, D 3/4, D 7/8	Oil Well Explosive 100%
EXTRA GELATIN: 40%, 75%	STONECUTTER™
GELAPRIME® F	REDH®A
UNIGEL®	RED H® B
UNIMAX®	POWERGEL D
VIBROGEL®: 1,3	60% Hi-Pressure Gelatin
Z POWDER™	IRESPLIT® D
DYNOMAX PRO™	IP: 724, 738

Product Class: Dynamites and Blasting Gelatins
Product Appearance & Odor: Powdery to gelatinous solid, light tan to dark brown color. Faint, waxy odor.
DOT Hazard Shipping Description: Explosive, blasting, type A 1.1D UN0081 II
NFPA Hazard Classification: Not Available (See Section IV - Special Fire Fighting Procedures)

SECTION II - HAZARDOUS INGREDIENTS

Ingredients:	CAS#	% (Range)	Occupational Exposure Limits ACGIH TLV-TWA	OSHA PEL-TWA
Nitroglycerin (NG)	55-63-0	1-20	0.05 ppm	0.05 ppm
Ethylene Glycol Dinitrate (EGDN)	628-96-6	8-76	0.05 ppm	0.05 ppm
Nitrocellulose	9004-70-0	0-6	None	None
Ammonium Nitrate	6484-52-2	0-75	None	None
Sodium Nitrate	7631-99-4	0-50	None	None
Sulfur[1]	7704-34-9	0-4	None	None

[1] This ingredient is not found in most of the products listed above.

Ingredients, other than those mentioned above, as used in this product are not hazardous as defined under current Department of Labor regulations, or are present in deminimus concentrations (less than 0.1% for carcinogens, less than 1.0% for other hazardous materials).

SECTION III - PHYSICAL DATA

Boiling Point: Not Applicable
Vapor Density: Not Applicable
Percent Volatile by Volume: Not Applicable

Evaporation Rate (Butyl Acetate = 1): Not Applicable

Vapor Pressure: Not Applicable
Density: 0.8-1.48 g/cc
Solubility in Water: Ammonium and sodium nitrates are completely soluble. NG and EGDN are very slightly soluble.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: Not Applicable **Flammable Limits:** Not Applicable
Extinguishing Media: (See Special Fire Fighting Procedures section.)
Special Fire Fighting Procedures: Do not attempt to fight fires involving explosive materials. Evacuate all personnel to a predetermined safe location, no less than 2,500 feet in all directions.
Unusual Fire and Explosion Hazards: Can explode or detonate under fire conditions. Burning material may produce toxic vapors.

SECTION V - HEALTH HAZARD DATA

Effects of Overexposure

Eyes: May cause irritation, redness and tearing.
Skin: Contact may result in headache, nausea and blood vessel dilation.
Ingestion: May result in headache, nausea, intestinal upset and blood vessel dilation.
Inhalation: May result in headache, nausea and blood vessel dilation.
Systemic or Other Effects: None known.

Emergency and First Aid Procedures

Eyes: Irrigate with running water for at least fifteen minutes. If irritation persists, seek medical attention.
Skin: Remove contaminated clothing. Wash with soap and water.
Ingestion: Seek medical attention.
Inhalation: Remove to fresh air. If irritation persists, seek medical attention.
Special Considerations: None.

SECTION VI - REACTIVITY DATA

Stability: Stable under normal conditions. May explode when subjected to fire, supersonic shock, or high-energy projectile impact, especially when confined or in large quantities.
Conditions to Avoid: Keep away from heat, flame, ignition sources and strong shock.
Materials to Avoid (Incompatibility): Corrosives (mineral acids, bases, strong acids).
Hazardous Decomposition Products: Carbon Monoxide (CO), Hydrogen Sulfide (H_2S), Nitrous Oxides (NO_X), and Sulfur Oxides (SO_X).
Hazardous Polymerization: Will not occur.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in Case Material is Released or Spilled: Protect from all ignition sources. In case of fire evacuate area not less than 2,500 feet in all directions. Notify authorities in accordance with emergency response procedures. Only personnel trained in emergency response should respond. If no fire danger is present, and product is undamaged and/or uncontaminated, repackage product in original packaging or other clean DOT approved container. Ensure that a complete account of product has been made and is verified. Follow applicable Federal, State, and local spill reporting requirements. Contact of this product with water may result in a reportable release.

Waste Disposal Method: Disposal must comply with Federal, State and local regulations. If product becomes a waste, it is potentially regulated as a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR, part 261. Review disposal requirements with a person knowledgeable with applicable environmental law (RCRA) before disposing of any explosive material.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation: Forced ventilation may be necessary where natural ventilation is limited. Magazines containing NG and/or EGDN based explosives must be ventilated before entry.
Respiratory Protection: None normally required.
Protective Clothing: Chemical resistant (nitrile) gloves are suggested.
Eye Protection: Safety glasses are recommended.
Other Precautions Required: Inhalation and skin contact should be minimized to avoid headaches, nausea, and blood vessel dilation. Protective clothing should be changed daily, more often if contaminated.

SECTION IX - SPECIAL PRECAUTIONS

Precautions to be taken in handling and storage: Store in cool, dry, well-ventilated location. Store in compliance with Federal, State, and local regulations. Keep away from heat, flame, ignition sources, and strong shock.
Precautions to be taken during use: Avoid breathing the fumes or gases from detonation of explosives. Use accepted safe industry practices when using explosive materials. Unintended detonation of explosives or explosive devices can cause serious injury or death.
Other Precautions: It is recommended that users of explosive materials be familiar with the Institute of Makers of Explosives Safety Library Publications.

SECTION X - SPECIAL INFORMATION

Chemical Name	CAS Number	% By Weight
Nitroglycerin	55-63-0	1-20

The reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR 372 may become applicable if the physical state of this product is changed to an aqueous solution. If an aqueous solution of this product is manufactured, processed, or otherwise used, the nitrate compounds category and ammonia listing of the previously referenced regulation should be reviewed.

Disclaimer

MATERIAL SAFETY DATA SHEET

SECTION I: IDENTIFICATION OF PRODUCT

COMPANY:	**Diversity Technologies Corp.**	DATE:	February 15, 2007
	8750 – 53rd Ave.	PHONE:	780-468-4064
	Edmonton, AB T6E 5G2	FAX:	780-469-1899

PRODUCT NAME: **POTASSIUM CHLORIDE (POTASH)**

PRODUCT USE: Oil well drilling fluid and cement additive.
CHEMICAL FAMILY: Inorganic salt CAS#: 7447-40-7

WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS)

WHMIS CLASSIFICATION: Not WHMIS controlled.
WORKPLACE HAZARD: Treat as nuisance dust.

TRANSPORTATION OF DANGEROUS GOODS (TDG)

PROPER SHIPPING NAME: Not regulated under TDG
TDG CLASSIFICATION: Not applicable
UN NUMBER (PIN): Not applicable
PACKING GROUP: Not applicable

SECTION II: HAZARDOUS INGREDIENTS

INGREDIENT	% (w/w)	CAS NUMBER	LD_{50} Oral-Rat	LC_{50} Inhal-Rat	ACGIH-TLV
Contains no WHMIS controlled ingredients.					

SECTION III: HEALTH HAZARDS

ROUTE OF ENTRY: [XX]EYE CONTACT [ ]SKIN [ ]INHALATION [ ]INGESTION
EYE CONTACT: May cause mild irritation, including stinging, watering and redness.
SKIN CONTACT: May cause mild irritation including redness and a burning sensation. Prolonged or repeated contact may cause dry skin. No information available on skin absorption.
INGESTION: Low to moderate degree of toxicity. LD_{50} (oral-rat) = 2.6 g/kg.
INHALATION: High dust levels may cause upper respiratory tract irritation.
CARCINOGENICITY: No information available.
TERATOGENICITY: No information available.

REPRODUCTIVE TOXICITY:	No information available.
MUTAGENICITY:	No information available.
SYNERGISTIC PRODUCTS:	No information available.

SECTION IV: FIRST AID MEASURES

SKIN CONTACT:	Flush with water. Dry area thoroughly and apply skin cream or moisturizing cream. If irritation persists, obtain medical attention.
EYE CONTACT:	Flush with gently flowing warm water for 15 minutes, or until irritation ceases. Hold eyelids open to ensure thorough flushing. If irritation persists, obtain medical attention.
INGESTION:	Do not induce vomiting unless directed to do so by medical personnel. If large amount swallowed, obtain medical attention.
INHALATION:	Move to fresh air. Apply oxygen or artificial respiration if required. If breathing difficulties, or distress, continue obtain medical attention.

SECTION V: PHYSICAL DATA

APPEARANCE AND ODOUR:	White to reddish-brown crystals; odourless	
SPECIFIC GRAVITY:	2.0	
BOILING POINT (°C):	1500 (sublimes)	
MELTING POINT (°C):	773	
SOLUBILITY IN WATER:	342 g/L @ 20°C	pH: 8-9 (5% sol'n)
PERCENT VOLATILE BY VOLUME:	0	
EVAPORATION RATE:	Not applicable	
VAPOUR PRESSURE (mmHg):	~0	
VAPOUR DENSITY (air = 1):	2.57	
BULK DENSITY:	Loose; 1025 – 1200 kg/m^3	

SECTION VI: FIRE AND EXPLOSION HAZARD DATA

FLASH POINT:	Not flammable
FLAMMABLE LIMITS:	Not applicable
EXTINGUISHING MEDIA:	Use media suitable for surrounding materials and packaging.
SPECIAL FIRE FIGHTING PROCEDURES:	Self-contained breathing apparatus required for fire fighting personnel.
UNUSUAL FIRE AND EXPLOSION HAZARDS:	None known.

SECTION VII: REACTIVITY DATA

STABILITY:	STABLE [XX]	UNSTABLE [ ]
INCOMPATIBILITY (CONDITIONS TO AVOID):	Avoid contact with hot nitric acid; may cause evolution of toxic nitrosyl chloride. Contact with other strong acids may produce hydrogen chloride gas. May react violently with bromine trifluoride and may explode if mixed with potassium permanganate and sulfuric acid.	
CONDITIONS OF REACTIVITY:	Contact with incompatible materials.	
HAZARDOUS DECOMPOSITION PRODUCTS:	Hydrogen chloride and fumes of Na_2O.	
HAZARDOUS POLYMERIZATION:	WILL NOT OCCUR [XX]	MAY OCCUR [ ]

SECTION VIII: PREVENTATIVE MEASURES

SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:	Use NIOSH approved dust mask, or respirator with dust/mist filters, if TLV is exceeded. 8 hour OEL Nuisance Dust Total Mass = 10mg/m^3.
VENTILATION:	Suggest local exhaust ventilation, if TLV's are exceeded.
PROTECTIVE GLOVES:	Suggest cloth or leather work gloves be worn to prevent skin contact.
EYE PROTECTION:	Safety glasses with side shields or goggles recommended.
OTHER PROTECTIVE EQUIPMENT (Specify):	Ensure eyewash station and emergency shower are available.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Wash thoroughly after handling. Do not get in eyes, on skin, or on clothing. Store in a cool, dry well-ventilated place away from incompatibles. Keep bags or fibre drums dry at all times. Product is hygroscopic (may absorb moisture from the air when relative humidity >72%).

STEPS TO BE TAKEN IN CASE THE MATERIAL IS SPILLED OR RELEASED

Use appropriate safety equipment. Collect by sweeping and scoop up or shovel. Collect uncontaminated material for repackaging. Collect contaminated material in an approved container for disposal. Keep out of sewers, storm drains, surface waters and soils.

WASTE DISPOSAL METHOD

Dispose in accordance with federal, provincial and local regulations. This product may be suitable for disposal in landfills; check with local operator. It is the responsibility of the end-user to determine if material meets the criteria of hazardous waste at the time of disposal. Dispose of all packaging in accordance with local regulations.

SECTION IX: PREPARATION

THE INFORMATION CONTAINED HEREIN IS GIVEN IN GOOD FAITH,
BUT NO WARRANTY, EXPRESSED OR IMPLIED, IS MADE.

DATE ISSUED:	February 15, 2007	BY:	Product safety committee
SUPERSEDES:	April 27, 2004	PHONE:	780-440-4923

Diversity Technologies Corp. is the parent company of Canamara-United Supply, Hollimex Products, The Drilling Depot and Westcoast Drilling Supplies.

Material Safety Data Sheet

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Salt Lake City, Utah 84119
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E-Mail: dnna.hse@am.dynonobel.com
FOR 24 HOUR EMERGENCY, CALL CHEMTREC (USA) 800-424-9300
CANUTEC (CANADA) 613-996-6666

MSDS # 1124
Date 08/13/08

Supercedes
MSDS # 1124 01/24/05

SECTION I - PRODUCT IDENTIFICATION

Trade Name(s): NONEL® LEAD LINE

Product Class: Shock Tube

Product Appearance & Odor: Hollow plastic tubing (normally yellow) with dusty inner coating of HMX and aluminum. No detectable odor.

DOT Hazard Shipping Description: **UN0349** Articles, explosive, n.o.s. (HMX) 1.4S II.
For 10,000 ft spools with Wire Lock Terminations only: Not regulated as an explosive, 0000

NFPA Hazard Classification: Not Applicable (See Section IV - Special Fire Fighting Procedures)

SECTION II - HAZARDOUS INGREDIENTS

			Occupational Exposure Limits	
Ingredients:	**CAS#**	**% (Range)**	**OSHA PEL-TWA**	**ACGIH TLV-TWA**
Cyclotetramethylene Tetranitramine (HMX)	2691-41-0	0.35	None[1]	None[2]
Aluminum (dust)	7429-90-5	0.04	15 mg/m^3 (total) 5 mg/m^3 (respirable)	10 mg/m^3

[1] Use limit for particulates not otherwise regulated (PNOR): Total dust, 15 mg/m^3 ; respirable fraction, 5 mg/m^3.
[2] Use limit for particulates not otherwise classified (PNOC): Inhalable particulate, 10 mg/m^3 ; respirable part., 3 mg/m^3.
Note: The above hazardous dust mixture is present at approximately 15 mg per meter of tubing.

Ingredients, other than those mentioned above, as used in this product are not hazardous as defined under current Department of Labor regulations, or are present in deminimus concentrations (less than 0.1% for carcinogens, less than 1.0% for other hazardous materials).

SECTION III - PHYSICAL DATA

Boiling Point: Not Applicable
Vapor Density: Not Applicable
Melting Point: HMX decomposes violently at melting pt., about 278°C
Evaporation Rate (Butyl Acetate = 1): Not Applicable
Vapor Pressure: Not Applicable
Density: Not Applicable
Solubility in Water: Not Soluble
Percent Volatile by Volume: Not Applicable

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: Not Applicable
Flammable Limits: Not Applicable
Extinguishing Media: Water, inert powder, CO_2
Special Fire Fighting Procedures: For shock tube only, consider initial isolation of at least 15 meters (50 feet) in all directions. Fight fire with normal precautions and methods used for plastic fires from a reasonable distance. IF DETONATORS OR OTHER EXPLOSIVES ARE PRESENT, DO NOT FIGHT FIRE.
Unusual Fire and Explosion Hazards: May burn vigorously with localized detonations and projection of fragments, with effects usually confined to the immediate vicinity of packages. Toxic smoke from combustion of the plastic material may be emitted. If product functions, high heat and pressure are released from the end of the tube if not covered or enclosed, typically by a metal device.

SECTION V - HEALTH HAZARD DATA

Effects of Overexposure

This is a packaged product that will not result in exposure to hazardous ingredients (inner coating materials) under normal conditions of use.
Eyes: Not a likely route of exposure. Dust particles may be irritating.
Skin: Not a likely route of exposure. Dust particles may cause skin irritation.
Ingestion: Not a likely route of exposure. Ingestion of large amounts of the reactive powder (HMX) is poisonous and may cause cardiovascular collapse.
Inhalation: Not a likely route of exposure. Breathing dust can cause respiratory irritation. During manufacture and at processing temperatures, irritating fumes may evolve.
Systemic or Other Effects: None known.
Carcinogenicity: No constituents are listed by NTP, IARC or OSHA.

Emergency and First Aid Procedures

Eyes: Irrigate with running water for at least fifteen minutes. If irritation persists, seek medical attention.
Skin: Wash with soap and water.
Ingestion: Not Applicable
Inhalation: Not Applicable
Special Considerations: None.

SECTION VI - REACTIVITY DATA

Stability: Stable
Conditions to Avoid: Keep away from heat, flame, impact, friction, ignition sources and strong shocks. Also avoid stretching to failure.
Materials to Avoid (Incompatibility): Incompatible with strong oxidizers and acids.
Hazardous Decomposition or Combustion Products: Hazardous carbon monoxide (CO), nitrogen oxide (NO_X) gases and products of plastic decomposition produced.
Hazardous Polymerization: Will not occur.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in Case Material is Released or Spilled: Protect from all ignition sources. In case of fire evacuate area not less than 50 feet in all directions. Notify authorities in accordance with emergency response procedures. Only personnel trained in emergency response should respond. If no fire danger is present, repackage undamaged devices in original packaging, accounting for every device. If the ends or tube wall have been opened such that powder may have

been released from the tube, isolate the spill area. Contamination of the HMX/Aluminum powder with sand, grit or dirt will render the material more sensitive to detonation. Carefully wet down and clean "loose" powder spills using a damp sponge or rag, avoid applying friction or pressure to the explosive, and place in a (Velostat) electrically conductive bag. Follow applicable Federal, State, and local spill reporting requirements.
Waste Disposal Method: Disposal must comply with Federal, State and local regulations. If product becomes a waste, it is potentially regulated as a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR, part 261. Review disposal requirements with a person knowledgeable with applicable environmental law (RCRA) before disposing of any explosive material.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation: None normally required. Provide enhanced ventilation if used in underground mines, indoors or other enclosed areas.
Respiratory Protection: None normally required. Extended testing of the product indoors or in enclosed areas may necessitate respiratory protection.
Protective Clothing: None normally required. Wear chemical-resistant gloves during post-detonation cleanup or spill cleanup operations.
Eye Protection: Safety glasses or goggles are recommended for handling, testing or cleanup.
Other Precautions Required: None

SECTION IX - SPECIAL PRECAUTIONS

Precautions to be taken in handling and storage: Store in cool, dry, well-ventilated location. Store in compliance with Federal, State, and local regulations. Keep away from heat, flame, ignition sources and strong shock. Only properly qualified and authorized personnel should handle and use Shock Tube.
Precautions to be taken during use: Use accepted safe industry practices when using explosive materials. Unintended detonation of explosives or explosive devices can cause serious injury or death. Avoid breathing the fumes or gases from detonation of explosives. Detonation in confined or unventilated areas may result in exposure to hazardous fumes or oxygen deficiency.
Other Precautions: It is recommended that users of explosive materials be familiar with the Institute of Makers of Explosives Safety Library Publications.

SECTION X - SPECIAL INFORMATION

This product contains the following substances that are subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

Chemical Name	CAS Number	% By Weight
None		

Disclaimer

Shell Canada Limited
Material Safety Data Sheet

Effective Date: 2006-06-05
Supersedes: 2003-06-05

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT:	**TELLUS* T 32**
SYNONYMS:	LOW TEMPERATURE HYDRAULIC OIL
PRODUCT USE:	Hydraulic Fluid
PRODUCT CODE:	**407-159**

SUPPLIER	**TELEPHONE NUMBERS**	
Shell Canada Limited (SCL)	**Shell Emergency Number**	1-800-661-7378
P.O. Box 100, Station M	**CANUTEC 24 HOUR EMERGENCY NUMBER**	1-613-996-6666
400-4th Ave. S.W.	For general information:	1-800-661-1600
Calgary, AB Canada		www.shell.ca
T2P 2H5		

This MSDS was prepared by the Toxicology and Product Stewardship Section of Shell Canada Limited.
*An asterisk in the product name designates a trade-mark(s) of Shell Canada Limited, used under license by Shell Canada Products.

2. COMPOSITION / INFORMATION ON INGREDIENTS

THIS PRODUCT IS NOT A WHMIS CONTROLLED SUBSTANCE.
See Section 8 for Occupational Exposure Guidelines.

3. HAZARDS IDENTIFICATION

Physical Description: Liquid Lightly Coloured Hydrocarbon Odour

Routes of Exposure: Exposure will most likely occur through skin contact or from inhalation of mechanically or thermally generated oil mists.

Hazards:

This product is not expected to be irritating and has a low level of toxicity under normal use.
Inhalation of oil mist or vapours from hot oil may cause irritation of the upper respiratory tract.

For further information on health effects, see Section 11.

4. FIRST AID MEASURES

Eyes: Flush eyes with water for at least 15 minutes while holding eyelids open. If irritation occurs and persists, obtain medical attention.

Skin: Wipe excess from skin. Wash contaminated skin with mild soap and water for at least 15 minutes. If irritation occurs and persists, obtain medical attention. If material is injected under the skin, get medical attention promptly to prevent serious damage; do not wait for symptoms to develop.

Ingestion: Not normally required; obtain medical attention if large amounts have been ingested. Do not induce vomiting. If vomiting occurs spontaneously, keep head below hips to prevent aspiration of liquid into the lungs.

Inhalation: Remove victim from further exposure. Additional first aid treatment is not ordinarily required.

Notes to Physician: In general, lubricating oils have low oral toxicity. High pressure injection under the skin may have serious consequences and may require urgent treatment.

5. FIRE FIGHTING MEASURES

Extinguishing Media: Dry Chemical
Carbon Dioxide
Foam
Water Fog

Firefighting Instructions: Material will not burn unless preheated. Product will float and can be reignited on surface of water. Do not use a direct stream of water as it may spread fire. Use water to cool fire exposed containers. Water may be used to flush spills away from exposure. Do not enter confined fire space without adequate protective clothing and an approved positive pressure self-contained breathing apparatus.

Hazardous Combustion Products: Carbon monoxide, carbon dioxide and dense smoke are produced on combustion.

6. ACCIDENTAL RELEASE MEASURES

Eliminate all ignition sources. Isolate hazard area and restrict access. Wear appropriate breathing apparatus (if applicable) and protective clothing. Stop leak only if safe to do so. Spilled material is slippery. Dike and contain land spills; contain spills to water by booming. For large spills remove by mechanical means and place in containers. Adsorb residue or small spills with adsorbent material and remove to non-leaking containers for disposal. Flush area with water to remove trace residue. Dispose of recovered material as noted under Disposal Considerations. Notify appropriate environmental agency(ies).

7. HANDLING AND STORAGE

Handling: Avoid excessive heat, formation of oil mist, breathing of vapours and mist of hot oil and prolonged or repeated contact with skin. Wash with soap and water prior to eating, drinking, smoking, applying cosmetics or using toilet facilities. Launder contaminated clothing prior to reuse. Use good personal hygiene.

Storage: Store in a cool, dry, well ventilated area, away from heat and ignition sources.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

The following information, while appropriate for this product, is general in nature. The selection of personal protective equipment will vary depending on the conditions of use.

OCCUPATIONAL EXPOSURE LIMITS (Current ACGIH TLV/TWA unless otherwise noted):
Oil mist (mineral): 5 mg/m3 (STEL: 10 mg/m3)

Mechanical Ventilation: Not normally required. Local ventilation is recommended if oil mist is present or if exposure limit is exceeded. Make up air should always be supplied to balance air exhausted (either generally or locally).

PERSONAL PROTECTIVE EQUIPMENT:

Eye Protection: No special eye protection is routinely necessary. Wear safety glasses as appropriate.

Skin Protection: Not normally needed. Chemically-resistant gloves should be worn for frequent or prolonged contact with this product.

Respiratory Protection: Not normally required under intended conditions of use. If airborne concentration is high (e.g. when product is heated), use a NIOSH-approved chemical cartridge respirator with organic vapour cartridges in combination with a P95 particulate filter.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid	**Odour:**	Hydrocarbon Odour
Appearance:	Lightly Coloured	**Odour Threshold:**	Not available
Pour Point	Pour Point < -39 °C	**Boiling Point**	
Vapour Pressure (absolute):		**Vapour Density (air = 1):**	Not available
Density:	approximately 869 kg/m3 @ 15 °C	**Flash Point**	COC > 160 °C
Specific Gravity (Water = 1):		**Lower Flammable Limit:**	Not available
pH:	Not applicable	**Upper Flammable Limit:**	Not available
Viscosity:	28.8 - 35.2 cSt @ 40 °C	**Auto-ignition Temperature:**	Not available
Evaporation Rate (n-BuAc = 1):	Not available	**Partition Coefficient (log K_{OW}):**	Not available
Water Solubility:	Insoluble	**Molecular Weight:**	
Other Solvents:	Hydrocarbon Solvents	**Formula:**	

10. STABILITY AND REACTIVITY

Chemically Stable: Yes
Hazardous Polymerization: No
Sensitive to Mechanical Impact: No
Sensitive to Static Discharge: No
Incompatible Materials: Avoid strong oxidizing agents.
Conditions of Reactivity: Avoid excessive heat, formation of vapours or mists.

11. TOXICOLOGICAL INFORMATION

Routes of Exposure: Exposure will most likely occur through skin contact or from inhalation of mechanically or thermally generated oil mists.

Irritancy: This product is not a primary skin irritant after exposure of short duration, is not a skin sensitizer and is not irritating to the eyes.

Acute Toxicity: This product is not expected to be irritating and has a low level of toxicity under normal use.

Chronic Effects: Prolonged or repeated contact may cause various forms of dermatitis including folliculitis and oil acne. Long term intensive exposure to oil mist may cause benign lung fibrosis.

12. ECOLOGICAL INFORMATION

Environmental Effects: Do not allow product or runoff from fire control to enter storm or sanitary sewers, lakes, rivers, streams, or public waterways. Block off drains and ditches. Provincial regulations require and federal regulations may require that environmental and/or other agencies be notified of a spill incident. Spill area must be cleaned and restored to original condition or to the satisfaction of authorities.

Biodegradability: Not readily biodegradable.

13. DISPOSAL CONSIDERATIONS

Waste management priorities (depending on volumes and concentration of waste) are: 1. recycle (reprocess), 2. energy recovery 3. incineration, 4. disposal at a licenced waste disposal facility. Do not attempt to combust waste on-site.

14. TRANSPORT INFORMATION

Canadian Road and Rail Shipping Classification:
This product is not regulated under the Canadian Transportation of Dangerous Goods Regulations for transport by road and rail.

15. REGULATORY INFORMATION

This product has been classified in accordance with the hazard criteria of the *Controlled Products Regulations* (CPR) and the MSDS contains all the information required by the CPR.

	THIS PRODUCT IS NOT A WHMIS CONTROLLED SUBSTANCE.
DSL/NDSL Status:	One or more of the components of this product are listed on the NDSL. All other components are on the DSL. This product and/or all components are listed on the U.S. EPA TSCA Inventory.
Other Regulatory Status:	No Canadian federal standard; however, for general discharge guidance, federal installations limited to 15 mg/L for total oil and grease. Provincial criteria are likely and should be requested when notifying provincial authorities.

16. OTHER INFORMATION

Revisions:	This MSDS has been reviewed and updated. Changes have been made to: Section 5 Section 8 Section 15

MATERIAL SAFETY DATA SHEET

SECTION I: IDENTIFICATION OF PRODUCT

COMPANY:	**Diversity Technologies Corp.**	DATE:	Dec. 23, 2008
	8750-53 Ave.	PHONE:	780-468-4064
	Edmonton, AB T6E 5G2	FAX:	780-469-1899

PRODUCT NAME: **W-OB POLYMER**

PRODUCT USE: Drilling mud additive
CHEMICAL FAMILY: Polysaccharide suspension CAS #: Mixture

WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS)

WHMIS CLASSIFICATION: D2B
WORKPLACE HAZARD: Skin and eye irritant

TRANSPORTATION OF DANGEROUS GOODS (TDG)

PROPER SHIPPING NAME: Not regulated
TDG CLASSIFICATION: Not applicable
UN NUMBER (PIN): Not applicable
PACKING GROUP: Not applicable

SECTION II: HAZARDOUS INGREDIENTS

INGREDIENT	% (v/v)	CAS NUMBER	LD_{50} Oral-Rat	LC_{50} Inhal-Rat	ACGIH-TLV
Ethoxylated nonylphenol	1-5	9016-45-9	5100 mg/kg	Not determined	Not available

SECTION III: HEALTH HAZARDS

ROUTE OF ENTRY:	[XX] EYE CONTACT [XX] SKIN [XX] INHALATION [XX] INGESTION
EYE CONTACT:	Irritant. Can cause redness, tearing and inflammation.
SKIN CONTACT:	Irritant. Can cause redness, irritation and inflammation.
INGESTION:	Low oral toxicity. May cause nausea, abdominal cramps and diarrhea.
INHALATION:	High concentrations of vapour and mist can cause irritation of the nose and throat
CARCINOGENICITY:	No information available.
TERATOGENICITY:	No information available.
REPRODUCTIVE TOXICITY:	No information available.

MUTAGENICITY:	No information available.
SYNERGISTIC PRODUCTS:	No information available.

SECTION IV: FIRST AID MEASURES

SKIN CONTACT:	Remove contaminated clothing. Immediately wash exposed area with water and soap for 5 minutes. If irritation persists, obtain medical attention.
EYE CONTACT:	Immediately flush with gently flowing warm water for 15 minutes, or until irritation ceases. When flushing period is completed, obtain medical attention.
INGESTION:	Rinse mouth and give 1 - 2 glasses of water to dilute. Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs keep head below hips to prevent aspiration. Even small amounts of liquid drawn into the lungs from swallowing, or vomiting may cause severe health effects. Obtain medical attention. Never give anything by mouth if patient is unconscious, rapidly losing consciousness or convulsing.
INHALATION:	Move patient to fresh air. Apply oxygen or artificial respiration if required. If breathing difficulties or distress continues obtain medical attention.

SECTION V: PHYSICAL DATA

APPEARANCE AND ODOUR:	Opaque dark yellow to beige liquid; little odour	
SPECIFIC GRAVITY:	1.078	
BOILING POINT (°C):	Not determined	
MELTING POINT (°C):	Not determined	
SOLUBILITY IN WATER:	Dispersible	pH: Not determined
PERCENT VOLATILE BY VOLUME:	Not determined	
EVAPORATION RATE:	Not determined	
VAPOUR PRESSURE (mmHg):	Not determined	
VAPOUR DENSITY (air = 1):	Not determined	
BULK DENSITY:	Not applicable	

SECTION VI: FIRE AND EXPLOSION HAZARD DATA

FLASH POINT:	Not flammable
FLAMMABLE LIMITS:	Not determined
EXTINGUISHING MEDIA:	CO_2, water, mist, foam
SPECIAL FIRE FIGHTING PROCEDURES:	Self-contained breathing apparatus required for fire fighting personnel.

UNUSUAL FIRE AND EXPLOSION HAZARDS:	None known.

SECTION VII: REACTIVITY DATA

STABILITY:	STABLE [XX]	UNSTABLE [ ]
INCOMPATIBILITY (CONDITIONS TO AVOID):	Strong oxidizers and acids.	
CONDITIONS OF REACTIVITY:	Not applicable.	
HAZARDOUS DECOMPOSITION PRODUCTS:	Oxides of carbon on combustion.	
HAZARDOUS POLYMERIZATION:	WILL NOT OCCUR [XX]	MAY OCCUR [ ]

SECTION VIII: PREVENTATIVE MEASURES

SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:	An approved respirator with organic vapour cartridge if TLV is exceeded.
VENTILATION:	Use local exhaust ventilation, process enclosure or other engineering control to prevent exposure.
PROTECTIVE GLOVES:	Rubber or viton gloves recommended.
EYE PROTECTION:	Chemical goggles and/or face shield required. Do not wear contact lenses.
OTHER PROTECTIVE EQUIPMENT (Specify):	It is recommended that chemical resistant protective clothing be worn at all times when handling this product. Make eye bath and emergency shower available.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Avoid ingestion. Practice reasonable caution and personal cleanliness. Avoid skin and eye contact. Avoid inhalation of vapours or mists. Wear suitable protection for eyes and skin when handling. Launder contaminated clothing before reuse. Avoid contact with incompatible materials. Store in cool, well-ventilated area away from sources of ignition. Keep container tightly closed when not in use. Store unused material in original container. Handle and store empty containers as if full.

STEPS TO BE TAKEN IN CASE THE MATERIAL IS SPILLED OR RELEASED

Use appropriate safety equipment including respiratory protection. Eliminate ignition sources. Ventilate area. Stop leak if possible to do so without risk. Soak up small spills with absorbent material. Contain large spills using absorbent materials. Collect spilled material and absorbents in approved containers for disposal. Prevent entry into bodies of water or sewer systems.

WASTE DISPOSAL METHOD

Dispose in accordance with federal, provincial and local regulations. It is the responsibility of the end-user to determine at the time of disposal whether the product meets criteria for hazardous waste. Empty containers, which have not been cleaned and purged, contain residual hazardous material and must be disposed of, or recycled, according to local regulations.

SECTION IX: PREPARATION

THE INFORMATION CONTAINED HEREIN IS GIVEN IN GOOD FAITH,
BUT NO WARRANTY, EXPRESSED OR IMPLIED, IS MADE.

DATE ISSUED:	December 23, 2008	BY:	Product safety committee
SUPERSEDES:	January 18, 2006	PHONE:	780-440-4923

Diversity Technologies Corp. is the parent company of Canamara-United Supply, Hollimex Products, The Drilling Depot and Westcoast Drilling Supplies.

Material Safety Data Sheet

Dyno Nobel Inc.
2650 Decker Lake Boulevard, Suite 300
Salt Lake City, Utah 84119
Phone: 801-364-4800 Fax: 801-321-6703
E-Mail: dnna.hse@am.dynonobel.com
FOR 24 HOUR EMERGENCY, CALL CHEMTREC (USA) 800-424-9300
CANUTEC (CANADA) 613-996-6666

MSDS # 1030
Date 09/05/07

Supercedes
MSDS # 1030 03/27/07

SECTION I - PRODUCT IDENTIFICATION

Trade Name(s):

DYNO® AP
DYNO® AP PLUS
DYNO® AP PLUS LD
DYNO® E5
DYNO® MC
DYNO® MC PLUS
DYNO® SL
DYNO® SL PLUS
DYNO® TX
DYNO® XTRA
DYNOSPLIT® AP

POWERMITE®
POWERMITE® AP
POWERMITE® Canadian
POWERMITE® LD
POWERMITE® LD PLUS
POWERMITE® PLUS
POWERMITE® RAISE BOMB™
POWERMITE® SL
POWERMITE® SL PLUS

Product Class: Emulsion Explosives, Packaged

Product Appearance & Odor: White or pink opaque semi-solid, which will appear gray if product contains aluminum. Little or no odor. Typically paper or plastic chub packaging.

DOT Hazard Shipping Description: Explosive, Blasting, Type E 1.1D UN0241 II

NFPA Hazard Classification: Not Available (See Section IV - Special Fire Fighting Procedures)

SECTION II - HAZARDOUS INGREDIENTS

			Occupational Exposure Limits	
Ingredients:	**CAS#**	**% (Range)**	**ACGIH TLV-TWA**	**OSHA PEL-TWA**
Ammonium Nitrate	6484-52-2	60-80	None	None
Sodium Nitrate	7631-99-4	10-18	None	None
Aluminum	7429-90-5	0-15	10 mg/m^3 (dust)	15 mg/m^3 (total)
Mineral Oil	64742-35-4	0-3	5 mg/m^3 (mist)	None

Ingredients, other than those mentioned above, as used in this product are not hazardous as defined under current Department of Labor regulations, or are present in deminimus concentrations (less than 0.1% for carcinogens, less than 1.0% for other hazardous materials).

SECTION III - PHYSICAL DATA

Boiling Point: Not Applicable

Vapor Density: (Air = 1) Not Applicable

Percent Volatile by Volume: <20 (water)

Evaporation Rate (Butyl Acetate = 1): <1

Vapor Pressure: Not Applicable

Density: 0.95-1.25 g/cc

Solubility in Water: Product partially dissolves very slowly in water.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: >100°C

Flammable Limits: Not Applicable

Extinguishing Media: (See Special Fire Fighting Procedures section.)

Special Fire Fighting Procedures: Do not attempt to fight fires involving explosive materials. Evacuate all personnel to a predetermined safe location, no less than 2,500 feet in all directions.

Unusual Fire and Explosion Hazards: Can explode or detonate under fire conditions. Burning material may produce toxic vapors.

SECTION V - HEALTH HAZARD DATA

Effects of Overexposure

Eyes: May cause irritation, redness and tearing.
Skin: Prolonged contact may cause irritation.
Ingestion: Large amounts may be harmful if swallowed.
Inhalation: Not a likely route of exposure.
Systemic or Other Effects: None known.

Emergency and First Aid Procedures

Eyes: Irrigate with running water for at least fifteen minutes. If irritation persists seek medical attention.
Skin: Remove contaminated clothing. Wash with soap and water.
Ingestion: Seek medical attention.
Inhalation: If irritation occurs, remove to fresh air.
Special Considerations: None.

SECTION VI - REACTIVITY DATA

Stability: Stable under normal conditions, may explode when subjected to fire, supersonic shock or high-energy projectile impact, especially when confined or in large quantity.
Conditions to Avoid: Keep away from heat, flame, ignition sources and strong shock.
Materials to Avoid (Incompatibility): Corrosives (strong acids and strong bases or alkalis).
Hazardous Decomposition Products: Nitrogen Oxides (NO_X), Carbon Monoxide (CO)
Hazardous Polymerization: Will not occur.

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be taken in Case Material is Released or Spilled: Protect from all ignition sources. In case of fire evacuate area not less than 2,500 feet in all directions. Notify authorities in accordance with emergency response procedures. Only personnel trained in emergency response should respond. If no fire danger is present, and product is undamaged and/or uncontaminated, repackage product in original packaging or other clean DOT approved container. Ensure that a complete account of product has been made and is verified. Follow applicable Federal, State, and local spill reporting requirements.
Waste Disposal Method: Disposal must comply with Federal, State and local regulations. If product becomes a waste, it is potentially regulated as a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR, part 261. Review disposal requirements with a person knowledgeable with applicable environmental law (RCRA) before disposing of any explosive material.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Ventilation: Not required for normal handling.
Respiratory Protection: None normally required.
Protective Clothing: Gloves and work clothing that reduce skin contact are suggested.
Eye Protection: Safety glasses are recommended.
Other Precautions Required: None.

SECTION IX - SPECIAL PRECAUTIONS

Precautions to be taken in handling and storage: Store in cool, dry, well-ventilated location. Store in compliance with Federal, State and local regulations. Keep away from heat, flame, ignition sources and strong shock.
Precautions to be taken during use: Avoid breathing the fumes or gases from detonation of explosives. Use accepted safe industry practices when using explosive materials. Unintended detonation of explosives or explosive devices can cause serious injury or death.
Other Precautions: It is recommended that users of explosive materials be familiar with the Institute of Makers of Explosives Safety Library Publications.

SECTION X - SPECIAL INFORMATION

The reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR 372 may become applicable if the physical state of this product is changed to an aqueous solution. If an aqueous solution of this product is manufactured, processed, or otherwise used, the nitrate compounds category and ammonia listing of the previously referenced regulation should be reviewed.

Disclaimer

Material Safety Data Sheet

1. Identification of the Product and the Company

Product Name: APS 706b Floc Log

Manufacturer: Applied Polymer Systems, Inc.
519 Industrial Drive
Woodstock, GA 30189
Tel. 678-494-5998
Fax. 678-494-5298
www.siltstop.com

Distributed by: Clear Flow Consulting, Inc.
#125, 65 Chippewa Road
Sherwood Park, AB T8A 6J7
Tel. 780-410-1403
Fax. 780-410-1406
www.clearflowconsulting.com

2. Composition / Information on Ingredients

Identification of the preparation: Anionic water-soluble co-polymer gel mix.

3. Hazard Identification

Placement of these materials on wet walking surface will create extreme slipping hazard.

4. First Aid Measures

Inhalation: None.

Skin contact: Contact with wet skin causes dryness and chapping, wash with water and soap.

Eye Contact: Rinse thoroughly with plenty of water, also under the eyelids, seek medical attention in case of persistent irritation.

Ingestion: Consult a physician

5. Fire-Fighting Measures

Suitable extinguishing media: Water, water spray, foam, carbon dioxide, dry powder.

Special fire fighting precautions: Floc Logs that become wet render surfaces extremely slippery.

Protective equipment for firefighters: No special equipment required.

6. Accidental Release Measures

Personal precautions: No special precautions required.

Methods for cleaning up: Dry wipe as well as possible. Keep in suitable and closed containers for disposal. After cleaning, flush away traces with water.

7. Handling and Storage

Handling: Avoid contact with skin and eyes. Wash hands after handling.

Storage: Keep in a cool, dry place.

8. Exposure Controls / Personal Protection

Engineering Controls: Use dry handling areas only.

Personal Protection Equipment

Respiratory Protection: none.

Hand Protection:	Dry Cloth, Leather, or Rubber Gloves.
Eye Protection:	Safety glasses with side shields. Do not wear contact lenses.
Skin Protection:	No special protective clothing required.
Hygiene Measures:	Wash hands before breaks and at end of workday.

9. Physical and Chemical Properties

Form:	Granular semi-solid gel
Color:	White to Brown
Odor:	None
pH:	3-10
Melting Point:	N/A
Flash Point:	N/A
Autoignition:	N/A

10. Stability and Reactivity

Stability:	Product is stable, no hazardous polymerization will occur.
Materials to Avoid:	Oxidizing agents may cause exothermic reactions.
Hazardous Decomposition Products:	Thermal Decomposition may produce nitrogen oxides (NO_x), carbon oxides.

11. Toxicological / Ecological Information

Acute Toxicity

LC 50 / *Daphnia magna* / 48h / >420 mg/L

LC 50 / *Oncorhynchus mykiss* / 96h / 637 mg/L

Chronic Toxicity

IC 25 (Survival) / *P. promelas* / 7 day / >1680 ppm
NOEC (Survival) / *P. promelas* / 7 day / 1680 ppm

IC 25 (Growth) / *P. promelas* / 7 day / >1680 ppm
NOEC (Growth) / *P. promelas* / 7 day / 1680 ppm

IC 25 (Survival) / *C. dubia* / 7 day / 257.3 ppm
NOEC (Survival) / *C. dubia* / 7 day / 210 ppm

IC 25 (Reproduction) / *C. dubia* / 7 day / 91.6 ppm
NOEC (Reproduction) / *C. dubia* / 7 day / 105 ppm

Bioaccumulation:	The product is not expected to bioaccumulate.
Persistence / Degradability:	Not readily biodegradable (~85% after 180 days)

12. Transport and Regulatory Information

Not regulated by DOT, RCRA status-Not a hazardous waste

NFPA and HMIS ratings:

NFPA:	Health: 1	Flammability: 0	Reactivity: 1
HMIS:	Health: 1	Flammability: 0	Reactivity: 1

CLEAR FLOW CONSULTING INC.
SOIL SOLIDIFICATION
EROSION CONTROL
WATER CLARIFICATION

Material Safety Data Sheet

1. Identification of the Product and the Company

Product Name: APS 703d#3 Floc Log

Manufacturer: Applied Polymer Systems, Inc.
519 Industrial Drive
Woodstock, GA 30189
Tel. 678-494-5998
Fax. 678-494-5298
www.siltstop.com

Distributed by: Clear Flow Consulting, Inc.
#125, 65 Chippewa Road
Sherwood Park, AB T8A 6J7
Tel. 780-410-1403
Fax. 780-410-1406
www.clearflowconsulting.com

2. Composition / Information on Ingredients

Identification of the preparation: Anionic water-soluble co-polymer gel

3. Hazard Identification

Placement of these materials on wet walking surface will create extreme slipping hazard.

4. First Aid Measures

Inhalation: None.

Skin contact: Contact with wet skin could cause dryness and chapping, wash with water and soap. Use of gloves recommended.

Eye Contact: Rinse thoroughly with plenty of water, also under the eyelids, seek medical attention in case of persistent irritation.

Ingestion: Consult a physician

5. Fire-Fighting Measures

Suitable extinguishing media: Water, water spray, foam, carbon dioxide, dry powder.

Special fire fighting precautions: Floc Logs that become wet render surfaces extremely slippery.

Protective equipment for firefighters: No special equipment required.

6. Accidental Release Measures

Personal precautions: No special precautions required.

Methods for cleaning up: Dry wipe as well as possible. Keep in suitable and closed containers for disposal. After cleaning, flush away traces with water.

7. Handling and Storage

Handling: Avoid contact with skin and eyes. Wash hands after handling.

Storage: Keep in a cool, dry place.

8. Exposure Controls / Personal Protection

Engineering Controls: Use dry handling areas only.

Personal Protection Equipment

Respiratory Protection:	none.
Hand Protection:	Dry Cloth, Leather, or Rubber Gloves.
Eye Protection:	Safety glasses with side shields. Do not wear contact lenses.
Skin Protection:	No special protective clothing required.
Hygiene Measures:	Wash hands before breaks and at end of workday.

9. Physical and Chemical Properties

Form:	Granular semi-solid gel
Color:	White to Brown
Odor:	None
pH:	3-10
Melting Point:	N/A
Flash Point:	N/A
Autoignition:	N/A

10. Stability and Reactivity

Stability:	Product is stable, no hazardous polymerization will occur.
Materials to Avoid:	Oxidizing agents may cause exothermic reactions.
Hazardous Decomposition Products:	Thermal Decomposition may produce nitrogen oxides (NO_x), carbon oxides.

11. Toxicological / Ecological Information

Acute Toxicity (EPA-821-R-02-012)

LC 50 (Survival) / *Ceriodaphnia dubia* / 48h / 673 ppm

NOAEC (Survival) / *Ceriodaphnia dubia* / 48h / 420 ppm

LC 50 / *Onchorhynchus mykiss* / 96h / 2928 ppm

Chronic Toxicity (EPA-821-R-02-013)

IC 25 (Survival) / *P. promelas* / 7 day / 77.8 ppm
NOEC (Survival) / *P. promelas* / 7 day / 52.5 ppm

IC 25 (Growth) / *P. promelas* / 7 day / 50.1 ppm
NOEC (Growth) / *P. promelas* / 7 day / 52.5 ppm

IC 25 (Survival) / *C. dubia* / 7 day / 78.7 ppm
NOEC (Survival) / *C. dubia* / 7 day / 52.7 ppm

IC 25 (Reproduction) / *C. dubia* / 7 day / 66.8 ppm
NOEC (Reproduction) / *C. dubia* / 7 day / 52.5 ppm

Bioaccumulation: The product is not expected to bioaccumulate.

Persistence / Degradability: Not readily biodegradable: (~85% after 180 days)

12. Transport and Regulatory Information

Not regulated by DOT, RCRA status-Not a hazardous waste

NFPA and HMIS ratings:

NFPA:	Health: 3	Flammability: 0	Reactivity: 1
HMIS:	Health: 2	Flammability: 0	Reactivity: 1

Updated: May 24-06

Material Safety Data Sheet

1. Identification of the Product and the Company

Product Name: APS 705 Silt Stop

Manufacturer: Applied Polymer Systems, Inc.
519 Industrial Drive
Woodstock, GA 30189
Tel. 678-494-5998
Fax. 678-494-5298
www.siltstop.com

Distributed by: Clear Flow Consulting, Inc.
#125, 65 Chippewa Road
Sherwood Park, AB T8A 6J7
Tel. 780-410-1403
Fax. 780-410-1406
www.clearflowconsulting.com

2. Composition / Information on Ingredients

Identification of the preparation: Anionic water-soluble co-polymer.

3. Hazard Identification

Aqueous solutions or powders that become wet render surfaces extremely slippery.

4. First Aid Measures

Inhalation: Move to fresh air. Use dust mask when handling.

Skin contact: Contact with wet skin could cause dryness and chapping, wash with water and soap. In case of persistent skin irritation, consult a physician.

Eye Contact: Rinse thoroughly with plenty of water, also under the eyelids, seek medical attention in case of persistent irritation.

Ingestion: Consult a physician

5. Fire-Fighting Measures

Suitable extinguishing media: Water, water spray, foam, carbon dioxide, dry powder.

Special fire fighting precautions: Aqueous solutions or powders that become wet render surfaces extremely slippery.

Protective equipment for firefighters: No special equipment required.

6. Accidental Release Measures

Personal precautions: No special precautions required.

Methods for cleaning up: Do Not flush with water. Clean up promptly by sweeping or vacuum. Keep in suitable and closed containers for disposal. After cleaning, flush away traces with water.

7. Handling and Storage

Handling: Avoid contact with skin and eyes. Avoid dust formation. Do not breathe dust. Use dust mask during handling. Wash hands after handling.

Storage: Keep in a cool, dry place. (0-30° C).

8. Exposure Controls / Personal Protection

Engineering Controls: Use local exhaust if dusting occurs. Natural ventilation is adequate in absence of dust.

Personal Protection Equipment

Respiratory Protection: Dust safety masks are recommended where dusting may occur.

Hand Protection: Dry cloth, leather or rubber Gloves.

Eye Protection: Safety glasses with side shields or face masks. Do not wear contact lenses.

Skin Protection: No special protective clothing required.

Hygiene Measures: Wash hands before breaks and at end of workday.

9. Physical and Chemical Properties

Form: Granular solid

Color: White

Odor: None

pH: 5-6

Melting Point: N/A

Flash Point: N/A

Autoignition: N/A

10. Stability and Reactivity

Stability: Product is stable, no hazardous polymerization will occur.

Materials to Avoid: Oxidizing agents may cause exothermic reactions.

Hazardous Decomposition Products: Thermal Decomposition may produce nitrogen oxides (NO_x), carbon oxides.

11. Toxicological / Ecological Information

Acute Toxicity: (EPA/600/4-90/027F)

LD 50 / *Rattus norvegicus* / oral / >5000 mg/kg
LC 50 / *Oncorhynchus mykiss* / 96h / 530 mg/L
LC 50 / *Daphnia magna* / 48h / >420 mg/L
EC 50 / *Selenastrum capricornutum* / 96h / >500 mg/L

Chronic Toxicity: (EPA/600/R-98/182)

IC 25 (Survival) / *P. promelas* / 7 day / 358 ppm
NOEC (Survival) / *P. promelas* / 7 day / 840 ppm

IC 25 (Growth) / *P. promelas* / 7 day / 94 ppm
NOEC (Growth) / *P. promelas* / 7 day / 105 ppm

IC 25 (Survival) / *C. dubia* / 7 day / 157.5 ppm
NOEC (Survival) / *C. dubia* / 7 day / 105 ppm

IC 25 (Reproduction) / *C. dubia* / 7 day / 27.7 ppm
NOEC (Reproduction) / *C. dubia* / 7 day / 26.25 ppm

Inhalation: The product is not expected to be toxic by inhalation.
Dermal: The result of testing on rabbits showed no toxicity even at high dose levels.
Bioaccumulation: The product is not expected to bioaccumulate.
Persistence / Degradability: Not readily biodegradable: (~40% after 28 days).

Chronic toxicity: A 2 yr feeding study on rats did not reveal adverse health effects.
A 1 yr feeding study on dogs did not reveal adverse health effects.

12. Transport and Regulatory Information

Not regulated by DOT, RCRA status-Not a hazardous waste

NFPA and HMIS ratings:

NFPA:	Health: 3	Flammability: 0	Reactivity: 1
HMIS:	Health: 2	Flammability: 0	Reactivity: 1

ASH GROVE

Material Safety Data Sheet
for
Agricultural Lime

Section I - Identity

Manufacturer's name and address: Ash Grove Cement Company
P. O. Box 25900
Overland Park, KS 66225

Emergency Telephone Number: (913) 451-8900

Information Telephone Number: (913) 451-8900

Chemical Name and Synonyms: Agricultural Lime

Chemical Family: Primarily a mixture of calcium carbonate and calcium hydroxide and may contain a minor amount of calcium oxide.

Revision Date: January 2005

Section II - Hazardous Ingredients

	CAS Number	OSHA PEL	1994-1995 ACGIH TLV	MSHA Limit from 1973 TLV
Calcium carbonate, $CaCO_3$	1317-65-3	Total dust, 15 mg/m^3 Respirable fraction, 5 mg/m^3**	10 mg/m^3*	10 mg/m^3
Calcium hydroxide, $Ca(OH)_2$	1305-62-0	5 mg/m^3	5 mg/m^3	N/A
Calcium oxide, CaO	1305-78-8	5 mg/m^3	2 mg/m^3	5 mg/m^3
*Particulate not otherwise classified containing no asbestos and less than 1% crystalline silica **Unless contains >1% crystalline silica (quartz)				

N/A = Not Applicable

Agricultural Lime can contain quartz >0.1%. The MSHA 1973 TLV/OSHA PEL for quartz is respirable dust only. $\dfrac{10 mg/m^3}{\% SiO_2+2}$

The 2000 ACGIH TLV for respirable quartz is 0.05 mg/m^3.

ACGIH American Conference of Governmental Industrial Hygienists
OSHA Occupational Safety and Health Administration
PEL Permissible Exposure Limit
TLV Threshold Limit Value

Section III - Physical/Chemical Characteristics

Chemical Family: Inorganic Base
Specific Gravity: Approximate range 2.3 to 2.60
Vapor Pressure(mm Hg): 0
Vapor Density: (Air=1) NA
Evaporation Rate: NA
Solubility in Water: 0.0014% (25°C)
Appearance and Odor: Soft white powder or granules; faint odor
Melting Point: Calcium hydroxide-decomposes above 600°C
Calcium carbonate-decomposes above 900°C

Section IV - Fire and Explosion Hazard Data

Flash Point (method used): NA; Agricultural Lime is non-combustible and not explosive.
Flammable or Explosive Limits: LEL: NA **UEL:** NA
Extinguishing Media: NA
Special Fire Fighting Procedures: Agricultural Lime is incombustible
Firefighting Media: Dry chemical, carbon dioxide, water spray or foam. For larger fires use water spray or fog.

CAUTION: Saturated water solutions of calcium hydroxide or calcium oxide can have pH of 12-12.49. See Section VII for appropriate precautions.

Unusual Fire and Explosion Hazards: None

Section V - Health Hazard Data

Agricultural Lime can contain quartz greater than 0.1%. Chronic long term exposure to respirable crystalline silica without the use of a proper respirator can cause silicosis. Silicosis may aggravate other chronic pulmonary conditions and may increase the risk of pulmonary tuberculosis infection.. Smoking aggravates the effects of silica exposure. NTP and IARC list respirable quartz crystalline silica as a carcinogen; OSHA does not.

Route(s) of Entry of calcium hydroxide, calcium oxide, and calcium carbonate: Inhalation; skin; eyes; ingestion

1. **Inhalation:** corrosive
   a. **Acute exposure:** Inhalation of low concentrations may cause sore throat, coughing, choking, dyspnea, and variable symptoms of headache, dizziness, and weakness. Intense exposures may result in tightness in the chest and delayed pulmonary edema. The solubility of the substance allows further penetration that may continue for several days.
   b. **Chronic exposure:** Bronchial irritation with chronic cough are common.

Section V - Health Hazard Data - (Continued)

c. **First aid:** Remove from exposure; move to fresh air immediately. If breathing has stopped, give artificial respiration. Keep affected person warm and at rest. Get medical attention.

2. **Skin contact:** corrosive
   a. **Acute exposure:** The substance can penetrate the skin slowly, producing soft, necrotic, deeply penetrating areas on contact. The solubility may allow further penetration that may continue for several days. The extent of damage depends on duration of contact.
   b. **Chronic exposure:** A chronic dermatitis may follow repeated contact.
   c. **First aid:** Remove contaminated clothing and shoes immediately. Wash affected area with soap or mild detergent and large amounts of water until no evidence of chemical remains (approximately 15-20 minutes). In the case of chemical burns, cover the affected areas with sterile, dry dressing. Bandage securely, but not too tightly. Get medical attention.
3. **Eye contact:** corrosive
   a. **Acute exposure:** Direct contact with the solid or aqueous solutions may cause conjunctival edema and corneal destruction; can lead to and may cause blindness.
   b. **Chronic exposure:** Prolonged contact may cause conjunctivitis.
   c. **First aid:** Wash eyes immediately with large amounts of water, occasionally lifting the upper and lower lids, until no evidence of chemical remains (approximately 15-20 minutes). Get medical attention immediately. Qualified medical personnel should perform administration of drugs to the eyes.
4. **Ingestion:** corrosive. If ingested, consult a physician immediately.

Quartz listed as an OSHA carcinogen: NO By NTP: YES By IARC: YES
Calcium carbonate, calcium oxide, calcium hydroxide listed as an OSHA carcinogen: NO By NTP NO By IARC: NO

Medical conditions generally aggravated by exposure: Respiratory disorders or diseases, dermatitis or other skin disorders may be aggravated by exposure.

Section VI - Reactivity Data

Stability: Stable under normal temperatures and pressures. Calcium hydroxide and calcium oxide will gradually absorb carbon dioxide when exposed to air, forming calcium carbonate.

Incompatibility (Materials to avoid): maleic anhydride, nitroparaffins, nitromethane, nitroethane, and nitropropane; all can form explosive salts with calcium hydroxide.

Phosphorous, when boiled with alkaline hydroxides, yields mixed phosphines that may ignite spontaneously in air.

Hazardous Polymerization: Will not occur.

Water: Calcium hydroxide and calcium oxide form corrosive solutions with water; pH: 12-12.49.

Hazardous Decomposition or By-Products: When heated above 580°C, calcium hydroxide loses water to form calcium oxide, quicklime.

Conditions to Avoid: NA

Section VII - Precautions for Safe Handling and Use

Steps to be Taken in Case Material is Released or Spilled:

Pick up spilled powder; avoiding dusting conditions. Spills should not be flushed to surface waters or sewers. Dispose of in accordance with all applicable local, state and federal requirements.

Handling: Avoid generation of excessive dust.

Storing: Protect against physical damage and store in dry place away from water or moisture.

Section VIII - Control Measures

Respiratory Protection: Use NIOSH/MSHA-approved (under 30 CFR 11) or NIOSH-approved (under 42 CFR 84) respirators in poorly ventilated areas, if an applicable exposure limit is exceeded, or when dust causes discomfort or irritation. (Advisory: Respirators and filters purchased after July 10, 1998 must be certified under 42 CFR 84.)

Firefighting: Self-contained breathing apparatus with a full facepiece operated in pressure-demand or positive-pressure mode.

Ventilation: Enclose all dusty processes; use local exhaust ventilation. Use mechanical ventilation to vent dust to collector.

Protective Gloves: Gauntlet type work gloves.

Eye Protection: Tight fitting goggles.

Other Protective Equipment: To avoid contact with skin, use long sleeve shirt and long pants; can use protective cream on exposed skin areas.

Work/Hygienic Practices: Avoid skin contact with product. If skin contact has occurred promptly remove from skin with soap and water. Follow listed precautions as appropriate during the repair and/or maintenance of contaminated equipment.

This product neither contains nor is directly manufactured with any controlled ozone depleting substances, Class I and II.

MATERIAL SAFETY DATA SHEET

Revision #: 02

Section 1 - Product Identification & Use

Product Name:	**Aluminum Sulphate**
WHMIS Classification:	Class D2B, Toxic Materials
TDG Classification:	Only regulated for TDG under class 9 if intended for disposal.
Supplier:	Advance Chemicals Ltd. 2023 Kingsway Avenue Port Coquitlam, BC V3C 1S9 Phone: (604) 945-9666 Fax: (604)945-9617
Emergency phone:	CANUTEC 24 hrs. (613) 996-6666

Section 2 - Hazardous Ingredients

Hazardous Components	%(w/w)	C.A.S. No.	LD_{50} & LC_{50}
Sulphuric acid, aluminum salt	60-100	10043-01-3	6207mg/kg, Oral(Mouse)

Section 3 - Physical Data

Physical state: Solid. Granules, or powder.	Boiling point: 290°C
Liquid density: 1.61 g/mL	Freezing point: 86°C
pH: >2.9 @ 5%	Solubility in water: Yes
Vapour pressure: N/A	Evaporation rate: N/A

Odour & Appearance: White to creamy white odourless solid.

Section 4 - Fire or Explosion Hazard

Flammability: The product is not considered to be flammable.
Extinguishing media: Use an extinguishing media for surrounding the fire, or all purpose foam by manufacturer's recommended techniques for large fires. Use water to cool fire exposed containers to prevent vapour build-up and rupture.
Hazardous Combustion Products: Wear self contained breathing apparatus. Product reacts with most metals to produce hydrogen gas, which may accumulate to produce explosive and/or flammable mixtures with air. Reacts violently with water with the evolution of heat.

Section 5 - Reactivity Data

Stability: Stable.
Incompatible substances: Strong bases. Strong oxidizing agents. Alkalis. Water-reactive materials such as oleum cause exothermic reactions.
Polymerization: Will not occur.
Conditions to Avoid: Temperatures over 760°C. Contact with water forms sulphuric acid. May corrode ferrous metals and mild steel in presence of moisture.
Hazardous Combustion Products: At temperatures above 760°C, sulfur oxide gases are released which are toxic, corrosive and are oxidizers. The remaining residue is caustic. The trioxide is also a fire hazard. Oxides of aluminum.

Section 6 - Toxicological Properties

Acute Toxicity: Aluminum Sulphate has been shown to cause liver, kidney and nervous system toxicity when tested on animals. Repeated ingestion may cause phosphate deficiency, which can weaken bones.
Skin contact: Burning, inflammation, blisters.
Eye contact: May irritate or burn eyes.
Inhalation: Dust or mist inhalation may irritate nose, throat and lungs.
Ingestion: May irritate the gastrointestinal tract and cause nausea, vomiting and purging. Acute exposure can cause incoorination, muscle spasms and kidney effects.

Section 7 - Preventative Measures

Personal Protective Equipment: Avoid contact with skin and eyes. Wear chemical protective gloves, goggles and face shield, rubber apron and boots. Eye wash fountains and safety shower facilities should be provided nearby for emergency use.
Respiratory protection: Use a NIOSH approved dust mask, for concentrations of up to 10 mg/m³. A NIOSH approved air-purrifying respirator equipped with acid gas/fume, mist cartridges for concentrations up to 20 mg/m³. An air supplied respirator if concentrations are unknown.
Ventilation Requirements: This product should be used in a well ventilated area at all times.
Action to take for spills & leaks: Wear chemical protective clothing, rubber gloves and suitable respiratory protection. Small spills should be wiped up with absorbent material and disposed of in government approved waste containers. The spilled product can be neutralized with a soda ash or baking soda and wet down with a little water to form a slurry. The spill area may then be flushed with large quantities of water. Larger spills should be contained by diking with sand, soil or other absorbent, non-combustible material, then transferred into approved waste containers for proper disposal. Keep product out of sewers, storm drains, surface run-off water and soil. Restrict access to non-protected personnel. Comply with all government regulations on spill reporting, handling and disposal of waste.
Disposal methods: Dispose of contaminated product and materials used in cleaning up spills or leaks in a manner approved for this material. Consult appropriate federal, provincial and local regulatory agencies to ascertain proper disposal procedures.
Note: Empty containers can have residues, gasses and mists, and are subject to proper waste disposal as mentioned above.
Storage & Handling Precautions: Warning, harmful or fatal if swallowed. Causes eye, skin and respiratory irritation. Avoid contact with eyes and repeated contact with skin and clothing. Do not ingest. Keep away from sources of heat and open flame. Keep container tightly closed when not in use. Store upright in a cool, dry, well ventilated place away from incompatible materials. Do not use pressure to empty container. Wash thoroughly after handling. Use with adequate ventilation. Tanks must be grounded and ventilated. Ensure proper electrical grounding procedures are in place during product transfer.
Repair and Maintenance Precautions: Do not cut, grind, weld or drill in, on or near this container.

Section 8 - First Aid Measures

If inhaled: Remove victim to fresh air. Give artificial respiration if not breathing. Get immediate emergency medical attention.
In case of eye contact: Immediately flush eyes with clean water for at least twenty (20) minutes, lifting the upper and lower eye lids occasionally. Get immediate emergency medical attention. Do not transport victim until the recommended flushing period has been completed, unless eye flushing can be continued during transport to the nearest emergency medical treatment facility.
In case of skin contact: Immediately flush skin with plenty of clean running water for at least fifteen (15) minutes. Remove contaminated clothing and shoes. If irritation persists after washing, get immediate medical attention. Wash and launder clothes before re-use.
In case of ingestion or swallowing: If victim is conscious and not convulsing, give one or two glasses of water to dilute material. Immediately contact the local poison control centre. Vomiting should only be induced under the direction of a physician or poison control centre. If spontaneous vomiting occurs, have victim lean forward with head down to avoid breathing in the vomitus. Rinse mouth and administer more water. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS VICTIM. GET IMMEDIATE EMERGENCY MEDICAL ATTENTION.

Section 9 - Preparation Information

Advance Chemicals Limited expressly disclaims all expressed or implied warranties of merchantability and fitness for a particular purpose with respect to the product provided. The information contained herein is offered only as a guide to the handling of this specific product, and has been prepared in good faith by technically knowledgeable personnel. This M.S.D.S. is not intended to be all inclusive, and the manner and conditions of use may involve other and additional considerations.
Revised: 19 October 2006; 15 December 2006

Baffinland
Iron Mines Corporation

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

WASTEWATER MANAGEMENT PLAN

Rev. No.	Revision	Date	Approved
0	Issued in Final	September 15, 2007	DC
1	Issued in Final	March 31, 2009	JM

ACKNOWLEDGEMENTS

This Wastewater Management Plan was prepared by Baffinland Iron Mines Corporation with the technical assistance, support, and review services of various consulting engineers and scientists. The consulting companies involved and the specific areas of technical expertise provided are listed below:

Seprotech Systems Inc. (Seprotech) of Ottawa ON - Wastewater Treatment Plant Design Development, Installation, Maintenance, Technical Support, and Operator Training.

Genivar Consultants LP (Genivar) of Timmins, Ontario Polishing Waste Stabilization Ponds (PWSPs) and Piping/Outfall Design, Construction QA/QC and As-Built Drawings, Author of September 15, 2007, Version of the Wastewater Management Plan.

AMEC Geomatrix Limited (AMEC) of Waterloo, Ontario - Treatment Plant Design Review and Development of Technical Strategy for Discharge of Treated Effluent in PWSPs.

Knight Piésold Ltd. (KPL) of North Bay, Ontario, and North/South Consultants (NSC) Inc. of Winnipeg, Manitoba - Receiving Environment Baseline Data Compilation, Mass Balance Modeling, Effects Prediction, and Toxicity Assessment.

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

WASTEWATER MANAGEMENT PLAN

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BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

WASTEWATER MANAGEMENT PLAN

SECTION 1.0 - INTRODUCTION

Genivar Consultants LP (Genivar), formerly B.H. Martin Consultants Ltd., was retained by Baffinland Iron Mines Corporation (BIM) in 2007 to design the sewage works for the Mary River Project (the Project), specifically for Mary River and Milne Inlet Camps on Baffin Island, Nunavut, to support the Bulk Sampling Program. As a requirement under BIM's Water Licence 2BB-MRY0710 issued by the Nunavut Water Board (NWB) on July 27, 2007, and in accordance with Part D, item 13, BIM was required to submit a Wastewater Management Plan (WWMP) as follows:

> *"The Licensee shall submit to the Board for approval, within thirty (30) days following the commissioning of the Waste Water Treatment Facilities, a Waste Water Management Plan which includes provision for Operation and Maintenance in accordance with the "Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories, 1996". The plan shall include options for treatment and disposal of sludge."*

On September 15, 2007, BIM submitted a Wastewater Management Plan (WWMP) to the NWB that addressed the following key elements related to sewage works and management at their Mary River and Milne Inlet Camps (refer to Figure 1 for location map):

- Process design,
- Construction and commissioning,
- Operation and maintenance, and
- Effluent discharge to receiving environment

The WWMP, herein, is a revised version of the September 2007 document that includes the most current technical information regarding infrastructure and process/operation for the wastewater and treatment facilities (WWTFs) at the Mary River and Milne Inlet Camps. The plan has been updated to accommodate future Project requirements with respect to sewage treatment and in consideration of operational experience with the WWTFs at Milne Inlet and Mary River gained over the years 2007 and 2008.

Specifically, this WWMP document is revised to include the following items:
:

- Changes to sewage infrastructure including the construction and commissioning of two additional Polishing/Waste Stabilization Ponds (PWSPs) at the Mary River Camp

- Revisions to operating manual documentation, maintenance, and monitoring practices to reflect enhancements that have been implemented since start-up of the WWTFs.
- Review and revision of the design basis of the sewage treatment systems in consideration of actual monitoring/operational/performance data.
- Presentation of a provisional option to add RBC media to the Mary River Camp sewage treatment system to address current and unexpected throughput limitations resulting from higher than anticipated average nitrogen loading.
- Proposed management and disposal technical strategy for the effluent currently residing in three (3) PWSPs at Mary River and one (1) PWSP at Milne Inlet.
- Proposed management and disposal technical strategy for sludge currently stored in the PWSPs.
- Review and validation of the prediction for no adverse impacts to the receiving environment associated with the discharge of treated sewage effluent and in consideration of the planned 2009 discharges from the PWSPs.

An overview and chronology of the sewage works at the Mary River and Milne Inlet Camps are provided in Sections 1.1 and 1.2, below. A location plan showing the two camps is provided as Figure 1.

1.1 MARY RIVER CAMP WWTF OVERVIEW

The existing camp at Mary River currently has a potential capacity for 200 persons. This capacity consists of a 100 person seasonal camp that was originally set up and used for the exploration work prior to 2007, plus an adjacent all-season camp with a nominal design capacity of 100 people that was constructed in late 2007 and early 2008. The all-season camp consists of predominantly Weatherhaven™ tents, two steel Quonset huts as maintenance facilities, and numerous small wooden outbuildings, situated approximately 200 meters from the shores of Camp Lake (refer to Figure 2 and Drawing 002).

A pre-engineered mechanical sewage treatment plant (referred to as the 'Tanks-a-Lot system') was commissioned in November 2007 and was operated until February 2008, when a new mechanical WWTF was commissioned, The new WWTF consisting of a Rotating Biological Contactor (RBC) and UV disinfection (manufactured and installed by Seprotech), was designed for tertiary levels of treatment with the potential for piped year-round discharge to Sheardown Lake. (The existing Tanks-a-Lot system was substantially decommissioned in the months that followed.) With the design basis that was adopted, the new RBC WWTF was sized for a nominal occupancy of 150 persons. Since, October 2008, the camp occupancy at Mary River has declined to less than 20 persons and will remain so until May 2009 when an exploration drilling program is scheduled to start. At that time, camp occupancy is not expected to increase beyond 50 persons. However, in the event of additional funding in 2009, and an expansion of the drilling and environmental programs, camp numbers could potentially expand beyond 50 persons.

During 2008, treated effluent from the RBC facility has not consistently met discharge requirements of the water licence and has been discharged to three PWSPs that have been constructed for this purpose. PWSP No. 1, No. 2, and No. 3 were commissioned in November 2007, May 2008, and December 2008, respectively. Since December 2008 to the present time, treated effluent from this facility has met licence criteria, however, effluent continues to be discharged to the PWSPs because of a failure of the heat trace for the outfall pipe, causing the outfall pipe to freeze.

In response to operating experience in 2008 and the longer than anticipated time that it has taken to ramp-up the RBC facilities at the Mary River Camp, BIM has conducted a review of the design basis for the facility, its standard operating procedures for operations and maintenance, and monitoring requirements, with the aim of consistently meeting discharge requirements to reduce the dependency on the use of the PWSPs. The later sections in this document present the results of the above work as well as the technical strategy and work plan that has been developed to treat, discharge, and monitor the partially treated effluent that is currently stored in the three PWSPs at the Mary River Camp.

1.2 MILNE INLET CAMP WWTF OVERVIEW

The Milne Inlet site is the shipping point for materials and supplies to and from the Mary River Operations (refer to Figure 3 and Drawing 003). An all-season trailer camp was installed in 2007 to support the annual re-supply and Bulk Sample Program operations. The camp facilities at Milne consist of a ShancoTM accommodation complex with a RBC WWTF (complete with UV disinfection) sized for a nominal capacity of 60 workers to support peak periods of activity, primarily during the initial mobilization and final ore shipment stages of the Bulk Sample Program. Since the completion of the Bulk Sample Program in October 2008, the Milne Inlet Camp population has declined to two persons and the RBC was shut down and winterized. Currently there are no plans to operate the RBC to support camp occupancy during 2009 since it is anticipated the total number of persons will remain very low. Toilet wastes at Milne Inlet are being managed through use of latrines and the incineration of latrine waste.

The RBC WWTF was commissioned in October 2007. During the start-up period, effluent and sludge were disposed of in a PWSP, constructed on site for that purpose. Treated effluent from this facility first met the water license discharge requirements in January 2008 and as such was directed to the approved receiving ditch upstream of Milne Inlet. Compliance with water license criteria enabled direct discharge to the receiving environment for the majority of 2008 with intermittent periods where effluent not meeting discharge criteria was directed to the PWSP. Similar to the situation at the Mary River Camp, a technical strategy and work plan is required to treat, discharge, and monitor the partially treated effluent that is currently stored in the PWSP the Milne Inlet Camp. This strategy and work plan is presented in this document.

SECTION 2.0 - WASTEWATER REGULATORY BACKGROUND AND CHRONOLGY

2.1 WASTEWATER MANAGMEMENT CHRONOLOGY

This section presents a chronological listing of key regulatory submissions/approvals and key activity/milestones related to wastewater treatment and management from September 2007 to the March 2008. Also included in this section are regulatory/government comments that were received in response to the submission of the original WWMP in September 2007 and also comments arising from other regulatory submissions since that time (e.g., Modification request for additional PWSPs at Mary River and Milne Inlet Camps).

Date	**Activity/Milestones and Regulatory Submissions/Approvals**
September 2007	Submission of Wastewater Management Plan
October 2007	Commissioning of Milne Inlet Rotating Biological Contactor (RBC) and Polishing / Waste Stabilization Pond (PWSP)
November 2007	Commissioning of 'Tanks-a- Lot' Wastewater Treatment Facility (WWTF) at Mary River
January 2008	As-Built submission for Milne Inlet RBC Facility
January 2008	As-Built submission for the Mary River 'Tanks-A-Lot' sewage system
January 2008	Treated effluent from Milne RBC meets Water Licence criteria and is discharged to the Milne Inlet
February 2008	Installation of all-season tent camp at Mary River
February 2008	Construction completion and commissioning of Mary River RBC facility
March 2008	Submission of Water Licence Annual Report (2007)
April 2008	Submission of Waste Disposal Facilities Modification Request for PWSP No. 2 and 3 at Mary River and an additional PWSP at Milne Inlet
May 2008	Construction completion and commissioning of Mary River PWSP No. 2
May 2008	Water License Modification granted - Waste Disposal Facilities
July 2008	As-built submission for Mary River RBC and PWSP No. 1 and 2
August 2008	Milne effluent tested for acute toxicity and passes
October 2008	Shut-down of Milne Inlet RBC due to low numbers in camp
November 2008	Submission Annual Geotechnical Inspection Report
December 2008	Construction completion and commissioning of Mary River PWSP No. 3
December 2008	Effluent from Mary River RBC starts meeting Water Licence Criteria
March 2009	Submission of revised WWMP
March 2009	As-built submission for Mary River PWSP No. 3

2.2 COMMENTS FROM REGULATORY/GOVERNMENT AGENCIES

Since the submittal of the WWMP in September 2007, there have been three rounds of comments received from regulatory and government agencies regarding wastewater management for the Project. Comments were received from INAC regarding the September 2007 submittal of the WWMP. BIM responded to these comments in a letter to the NWB, dated December 9, 2007. This letter and attachments are provided for reference in Appendix A.1 of this document.

The second round of comments on wastewater management was received from Environment Canada and INAC Water Resources Division in April 2008 regarding BIM's Request for Modification to Waste Disposal Facilities. The third round of comments was received from Environment Canada in response to BIM's Annual Water Licence Report submission. The above correspondence from Environment Canada and INAC are also provided for reference in Appendix A.2, along with a tabulated summary of the comments and BIM's response/action for each (refer to Table A.2, Appendix A).

SECTION 3.0 - DESIGN CRITERIA, CAPACITY, AND PROCESS REVIEW

This section presents the original design basis for the Mary River and Milne Inlet RBCs and presents the results of a process design review that was performed for Mary River RBC system in particular. This review was undertaken due to the longer than anticipated time that it has taken to achieve water licence criteria for treated effluent. The objective of the review was to provide recommendations on the actual treatment capacity of the Mary River sewage treatment system. As a follow-up to this work a provisional option to install additional media to the Mary River RBC is provided as a means of eliminated nitrogen removal as a current limitation in the ability of the facility to meet its design throughput.

The treated effluent from the Milne Inlet RBC first met the water licence discharge requirements in January 2008 and, since then, there has been direct discharge to the receiving environment for the majority of 2008, with intermittent short periods where effluent not meeting discharge criteria was directed to the PWSP. These periods resulted from minor upset conditions in the RBC related to mechanical or process maintenance, and intermittent spikes in camp occupancy that resulted in higher than design loadings. Based on operational experience over 2008, the Milne RBC treatment system is considered to be generally performing within its expected operational parameters..

3.1 DESIGN BASIS

Per capita sewage flows and strengths were originally estimated based on the values found in Table 10.3, 10.4 and 13.1 of the 1996 “Cold Regions Utilities Monograph, Third Edition”, a publication highly respected and used in Canada and USA for the design of infrastructure in the arctic regions. Copies of these Tables are included in Appendix B to this report.

The characteristics of sewage in remote/cold regions, depend on the type of work being performed, work schedules, facilities provided and the type and capacity of the water supply. These factors directly affect the flow rates and the amount of dilution seen in the wastewater.

For design of the freeze protection of the forcemain, the minimum ambient temperature was assumed to be -45 degrees C and wind speed was assumed to be 40.3 kph. The heat tracing on the forcemain was designed to keep the pipe contents at 5 degrees C.

The sewage at both camps was expected to be a ‘moderately diluted wastewater’ as defined in Table 10.4 in Appendix B. The average BOD5/TSS levels for this type of wastewater were expected to be 460 mg/l BOD5 and 490 mg/l TSS. In addition, a loading of 65 mg/l TKN and 10 mg/l phosphorus was assumed by Seprotech, the manufacturer of the RBC units, derived from their experience with similar operating facilities.

Average flow rates for similar camps have been recorded in the range of 132 to 220 lpcd. The assumed average flow rate of 225 lpcd was adopted for the design.

Sewage generation was conservatively assumed to be 225 litres per capita per day (225 lpcd) with a maximum loading of 460 mg/L BOD5, 490 mg/L TSS, 65 mg/L TKN and 10 mg/L Phosphorus.

The tables below provide a summary of the original design sewage flows and strengths, the discharge requirements of the water licence, and the original design basis of the pre-engineered RBC units. The original design briefs and loading calculations completed by Seprotech are provided in Appendix C to this report.

Design Sewage Flows and Strengths

Facility Type	Water/Sewage Quantity (lpcd)	BOD_5/TSS (Avg. – mg/l)	No. of Persons (Capita)	Total Daily Flow (l/d)	Total Flow 400 days (m^3)
Drilling Camp	83 to 227	460/490	-	-	
Average Work Camp	170	460/490			
Average Construction Camp	220		-	-	
Design Criteria for Mary River Camp	**225**	**460/490**	**150**	**33,750**	**13,500**
Design Criteria for Milne Inlet Camp	**225**	**460/490**	**60**	**13,500**	**5,400**

Water License Discharge Requirements and the Original Design Basis

Parameter	**Water License Requirements Maximum Average Concentration**		**Wastewater Treatment Plant Effluent Concentrations**	
Location	Milne Inlet WWTF	Mary River WWTF	Milne Inlet WWTF	Mary River WWTF
BOD_5	100 mg/L	30 mg/L	20	10
TSS	120 mg/L	35 mg/L	20	10
Faecal Coliform	1,000 CFU/100mL	10,000 CFU/100mL	Less than 200 Counts per 100 ml	Less than 200 Counts per 100 ml
Oil and Grease	No visible sheen	No visible sheen	Removed by grease traps	Removed by grease traps
pH	Between 6.0 and 9.5	Between 6.0 and 9.5	Between 6.0 and 9.5	Between 6.0 and 9.5
Toxicity	Final effluent not acutely toxic	Final effluent not acutely toxic	Not acutely toxic due to nitirification	Not acutely toxic due to nitirification
Ammonia	N/A	N/A	2 mg/L NH3-N	2 mg/L NH3-N
Total Phosphorus	N/A	N/A	N/A	0.5 mg/L target level**

** Note: The 0.5 mg/L phosphorus target level is considered to be conservative based on anticipated overall phosphorus loadings to Sheardown Lake and modeling results that are presented in Section 10 of this document. It also needs to be recognized that because these target levels are very close to what is technically achievable, that levels may on occasion may range between 0.5 to 1.0 mg/L, especially as related to discharge from the PWSPs. The modeling takes this 0.5 to 1.0 mg range into consideration when calculating loadings for discharge from the PWSPs..

3.2 MARY RIVER RBC DESIGN PROCESS EVALUATION

Due to the poorer than expected performance of the Mary River RBC sewage treatment system, a review was performed by AMEC Geomatrix Limited (AMEC) on the original design basis by comparing this to actual 2008 operating conditions with the aim of identifying the actual treatment capacity of the system. The treatment capacity recommendation is based on an independent review of the design parameters, the estimated original design capacity, and the actual loading data recorded during the 2008 operating season. AMEC's technical memorandum, *Mary River RBC Design Process Evaluation*, is provided in Appendix D to this report, contains the technical details of the evaluation. A summary of this work including key results is provided below.

For general background, it is important to understand that RBC design is based on hydraulic and organic loading rates across a surface area and that increases or decreases in surface area increase the fundamental treatment capacity of the system. The variability in surface area is provided by the configuration of the media (spacing and diameter) and promotes biofilm growth. The biofilm is responsible for removal of organic and nutrient constituents. Once the sludge reaches a certain thickness it sloughs off of the media for removal. AMEC conducted an independent review of the design parameters used by Seprotech against accepted published values. Based on the results of this review, in terms of design flowrates and organic loading capacity of the system, it was concluded that although the system has been designed to be within published loading criteria, little flexibility or safety factor has been designed into the system. It is possible that small changes in wastewater characteristics would have a significant impact on treatment efficiency.

AMEC also compared the actual 2008 measured wastewater loadings data with the design basis for the system. The results of this comparison was that the actual flowrates were lower than the design basis (26 m3/day compared with 33.75 m3/day in design basis). It is suspected that the daily habits of camp crews have impacted the overall flowrates to the wastewater treatment system in that some flows of dilute wastewater have not been entering the system. The higher concentration material has continued to enter the system which has resulted in overall wastewater concentrations that are higher (particularly nitrogen measured as TKN) than in the original design basis. The resulting mass loading rates were similar to design mass loading rates although BOD5 and TSS loadings were less than estimated while TKN loading was higher than original estimates.

It has been identified that TKN is the limiting design parameter for the RBC system currently operating at Mary River. The treatment system was designed with a maximum TKN loading of 2194 g/day. To produce effluent consistently meeting the water license criteria in the current configuration (one shaft, four stages) the number of staff on-site at any one time would be limited to 123 people based on per capita loading rates of 16.9 g of nitrogen/person/day experienced in 2008 in order to provide sufficient surface area for nitrification.

The key tables summarizing these results are provided in AMEC's technical memorandum found in Appendix D to this report.

3.3 PROVISIONAL OPTION – ADDITIONAL RBC MEDIA

A treatment option has been developed to enable the Mary River RBC to treat sewage at the originally designed hydraulic throughput. By adding additional growth media to the RBC, the sewage system will be capable of treating the higher than expected nitrogen levels while preserving the design hydraulic throughput.

In late 2008, anticipating a potential treatment bottleneck, Baffinland purchased from Seprotech a stand-alone RBC media unit. This unit has not been installed but consists of a tank assembly complete with 3,038 m^2 of high density packaged media designed specifically for nitrification. Seprotech has provided a design basis for this system and design brief which is provided in Appendix D to this report. AMEC conducted a review of the provisional system including development of a conceptual process flow diagram for the proposed configuration (also provided in Appendix D).

The suggested layout would consist of adding the new media in series with the existing four (4) stages of media contained within the RBC facility. By adding an additional four (4) stages of media, the surface area available for treatment would increase to 5,382 m^2. Connecting the existing 4-stage Shaft #1 in series with the 4 stage shaft Shaft #2 would provide a total of two (2) shafts and eight (8) stages.

In the proposed configuration the first four media stages would be used for BOD removal and the remaining 4 stages would be used for nitrification. Although the additional media will not increase the existing hydraulic capacity it will allow the existing system to operate at the original design capacity instead of the current "TKN limited" capacity. The maximum hydraulic loading would be limited by the system hydraulic loading of 33.75 m3/day. The additional shaft would increase the existing treatment capacity and result in a more robust system capable of treating a maximum of 236 people at 143 L/person/day. The tanks, pumps, alum system and filter systems will not need to be upgraded as the hydraulic capacity will not change.

For the purposes of determining a maximum number of staff that the Mary River facility can support the sizing calculations were based on calculated mass loading and available surface area. This analysis and results are presented in the AMEC TM in Appendix D.

SECTION 4.0 - SEWAGE TREATMENT AND DISCHARGE

4.1 TREATMENT

Treatment of sewage at the Mary River Site is by a ROTORDISK®; N-70 packaged RBC System by Seprotech Systems Inc. Effluent from the sewage treatment system has the potential to be transmitted directly to the submerged outlet at Sheardown Lake via an insulated 75 mm forcemain. Since start-up in February 2008, treated effluent has been discharged to the three PWSPs constructed for that purpose. At the present time the outfall pipe is frozen due to failure of the heat trace, near the outfall end. This is scheduled to be repaired in early summer to allow discharge to Sheardown Lake to commence.

The fully contained RBC system is comprised of a primary settlement tank, a Rotating Biological Contact (RBC) tank, and a secondary settling tank. Raw sewage is pumped into the primary settlement tank, whereby, heavy solids are retained through gravity settling and thickening. Supernatant from the primary settlement tank enters the RBC tank through an inlet slot located at the front section of the RBC tank. The RBC tank is made up of four stages, or disk banks. The four separate disk banks are mounted on a common rotating shaft. As the disk banks are partially submerged, the rotation serves to provide continual aeration for the fixed film biological growth and filtering process (which occurs on the disk banks). The first disc bank represents 40% of the total RBC surface area and is responsible for the most significant reduction in BOD. Subsequently, the accumulation of biological growth will be the greatest on the film disc bank and gradually decrease through subsequent sections. The growth will be generally thick and often filamentous on the 1st disk bank, becoming thinner and more compact on stages 2 through 4. Under certain operating conditions, nitrifying bacteria may become dominant in the 3rd and 4th disc banks. The 4th disc bank has a circulation device that allows well-treated liquid to be recycled to the primary settling tank. Treated water from the RBC enters the secondary settlement tank, whereby biomass sloughed from the disks and other suspended solids settle through gravity.

The existing RBC system uses aluminum sulphate (“alum”) to precipitate dissolved phosphorus and form insoluble aluminum phosphate. This insoluble aluminum phosphate settles in the RBC tankage and is periodically removed along with the accumulated biological solids sloughed off from the rotating media. Thus, phosphorus removal is a 2-stage process whereby the dissolved phosphorus is first precipitated to form a solid, and secondly those solids are then removed from the treated water. For systems that experience occasionally high suspended solids concentrations in the effluent, meeting low phosphorus concentrations can be problematic. To ensure the Mary River WWTF is able to consistently meet a 0.5 mg/L phosphorus discharge target concentration, the existing alum addition program can be combined with effluent filtration.

The dimensions and sizes of the system can be seen in the the Seprotech drawings provided in Appendix C.

Treatment of sewage at Milne Inlet is by a ROTORDISK®; B-30 packaged RBC System by Seprotech Systems Inc. This system is similar to the N-70 unit. In order to meet the requirement of the water license for a non-acutely toxic effluent, this unit was modified as part of its original installation to promote nitrification. The B-30 system operation is similar to the N-70 as discussed above.

During the open water season in 2009, the partially treated effluent contents in the three PWSPs at Mary River and the one PWSP at Milne Inlet will be treated as required to meet water licence requirements and discharged to the receiving environment. The technical strategy and work plan for this project are presented in Section 6.0 of this document.

4.2 MARY RIVER DISCHARGE

Since start-up, all effluents have been directed to the PWSPs. The location of the three PWSPs relative to the RBC system is shown in Figure 2 and Drawing 002.

The as-built report for the sewage treatment system including the RBC, PWSP No. 1 and No. 2, and associated piping and outfall was submitted to the NWB in July 2008. The as-built report for PWSP No. 3 was submitted to the NWB in March 2008. These reports contain detailed design and as-constructed survey information. Drawings Nos. 002, 004, 005, and 006 provide as-built plans and profiles for the Mary River Camp sewage treatment infrastructure including piping, outfall, and PWSPs. In general, the designs of the PWSPs consist of cells lined with a 1.0mm (40 mil) HDPE liner. The slopes of the PWSPs designed to be a minimum of 2H: 1V with allowance for 0.3m of sludge, 1.5 m of water, and 0.6m of free board. Total operating volume for the combined volume of the three PWSPs at Mary River is approximately 9,400 m^3.
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Since December 2008, the treated effluent from the Mary River RBC system has met water licence effluent criteria, therefore, it is planned to discharge treated effluent to Sheardown Lake in late June or early July, as soon as the outfall pipe in the vicinity of Sheardown Lake can be repaired and reinstalled.

Freeze protection has been designed by Urecon Limited. The 75 mm DR 26 HDPE pipe is fitted with 50 mm of polyurethane insulation and a PVC jacket. Inside the insulation, an integral conduit houses a Thermocable C13-240-COJ heating cable with an output of 13 watts/meter controlled by an electronic thermostat set at 5 degrees C with a high limit of 65 degrees C for protection of the HDPE pipe. Prior to repairing the damaged heat trace section of pipe, an analysis will be conducted to identify the cause of the failure and corrective action will be taken as warranted.

4.3 MILNE INLET DISCHARGE

During the RBC start-up at Milne Inlet (from November 2007 to January 2008), treated effluent from the plant was transported to the PWSP via vacuum truck. The location of the PWSP relative to the RBC and other camp infrastructure is shown on Figure 3 and Drawing 003. Commencing in January 2008, treated effluent was discharged to the receiving environment with the exception of short periods when water licence criteria were not or not likely being met. During normal operation, treated effluent is transported regularly from the RBC via vacuum or tanker truck to local drainage ditch (non-fish bearing) where the effluent is released to the ditch that flows to the receiving environment. The dimensions of the ditch are as follows: average width of the drainage ditch is 15 m, average depth relative to surrounding land is 1.9 m and approximate length of the ditch 275 m. The ditch discharges to Milne Inlet.

The Milne Inlet RBC was shut down and winterized in October 2008. At the present time it is not likely that the RBC will be operational due to the projected low camp occupancy. Based on an occupancy level of less than five (5) persons, latrines will be used and the collected waste incinerated at Mary River.

The as-built for the Milne RBC and PWSP was submitted to the NWB in December 2007. The PWSP consists of a cell lined with a 1.0mm (40 mil) HDPE liner. The slopes of the PWSP are 2H: 1V with allowance for 0.3m of sludge, 1.5 m of water, and 0.6m of free board. Total operating volume of the PWSP at Milne Inlet is approximately 575 m^3. Detailed as-constructed drawings and profiles of the PWSP at Milne is presented in Drawings 003 and 007.

The effluent from the RBC System is transferred to a holding tank with a capacity of two days of average flow. The effluent holding tank is housed adjacent to the RBC System to protect the tank from freezing. Inside temperature is normally kept at a minimum of 10 degrees C. The holding tank itself is sized to hold twice the average daily sewage volume generated.

The discharge location along the drainage ditch is protected by means of an energy dissipater to prevent erosion. Silt fences have been maintained downstream from the discharge location as an additional protective measure.

SECTION 5.0 - OPERATIONS AND MAINTENANCE (O&M)

Both routine and non-routine O&M procedures are described in detail in the Installation, Operation, and Maintenance Manuals provided in Appendix E. They are briefly summarized in the subsections below.

5.1 TRAINING

The manufacturer of the RBC WWTFs (Seprotech) provides training to BIM managers and RBC facility operators during routine periodic visits to the Project site, as well as providing a training program at their Ottawa offices. Seprotech have provided the level of training to BIM supervisors and operators that it recommends to clients of their equipment. To enhance management capabilities and enable continuity of operation, BIM designates specific contract operators for its WWTFs. These operators have undergone on-site training by the manufacturer, Seprotech, as described above. Seprotech is also available to provide on-call expert advice, as required. BIM is currently developing in-house training capabilities for its WWTF operators.

5.2 ROUTINE O&M

BIM have developed a checklist for routine inspections that occur on a daily basis. A copy of the checklist that is used is provided in Appendix E.1. When the checklist is completed, it is provided to the BIM Camp Manager where the results of the inspection are reviewed and any actions taken as required. The record is safely stored in a record filing system developed for the purpose. In addition to reviewing the daily checklists for upset conditions that might require action, the treatment plant operators are instructed to immediately notify the Camp Manager as soon as an atypical condition is observed.

The following procedures associated with operation and maintenance of the sewage facilities are performed on a scheduled basis while the Mary River and Milne Inlet Camp RBCs are in operation:

- Visual inspection of the RBC unit to detect any leaks, malfunctions, discoloration, foul odours (refer to checklist for complete list).
- Monitoring for indicator parameters such as pH and temperature.
- Visual inspection of camp kitchen grease traps to ensure proper operation
- Visual inspection of effluent pipeline and heat trace checks along the pipeline to detect any leaks, damage or malfunction of the heat tracing system
- Visual Inspection of the pump station at the camp to verify the liquid levels, and detect any system blockages
- Visual inspection of the discharge outfall to ensure continuous discharge and detect any leaks in the embankment

Prior to inspecting the RBC unit, the operator must ensure that the unit is well ventilated and appropriate personal protective gear is worn, including disposable gloves. During routine visual inspection of the RBC unit, attention will be paid to the nature of the biological growth on the disk media. The colour of the growth will typically be dark brown to black on the 1st disk stage. The growth on disks 2-4 will typically range between medium brown to tan on the final section. Unusual discoloration/texture of the disk media growth or strong sour odours could be indicative of process malfunction. Full details of the routine inspections and troubleshooting guidelines are provided in the Seprotech O&M Manual. These conditions are also noted on the daily checklists.

5.3 NON-ROUTINE O&M

Non-routine O&M procedures will be preformed associated with the following system needs:

- Sewage sludge management (discussed in Section 6 of this report)
- Unit Start up
- Unit Shutdown
- Special start-up procedures must be followed if the RBC unit has been out of operation. These procedures are outlined in detail in Appendices E.2 and E.3, and are briefly summarized below:
    - Support bearings on shaft and coupling re-lubricated;
    - Primary settling tank should be filled with fresh water;
    - While the RBC is rotating, introduce wastewater at design or less than design loading rates; and
    - Unit start-up normally requires 2 ½ to 3 weeks, with 50% BOD removal often occurring after one week
    - Shut down procedures are necessary if the treatment unit is to be taken out of operation for any significant period of time. These procedures are briefly summarized below:
    - Remove all accumulated sewage sludge from settlement chambers;
    - Clean disk media and flush unit clean; and
    - Drain tanks and pipes and disconnect pipes.

SECTION 6.0 - PWSP EFFLUENT RELEASE TECHNICAL STRATEGY AND WORK PLAN

BIM retained AMEC to prepare a technical strategy for the management, treatment, and disposal of the wastewater and sludge solids stored in the polishing/waste stabilization ponds (PWSPs) at Milne Inlet and the Mary River facilities. The technical strategy for managing sludge is detailed in Section 7.0.

This technical strategy has been developed using information gathered from a number of sources including analytical monitoring/sampling data for the RBC and PWSPs, the Mary River RBC process design evaluation (Section 3.2), and environmental discharge criteria established based on water licence requirements and considering potential impacts to the receiving environment. The technical strategy was therefore developed iteratively and in cooperation with Knight Piesold (KP), North/South Consultants (NSC), and BIM, to quantify the projected discharge limits that will be required to meet this objective (refer to Section 10). Discharge water from the PWSPs will meet the Water Licence criteria that were detailed in Section 3.1 of this report and are specified in Part D, Items 10 and 11 of Water Licence 2BB-MRY0710. The target level for phosphorus has been established at 1.0 mg/L in consideration of anticipated overall phosphorus loadings to Sheardown Lake and modeling results that are presented in Section 10 of this document. Ammonia concentrations will be acutely non-toxic.

To the extent possible, the 2009 discharge plans and options presented are flexible with a view to developing a long term operating philosophy that can accommodate various seasonal operating requirements. Due to the uncertainty of the PWSP water quality at Milne Inlet and Mary River, a complete evaluation was not possible prior to the commencement of open water season in June 2009. The technical strategy was developed to identify the sequence of events required that will allow a timely and successful discharge of the PWSP's without interrupting ongoing site operations. The strategy for treating and discharging the accumulated water from the PWSPs involves the following steps:

1. Conduct environmental sampling and analysis of the accumulated water and solids in each PWSP.
2. Confirm PWSP water levels and volumes of water and solids for disposal from each PWSP.
3. Conduct bench-scale treatability testing of PWSP samples.
4. Review and select the specific treatment process for scale-up.
5. Develop a discharge workplan for each PWSP.
6. Execute the technical workplan to treat and discharge each of the PWSPs.

BIM will execute the recommended technical strategy with AMEC's guidance during the 2009 discharge season. The discharge workplan, once established, will be designed so that it can be utilized during future annual open water discharge seasons. The detailed strategy and potential options for treatment and discharge of the PWSPs at Mary river and Milne Inlet Camps are provided in a technical memorandum entitled *Technical Strategy for 2009 PWSP Treatment* prepared by AMEC and presented in Appendix F of this report.

SECTION 7.0 - ROUTINE SLUDGE MANAGEMENT AND LONG TERM TECHNICAL STRATEGY AND WORK PLAN

7.1 ROUTINE SLUDGE MANAGEMENT

At the design capacity of the RBC System at Mary River, the sludge accumulates at a rate of approximately 13.5 kg per day in the Primary Settling Tank. During periods of camp occupancy at design capacity, this sludge is typically removed to PWSP No 1 or 2 at a frequency of approximately 80 days (this frequency varies in accordance to actual conditions realized). Thus, at every 80-day interval, approximately 20 m^3 of wet sludge will be transferred to the PWSP. The accumulation of sludge can be indirectly monitored by visually observing the thickness of the scum blanket on the surface of the primary settlement tank. Based on actual operating conditions and observed sludge removal rates, the above rate of removal seems to have been validated, although in practice, the quantification of sludge volumes is difficult and depends on density and amount of effluent removed with the sludge.

At the design capacity of the RBC System at Milne Inlet, sludge accumulates at a rate of approximately 12.9 kg per day at the Primary Settling Tank. Based on this rate of generation and average camp occupancy, the sludge would be removed to the PWSP at a frequency of every 52 days (this frequency of course varying in accordance to actual conditions realized). Thus, at every 52-day interval, approximately 13 m^3 of wet sludge will be transferred to the PWSP. No sludge has been generated at Milne Inlet since shutdown of the RBC in October 2008.

7.2 LONG TERM SLUDGE MANAGEMENT AND TECHNICAL STRATEGY

The PWSPs currently hold either wastewater or comingled wastewater and solids. There are currently an estimated 200 m^3 of settled sludge solids in the PWSP at Milne, 800 m^3 in Mary River PWSP No.1 and 150 m^3 in Mary River PWSP No.2. These three solids-containing ponds also hold non-compliant wastewater.

The existing approach to wastewater solids management is to use the PWSP as a sludge drying bed with seasonal treatment and discharge of any accumulated separated wastewater. Once the sludge is sufficiently dry (determined by monitoring the moisture content of the sludge), tests on the sludge content would be performed and depending on the results the contents would be landfilled on site. Accumulated supernatants would be directed to the existing WWTF for treatment as required, should it not meet effluent discharge criteria set by the water license. The treatment of sludge solids and effluent in the PWSPs are interrelated activities that can result in complications that need to be effectively managed. For example, the treatment of non-compliant wastewater may require chemical addition and agitation which can re-suspend any settled solids (refer to Section 6) and the re-suspension of the settled wastewater solids can have negative effects on the treatment of the target wastewater contaminants. In order to prevent future treatment issues, the current sludge management plan will be reviewed and assessed for effectiveness.

AMEC were recently retained by BIM to develop a technical strategy for treating and managing the accumulated solids from the PWSPs. The technical strategy is presented in an AMEC memorandum (see Appendix F) and is summarized below. It involves the following steps which will be undertaken during 2009:

1. Conduct environmental sampling and analysis of the accumulated solids in each of the PWSPs.
2. Confirm PWSP solids levels and volumes of water and solids for disposal from each PWSP.
3. Conduct bench-scale treatability testing of PWSP samples
4. Review and select the specific treatment process for scale-up.
5. Develop a detailed solids treatment workplan for each PWSP.
6. Execute the technical workplan to treat the solids while managing the resultant wastewater at each of the PWSPs.

Treatability testing of the solids will allow BIM to improve the sludge dewatering and storage plan which can be executed during the 2009 and 2010 discharge seasons. The solids treatment workplan will be designed so that it can be utilized by throughout future operating seasons to avoid additional handling during the open water season.

The solids management strategy employed at the Milne Inlet and Mary River facilities will focus on segregation of the sludge solids and non-compliant wastewater streams to simplify annual handling and treatment. Site specific conditions will determine which method will be the most feasible option for solids management.

SECTION 8.0 - CONTINGENCY MEASURES

Design criteria for Mary River Camp WWTF have been reviewed and revised to provide additional conservatism. The average occupancy level for Mary River has now been established at 123 persons, revised downward from the original 150 persons. In the event that the Mary River Camp occupancy expands to greater numbers, a provisional contingency involving the installation of additional RBC media can be implemented (refer to Section 3.3). There is currently acceptable conservatism built into the Milne Camp WWTF. The WWTF's and PWSP effluent discharge strategy and workplan are designed to be protective of the receiving environment and meet or exceed the requirements of the water license. Baffinland has incorporated the temporary storage ponds to be used during periods of start-up, shut-down or during periods of system upset.

The RBC units and the PWSPs are located sufficiently remote from surface water bodies. The RBC is a fully enclosed unit and the PWSPs are designed with an impermeable liner. In the event of a spill of untreated or partially treated sewage from these facilities, Baffinland will follow the procedures its spill response plan. Sewage spills are treated the same as more immediately hazardous hydrocarbon based spills.

SECTION 9.0 - SAMPLING, MONITORING, AND REPORTING

Monitoring and reporting under the water license is described in the updated Site Water Management Plan. Generally, sampling and monitoring of the wastewater treatment systems will include the following:

- Regular sampling of sewage discharge at both WWTFs and PWSPs in accordance with water licence requirements.
- More frequent internal process sampling and monitoring as required to identify potential upset conditions early that could lead to non-compliance.
- Record of volumes of sewage effluent discharged and sludge generated in accordance with water licence requirements.
- Completion of daily checklists related to the O&M requirements for the facilities and the reporting of any upset conditions that require action.
- Aquatic effects monitoring program to confirm/validate environmental predictions.

The monitoring program will identify upset conditions related to the WWTF which will be immediately reported to the Camp Manager for corrective action.

SECTION 10.0 - EFFLUENT EFFECT ON RECEIVING WATERS

Knight Piesold Ltd. (KPL) and North/South Consultants (NSC) were retained by BIM in 2007 to assess potential effects on the receiving waters from the WWTF and confirm that facility designs were appropriate given the projected operating schedule, and projected discharge concentrations and loadings. Based on available receiving environment data and process design considerations, the final effluent from the facilities was expected to be non-acutely toxic. The potential for eutrophication of the fresh water receiving environment (Sheardown Lake) was also evaluated by means of a mass balance modelling approach that used conservative assumptions. The model results indicated that fully mixed concentrations of TSS, ammonia, and nitrate would be within CCME guidelines for the protection of aquatic life, and that total phosphorus increases would remain within triggers specified in the CCME guidance framework for the management of phosphorus. Localized and short-term effects to biota were predicted to occur in the vicinity of the outfall, including localized DO depletion and chronic effects related to TSS, ammonia, and nitrate. The conclusions of the 2007 assessment were that that overall sites and facilities were designed to limit the impact of the treated sewage effluent on the receiving environments

In this updated WWMP, previous modeling has been updated to reflect current conditions and 2009 operational plans. This update was completed by KPL and NSC. The results of this work are summarized in this section and detailed methodology and results are provided in a technical memorandum which is presented in Appendix G.

10.1 EFFLUENT TOXICITY

Environment Canada recommended toxicity testing of the treated effluent during review of BIM's application to amend its water license in 2007, and the Nunavut Water Board incorporated this requirement into the amended water license. The WWTFs have been designed accordingly.

Environment Canada developed a guideline with respect to ammonia in wastewater effluent discharges (Canada Gazette, 2004). This guideline recommends weekly testing of ammonia and pH in wastewater effluent to establish if the effluent is acutely toxic, based on the following relationship established between ammonia concentration and pH:

$$y = 306132466.34 \times (2.7183(-2.0437 \times pH))$$

This relationship between ammonia concentration, pH and acute toxicity is shown on the attached Figure 4, extracted from the Environment Canada guideline (Canada Gazette, 2004).

The acute toxicity of ammonia increases with increasing with pH. Knight Piésold measured pH in the marine waters of Milne Inlet on two occasions in August 2007 and recorded pH measurements of 8.05 and 8.15. During water quality monitoring of on-ice drilling in May and June 2007, a pH of 8.27 was recorded. Based on the higher of these two summer-time pH measurements (pH= 8.15), the threshold at which ammonia is acutely toxic in the receiving waters of Milne Inlet is 17.9 mg/L.

Based on a pH of 8.0 in Sheardown Lake, ammonia is acutely toxic in that receiving water at 24.3 mg/L.

The RBC treatment facilities include nitrification such that ammonia-nitrogen concentrations in the final effluent will be less than 2 mg/L, which is non-acutely toxic according to the Environment Canada guideline. The final effluent from the RBCs is therefore expected to be acceptable for direct discharge to the final receiving waters of Sheardown Lake and Milne Inlet before mixing. The final effluent discharged from the PWSPs will be non-acutely toxic as demonstrated by water quality and toxicity sampling/analyses that will be conducted prior to and during discharge using applicable and approved methods.

10.2 EFFECTS OF SEWAGE EFFLUENT DISCHARGES TO SHEARDOWN LAKE

Baseline Water Quality and Limnology of Sheardown Lake

A description of baseline water quality and limnological conditions of Sheardown Lake was provided in the 2007 WWMP that included data collected in 2006 and 2007. This description has been updated to include 2008 data. Figure 5 presents the bathymetry of the northwest basin of Sheardown Lake ("Sheardown Lake NW") and Figure 6 presents the locations of 2008 sampling sites. Detailed methodology and tabulated results of the baseline data for Sheardown Lake are provided in the attached Technical Memorandum (TM) presented in Appendix G.

Thermal stratification has been observed in Sheardown Lake NW in summer at some locations but temperature was relatively uniform across depth in winter and in September in 2007 and 2008. In general, dissolved oxygen has also been relatively uniform across depth and above the CCME guidelines for the protection of aquatic life, however there were two locations where oxygen depletion was observed at depth in winter 2007. Overall, the available information indicates that the majority of the water column and lake volume is well-oxygenated throughout the year but may develop pockets of oxygen depletion at depth during some periods.

In general, Sheardown Lake NW is a relatively clear lake (low turbidity and high Secchi Disk depth), is alkaline in the open-water season (pH > 8) and near neutral in the winter (Mean pH of 7.03 in May 2007), soft (hardness typically at or below 60 mg/L), and contains a relatively low concentration of dissolved solids (mean of 71 mg/L in the open-water season and 102 mg/L in winter). Like other lakes in the area, Sheardown Lake NW is nutrient-poor and contains low levels of TP and inorganic forms of nitrogen. TP was generally near or below the analytical detection limit (0.003 mg/L) over the period of study. Lake-wide mean TP concentrations were somewhat higher in the open-water season of 2008 than 2007, although concentrations were generally similar. Similarly, nitrate, nitrite, and ammonia concentrations are low and were generally not detected.

According to the CCME phosphorus guidance framework, Sheardown Lake would be classified as "ultra-oligotrophic" or "oligotrophic" on the basis of TP.

Potential Effects to Sheardown Lake

A mass balance approach, similar to what was undertaken in 2007, was used to evaluate potential effects to water quality in Sheardown Lake NW of discharge of the treated sewage effluent from the ponds at the Mary River site, based on the effluent quality, volume/discharge rate and duration and timing of release provided by AMEC.

Many water quality parameters are very low in Sheardown Lake NW – as they are in other nearby lakes. In particular, ammonia, total suspended solids (TSS), total phosphorus (TP), nitrate, biological oxygen demand (BOD), and bacteria have generally occurred near or below the analytical detection limits over the period of study.

The mass-balance modeling approach was conservative and assumed a "closed" system (i.e., no inflow or outflow), no settling or degradation of effluent parameters, (cumulative loading associated with effluent releases from July 1, 2009 through May 30, 2010. Specifically, loading associated with the pond discharges and the RBC effluent were calculated and assumed to be concurrently present in the lake (i.e., all discharges would remain and accumulate over the period of evaluation) at loading rates that are anticipated based on projected camp occupancy. Pond discharges are expected to occur in August for a period of 2-4 weeks. To maintain a conservative approach, the loadings associated with cumulative releases such as ongoing RBC operation were calculated and assumed to be instantaneously released to the lake. In actuality, the releases will be more gradual and will occur over a range of environmental conditions (e.g., water temperatures). In addition, losses would be expected through outflows, some dilution would be expected due to inflows, and internal settling and transformations of some parameters would be expected. However, a conservative approach was used in the interest of minimizing risk.

Additionally, to provide 'near-field' estimates of the potential effects of the effluents on water quality in Sheardown Lake NW, mass-balance modeling was applied to near-field areas surrounding the effluent outfall. This exercise was intended to provide greater resolution regarding potential changes in water quality near the outfall but does not represent a 'plume model'.

Potential toxicity of the effluents at end-of-pipe was evaluated by comparing effluent quality, provided by AMEC, to CCME water quality guidelines for the protection of aquatic life and to the Environment Canada acute toxicity estimation method for ammonia (Canada Gazette 2004). Potential effluent toxicity was considered for each wastewater stream and for the flow-weighted mean effluent quality.

Whole-lake mass balance modeling predictions are presented in the table below (this will be a simplified Table 5 from the memo). The estimated fully-mixed concentrations of TSS, ammonia, fecal coliform bacteria, and BOD in Sheardown Lake NW are low and would represent changes that would not be detectable. In each case, the fully-mixed concentrations would be either below or at the analytical detection limit. Change in pH is similarly predicted to be undetectable. The predicted increase in the whole-lake TP concentration due to the combined inputs of treated pond effluents and the RBC effluent is 0.0004 to 0.0007 mg/L which like other parameters would be too small to be detected. However, mixing processes in lakes, in particular, can be slow and it is not uncommon for gradients in conditions to exist across the entirety of a lake (i.e., fully mixed conditions may not be attained). Regardless of the precise mixing properties, effects would be greatest near the effluent discharge point.

To provide some information on potential near-field effects in the vicinity of the effluent discharge point, mass-balance modeling was also conducted using lake volumes associated with areas of 0.001 km2, 0.01 km2, and 0.1 km2. Detailed results of this work are presented in the TM, Appendix G. Based on the results of the modelling, localized in TSS and BOD are expected. However, Sheardown Lake NW is generally well-oxygenated, particularly during the time of year when RBC and PWSPs would be discharged concurrently. TSS may exceed CCME guidelines over an area of less than 0.01 km^2 and TP may exceed the CCME TP guidance framework triggers in the lake near the effluent outfall over an area of approximately 0.1 km2 This may result in some increased primary production within this area of the lake in the open-water season. Based on the results of the modeling that there may be some localized changes, particularly with respect to TSS and total phosphorus reflected by a comparison to CCME guidelines, but that these changes are not expected to result in an overall adverse effect on Sheardown Lake. Since pond effluents will not be discharged over a prolonged duration, this effect is expected to be short-term and reversible. It should be noted that these predictions of potential near-field effects are based on a high level of conservatism that is detailed more fully in the technical memorandum (Appendix G).

Acute toxicity of the effluents was estimated using the Environment Canada formula presented in the Canada Gazette (2004) and the pH of the effluents. The projected ammonia concentrations are notably lower than the calculated acute toxicities of the effluent. Refer to the TM, Appendix G for detailed presentation of the toxicity estimates.

Summary of Mass-Balance Modeling Results for Sheardown Lake NW (For the Fully Mixed Condition).

	TP[1] (mg/L)	TSS (mg/L)	BOD5 (mg/L)	TKN (mg/L)	Feacal Coliforms (CFU/100 mL)	Ammonia (mg N/L)	pH
Mean Treated Pond Effluent (flow weighted)	0.47-0.91	27	21	12	381	1.4	7.52
RBC Effluent (total July 1 - May 30)[2]	0.3	7	4	1.4	10	0.2	7.65
Using Half the Detection limit for lake water quality							
Existing Concentrations in Sheardown Lake (2007/08 average): using half the DL	0.003	2	<1	0.12	<1	<0.02	8.00
Mass-balance Model With Treated Pond Discharges	0.0034-0.0037	2.02	0.5	0.129	0.8	0.011	8.00
Mass-balance Model with RBC Effluent	0.0030	2.00	0.5	0.120	0.5	0.010	8.00
Mass-balance Model with both Treated Pond and RBC Effluents	0.0034-0.0037	2.02	0.5	0.130	0.8	0.011	8.00
Using the Detection limit for lake water quality							
Existing Concentrations in Sheardown Lake (2007/08 average): using the DL	0.004	2	<1	0.12	<1	<0.02	8.00
Mass-balance Model With Treated Pond Discharges	0.0044-0.0047	2.02	1.0	0.129	1.3	0.021	8.00
Mass-balance Model with RBC Effluent	0.0040	2.00	1.0	0.120	1.0	0.020	8.00
Mass-balance Model with both Treated Pond and RBC Effluents	0.0044-0.0047	2.02	1.0	0.130	1.3	0.021	8.00
Effect of Treated Pond Effluents Alone (no Lake Background)	0.0004-0.0007	0.02	0.0	0.010	0.3	0.001	-

[1] Ranges presented for TP represent mass-balance model predictions using 0.5 mg/L and 1.0 mg/L TP concentrations (and associated loadings) for effluents from Pond 1 and 2. The actual effects are expected to lie between these boundaries, depending on effluent treatment performance.

[2] Projected effluent loadings from the Mary River Camp RBC were based on current estimates of future operational conditions. Actual discharge loadings from the RBC may be higher based on potential ramp-up of the work plan and actual water use limits as specified in the water licence. As such, the model may be updated periodically as required.

10.3 EFFECTS OF SEWAGE EFFLUENT DISCHARGES AT MILNE INLET

Receiving Drainage Ditch

The receiving environment for the treated sewage effluent at Milne Inlet is a large, wide ditch, several hundred metres in length, which reports to Milne Inlet. This drainage ditch has a small associated catchment of approximately 0.25 km2.

Milne Inlet – Final Receiving Water

Available bathymetry for Milne Inlet is shown on Figure 3. The measurements shown on Figure 3 have not been corrected for tidal variations so are considered approximate. Near-shore water depths have not been collected but water depths ranging from 1.5 m to 2.8 m was measured in excess of 60 m from shore, after which water depth quickly increases to 10 to 15 m. The assumed average water depth from the shoreline to 60 m from shore is 1.0 m. Milne Inlet has semi-diurnal tides with the lowest tide typically ranging from 0.1 to 0.3 m and the highest tide typically rangeing from 2.2 to 2.4 m (Department of Fisheries and Oceans, 2006). Current velocity within the Eclipse Sound area generally ranges from 15-35 cm/s (Buckley et a.l 1987; Dickens et al. 1990).

Data collected in Ragged Channel, located at Cape Hatt near the northern end of Milne Inlet, indicated that temperature and salinity characteristics at that site were typical of the region (Buckley et al. 1987). In the ice-free season, freshwater inputs from snow melt and rain run off establish a strong surface layer characterized by lower salinity and higher water temperature, which ultimately is mixed with underlying cooler and more saline water by wind and currents. As the open water season progresses and freshwater inputs are reduced, the strength of the surface layer is reduced and thermal and saline stratification is reduced.

At Ragged Channel, water temperature during ice covered conditions (June, 1980) was 1.5ºC throughout the water column. During open water conditions in August, 1980, at the same location, water temperature was approximately 4ºC at the surface and declined to -1ºC by about 70 m depth (Buckley et al .1987). Similarly, salinity was uniform at ~32 ppt through the water column during June, but was stratified during August. At that time, surface salinity was about 24 ppt, and increased through the upper 10 m or so of the water column to about 30 ppt (Buckley et al. 1987). Recent salinity measurements at surface where the drainage ditch reports to Milne Inlet measured 22.9 ppt (Knight Piésold, unpublished data).

In-situ water quality measurements were recorded by Knight Piésold on three occasions at the shore where the ditch discharges in August 2007, and water temperatures ranged from 4.4ºC to 9.2ºC, pH ranged from 8.05 to 8.15, and dissolved oxygen ranged from 10.75 to 11.30 mg/L (Knight Piésold, unpublished data).

Discharge Conditions

Discharge conditions will vary with the season. In early summer (i.e. July), the active layer thaws and sea ice deteriorates and pulls away from shore. July has the largest monthly runoff and is also the month subject to break-up. For example, in early July 2007 and 2008, most of the sea ice at the lower portion of the inlet had melted, whereas sea ice in the upper half of the inlet towards the mouth was still intact. Phillips Creek would appear to have a meaningful influence on the deterioration of ice at the head of the inlet. Freeze up begins in late September or early October. Open water is present roughly from July through September.

The effluent is trucked to a dedicated location where it is released to the ditch (refer to Figure 3) Some infiltration of the effluent into the active layer is expected to occur as the effluent flows towards Milne Inlet, depending upon the progress of ground thaw. During regular RBC operations, it is expected that at the low rate of discharge to the ditch that very little to none of the treated effluent will report directly to Milne Inlet.

During winter operations, effluent discharged to the drainage ditch freezes. The maximum volume of effluent that could be discharged to the ditch during this 8-month period (measured as water and not ice) is roughly 3,240 m3 based on the peak design capacity of the WWTF. Actual volumes will be less. Due to low temperatures, the effluent will freeze within the ditch. During the spring thaw, the frozen treated effluent will melt and flow to the thawing ice or marine waters of Milne Inlet. It is estimated that the ice pack will melt over an approximate four week period from approximately mid-June to mid-July. Since the final effluent will be non-toxic, no meaningful environmental effects are anticipated under this discharge scenario. The winter storage, melting, and subsequent mixing in the final receiving waters of Milne Inlet provide some contingency if the final effluent does not achieve the expected treatment levels. A mixing zone in Milne Inlet has not been calculated on the basis that the effluent already meets discharge and acute toxicity requirements. Mixing zones are commonly incorporated into the design of sewage management facilities.

The decanting of the Milne PWSP will involve the discharge of approximately 500 m^3 of effluent over a roughly two to four week period likely in August and early September. During this period Milne Inlet will have open water and maximum mixing is anticipated due to the actions of winds and currents. This is anticipated to be the only effluent stream at Milne Inlet during 2009 because the Milne Inlet RBC treatment system is not expected to be operational due to low camp occupancy.

SECTION 11.0 - CLOSING

A review of the design and 2008 operating experience for the Mary River RBC have indicated that the nitrogen influent concentrations/loadings for the facility were double what was predicted in the original design basis, resulting in a reduced capacity to treat ammonia when camp occupancy is high. In response to this finding, the capacity of the system, as measured by camp occupancy numbers, has been reduced (from 150 to 123 persons). In the event that camp numbers increase beyond 123 persons in the future, a treatment option has been developed to enable the Mary River RBC to effectively treat sewage at the originally designed hydraulic throughput. By adding additional growth media to the RBC, the sewage system will be capable of treating the higher than expected nitrogen levels while preserving the design hydraulic throughput and reduce dependence on PWSP storage of treated effluent.

During 2008, Milne Inlet RBC was operating in compliance with water license criteria which enabled direct discharge to the receiving environment for most of the year with only intermittent periods where effluent not meeting discharge criteria was directed to the PWSP.

A technical strategy and work plan for the management, treatment, and disposal of the wastewater and sludge solids stored in the PWSPs at Milne Inlet and the Mary River facilities has been developed. The plan will enable discharge and treatment as required of stored partially treated effluent to the receiving environment during the 2008 open water season. Previous 2007 modeling of potential effects to Sheardown lake was updated to reflect current conditions and the 2009 operational plans that include discharge of PWSP effluent. The results of the modeling indicated that there may be some localized changes in water quality in the vicinity of the outfall, but effects to the lake as a whole are expected to be small and water quality is predicted to remain within CCME guidelines for the protection of aquatic life on a lake-wide basis. In addition, at Mary River and Milne Inlet, effluent after treatment is not expected to be acutely toxic to aquatic life.

Proper system maintenance and monitoring of effluent quality continue to be an important and on-going factor to ensure that the RBC systems will operate in compliance with the Water License and do not adversely impact receiving environments.

SECTION 12.0 - REFERENCES

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FIGURES AND DRAWINGS

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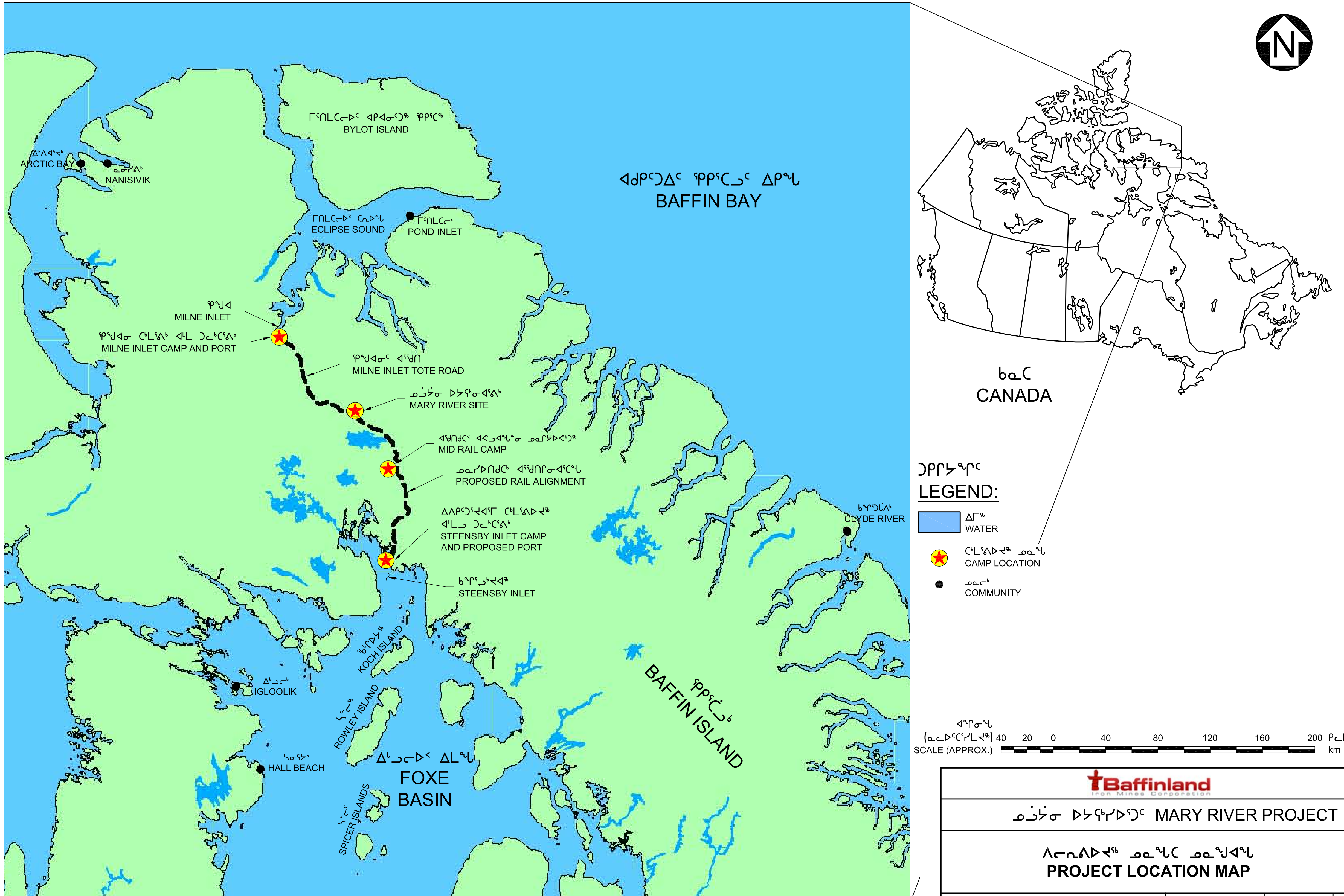

Baffinland
Iron Mines Corporation

MARY RIVER PROJECT

PROJECT LOCATION MAP

P/A NO.	REF.	REV.
NB102-181/15	NB09-00214	0

FIGURE 1

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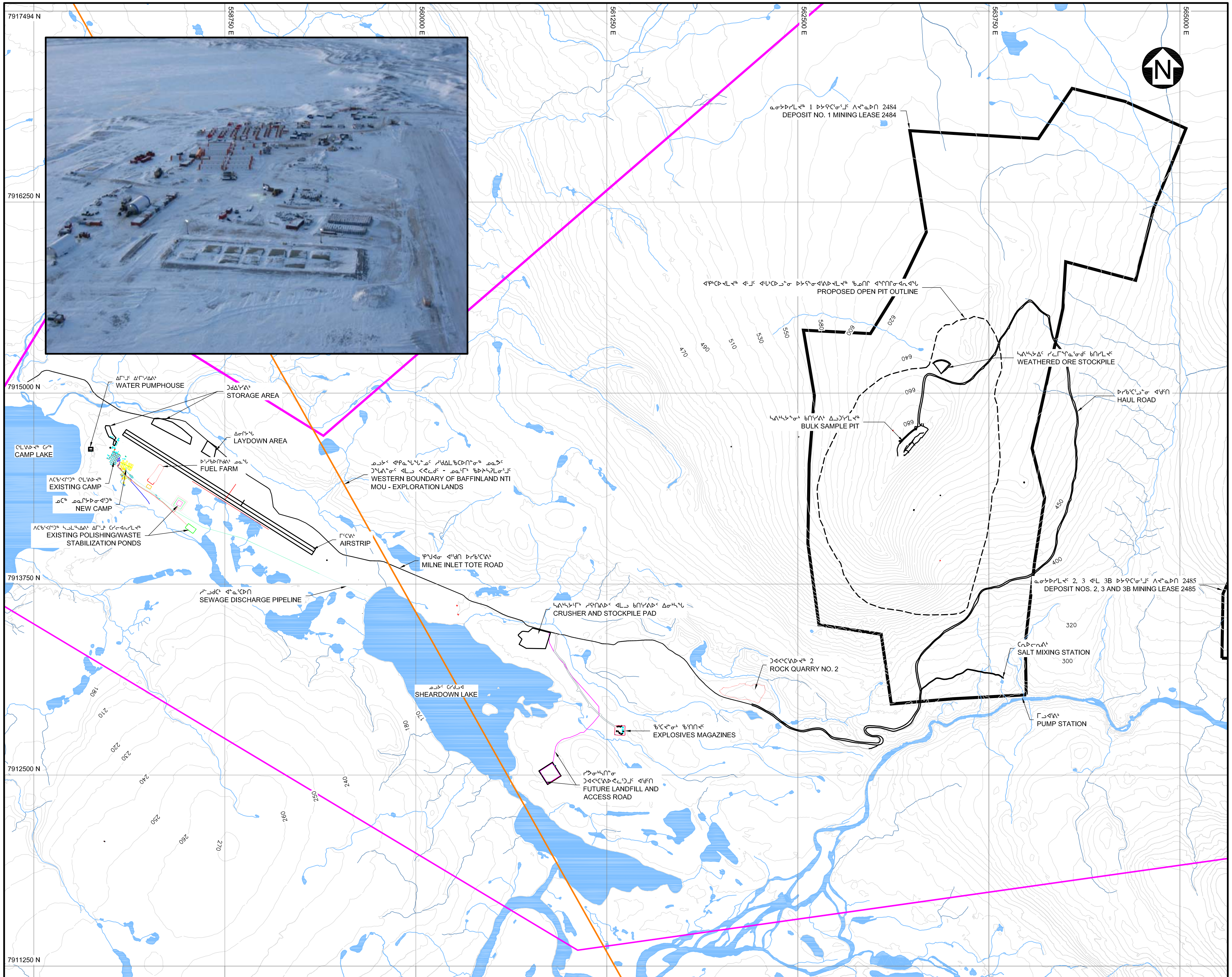


LEGEND:

- WATER
- RIVER/STREAM/DRAINAGE
- BAFFINLAND'S COMMERCIAL LEASE ON INUIT OWNED LAND
- MINING LEASE BOUNDARY
- WESTERN BOUNDARY OF BAFFINLAND NTI MOU - EXPLORATION LANDS

NOTE(S):

1. COORDINATE GRID IS UTM (NAD83) ZONE 17 AND IS IN METRES.
2. CONTOUR INTERVAL IS 10 METRES.
3. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
4. MINE SITE INFORMATION PROVIDED BY GENIVAR DECEMBER 9, 2008.
5. REFER TO PHOTO SHEETS FOR ADDITIONAL DETAIL OF CAMP AREA.

1. UTM (NAD83) Zone 17
2. 10
3. Eagle Mapping (2005)
4. Genivar

SCALE 250 125 0 250 500 750 1000 1250 m

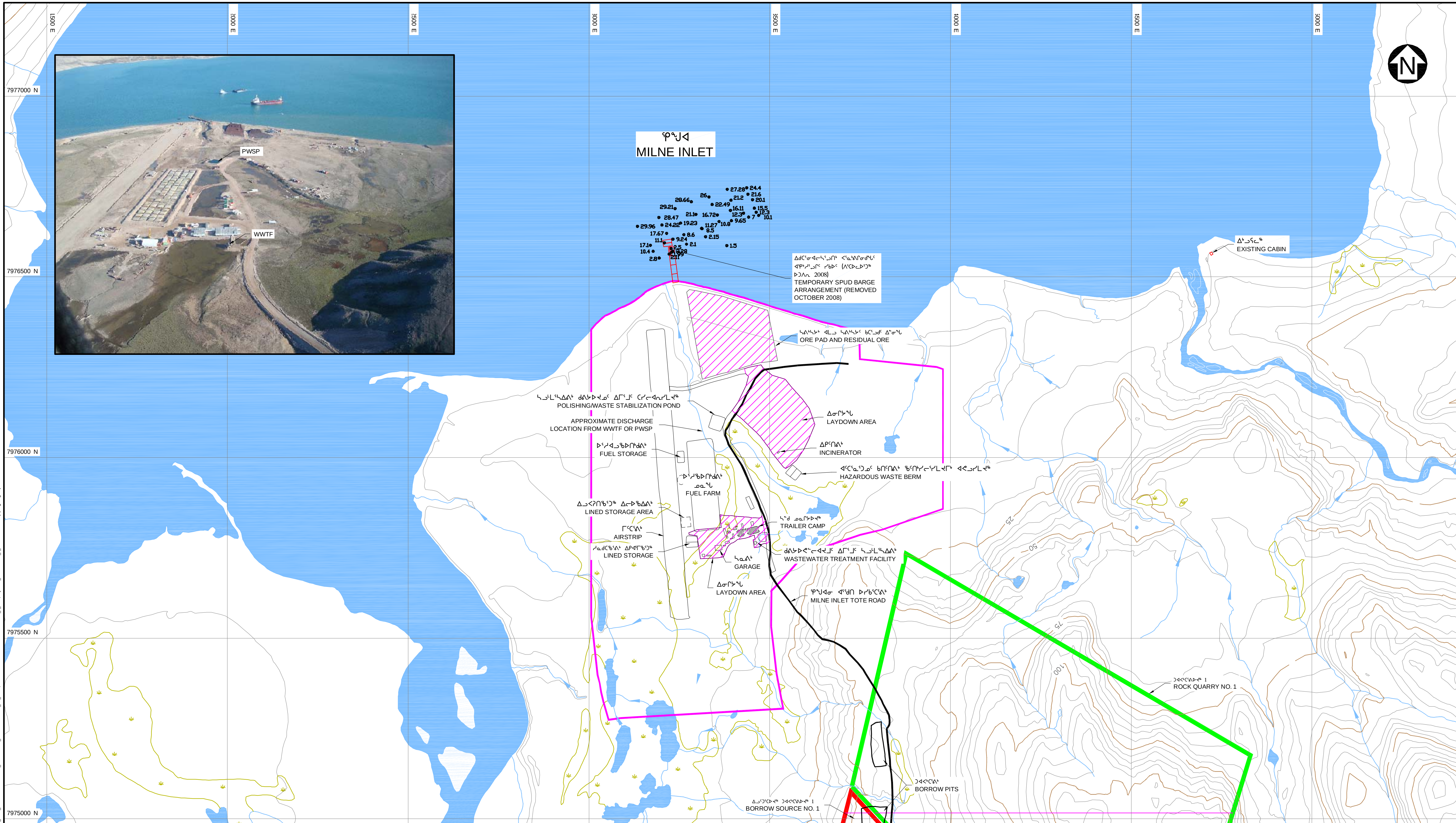
Baffinland Iron Mines Corporation

MARY RIVER PROJECT

EXISTING SITE LAYOUT AT MARY RIVER

P/A NO.	REF.	REV.
NB102-181/15	NB09-00214	0

FIGURE: 2



LEGEND:

- WATER
- WETLAND
- LAYDOWN AREA
- BAFFINLAND'S COMMERCIAL LEASE ON INUIT OWNED LAND
- RIVER/STREAM/DRAINAGE
- DIRECTION OF SURFACE WATER RUNOFF
- MILNE INLET TOTE ROAD
- ROAD
- EXISTING ROCK QUARRY (IOL COMMERCIAL LEASE)
- EXISTING BORROW AREA (IOL COMMERCIAL LEASE)

1. EAGLE MAPPING (2005)
2. UTM (NAD83) ZONE 17

NOTE(S):

1. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 5 METRES.

SCALE 100 50 0 100 200 300 400 500 m

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

EXISTING SITE LAYOUT AT MILNE INLET

P/A NO.	REF.	REV.
NB102-181/15	NB09-00214	0

FIGURE 3

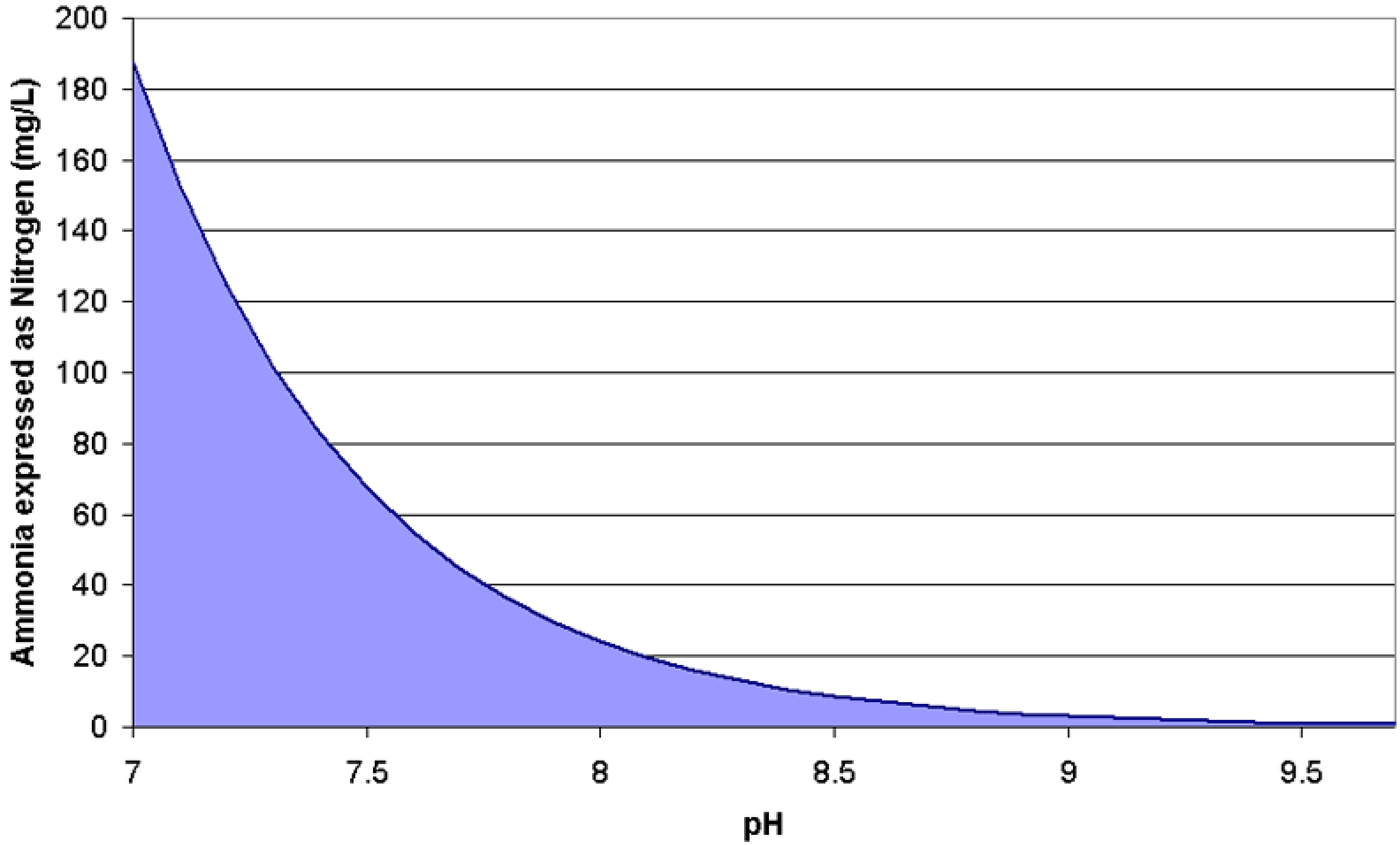


Figure 4. Acute Toxicity of Ammonia with pH.

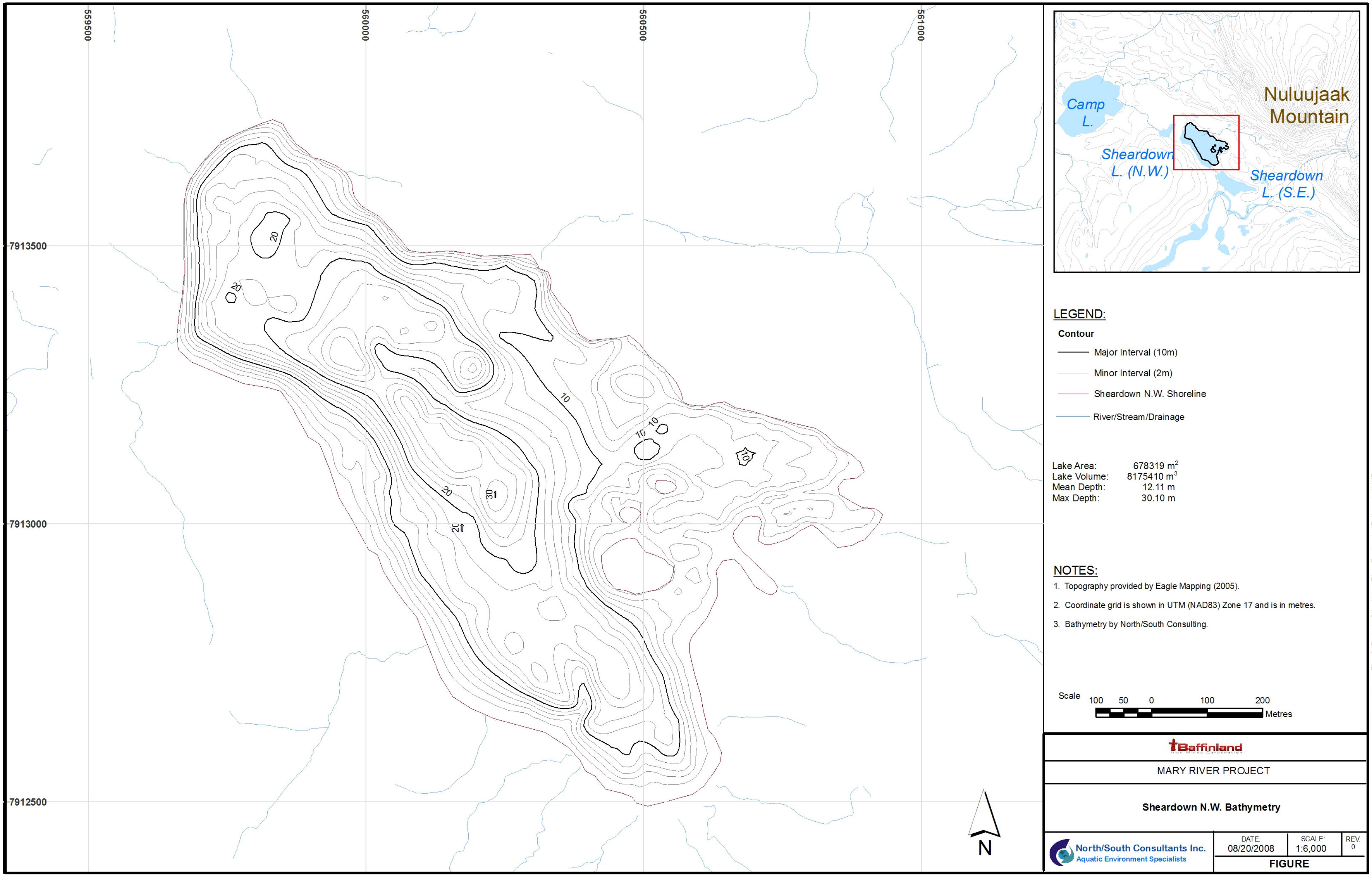


Figure 5: Sheardown Lake NW Bathymetry

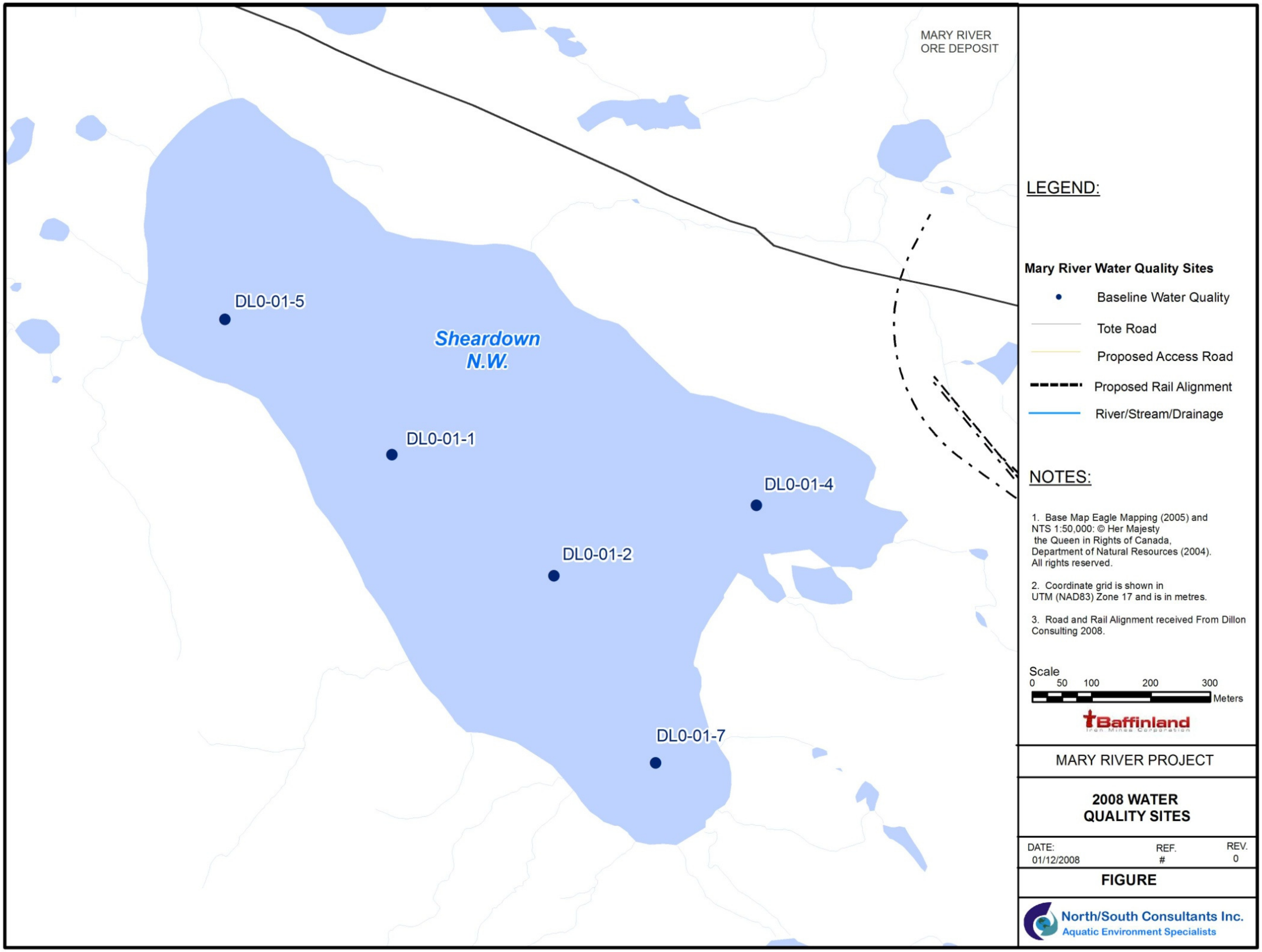
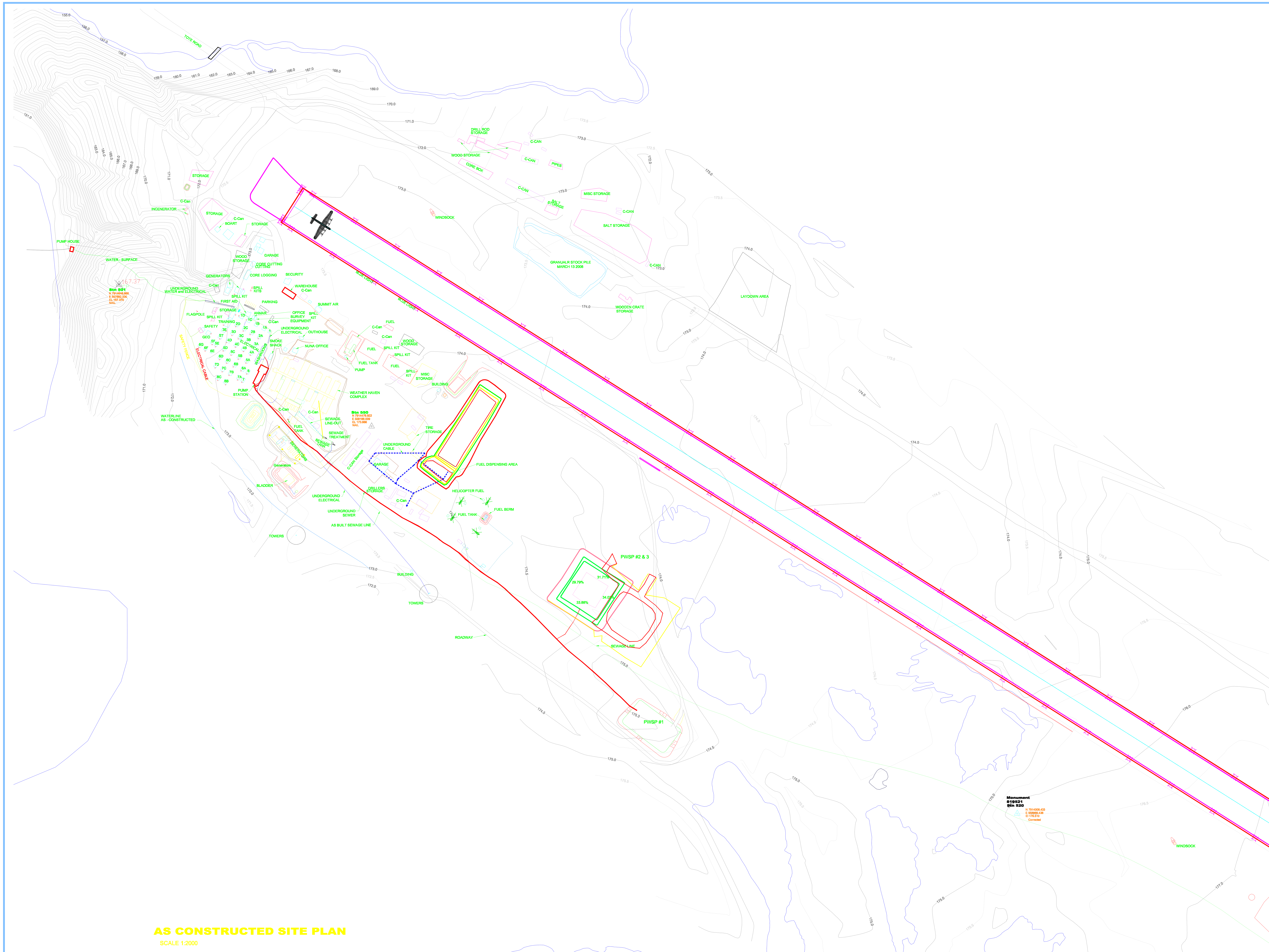


Figure 6: Sheardown Lake NW Water Quality Sites



AS CONSTRUCTED SITE PLAN

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Drawing

AS CONSTRUCTED MARY RIVER SITE PLAN

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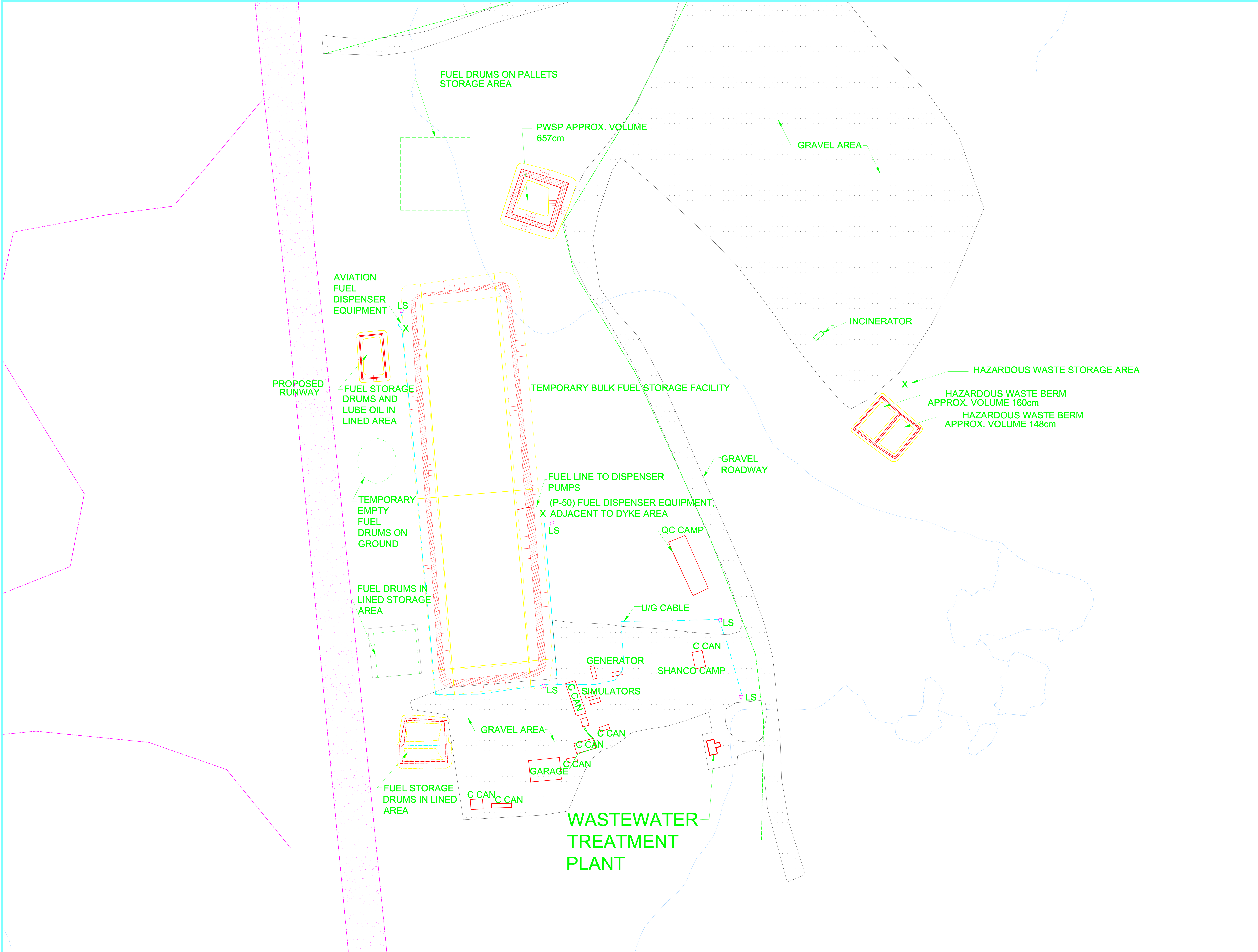
MARCH 2009	REPORT/WWMP DRAWINGS/
Scale 1:2000	Job Number 09-058
Drawn SO	
Checked MK	Drawing Number 002
Approved	



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Drawing
MILNE INLET AS CONSTRUCTED SITE PLAN

Date: MARCH 2009	CADD File Number: REPORT/WWMPDRAWINGS/
Scale: 1:1000	Job Number: 09-058
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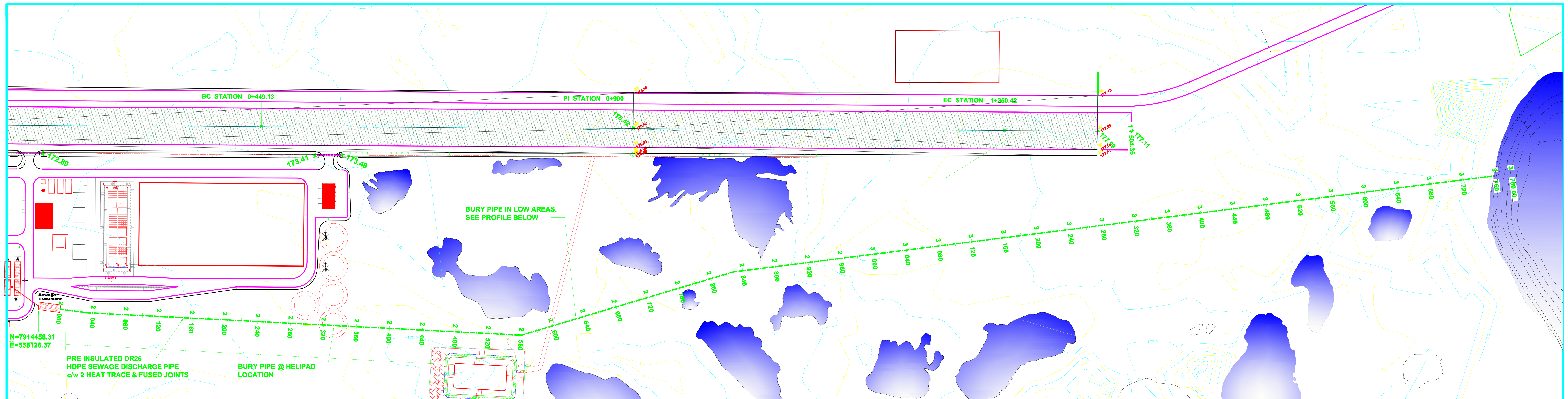
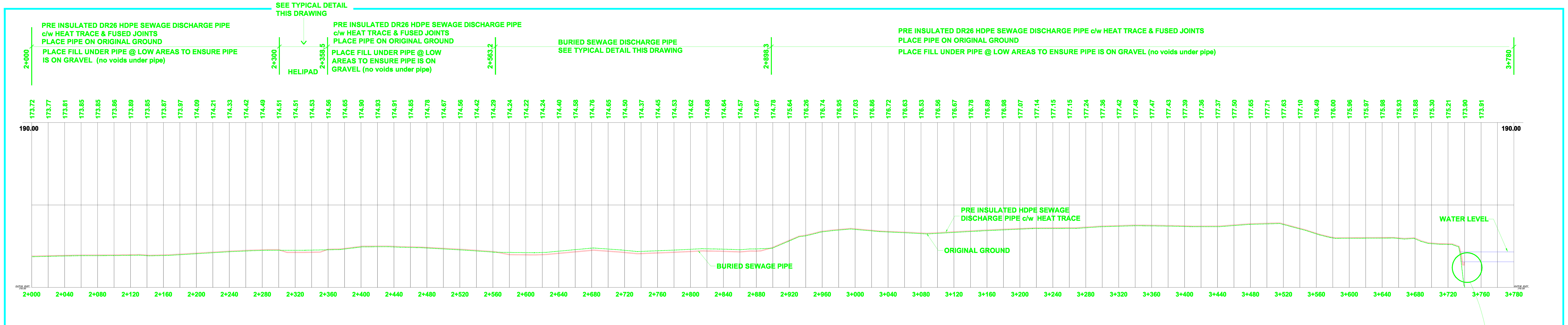
Checked	Drawing Number: 003
Approved	



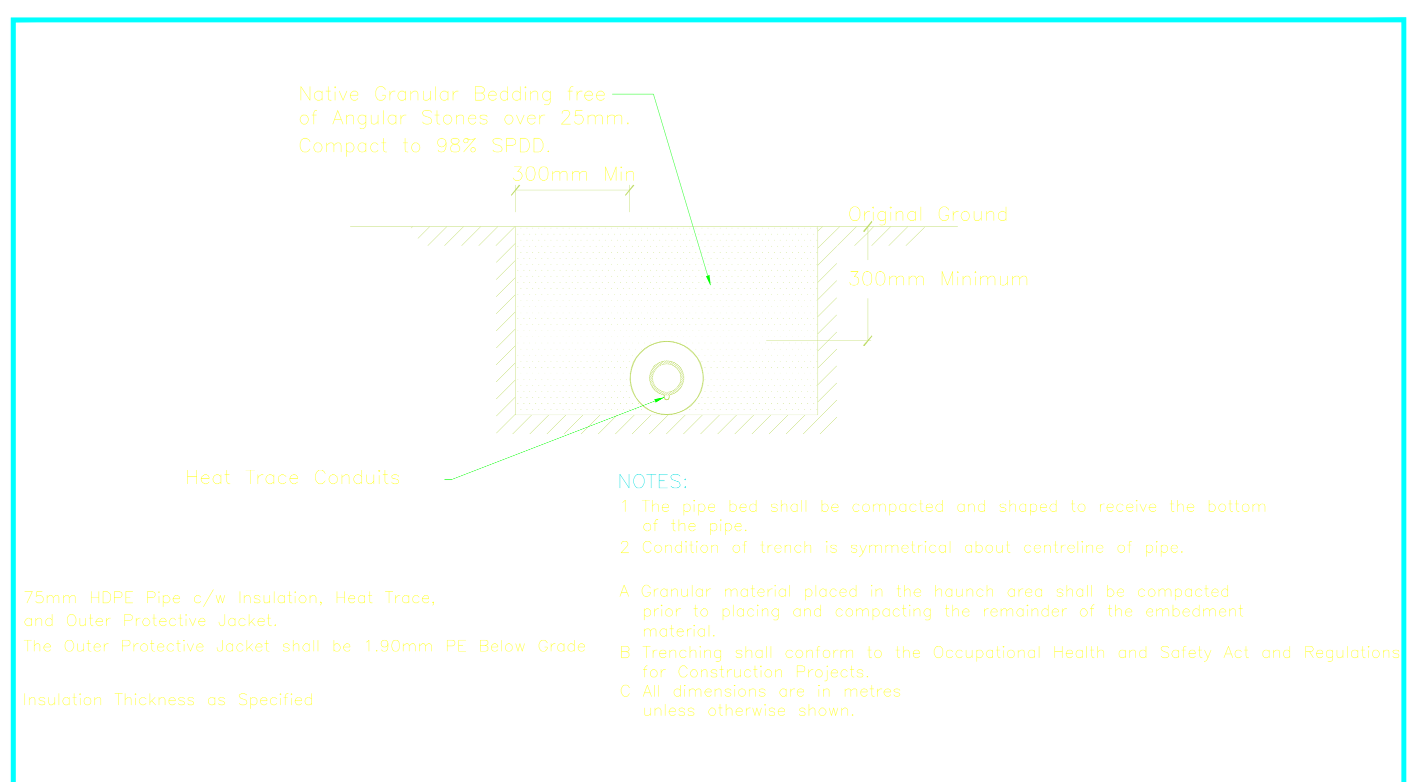
SITE PLAN

SCALE 1:2500



PROFILE THRU SEWAGE DISCHARGE PIPE

SCALE 1:2500 HORIZONTAL
SCALE 1:200 VERTICAL



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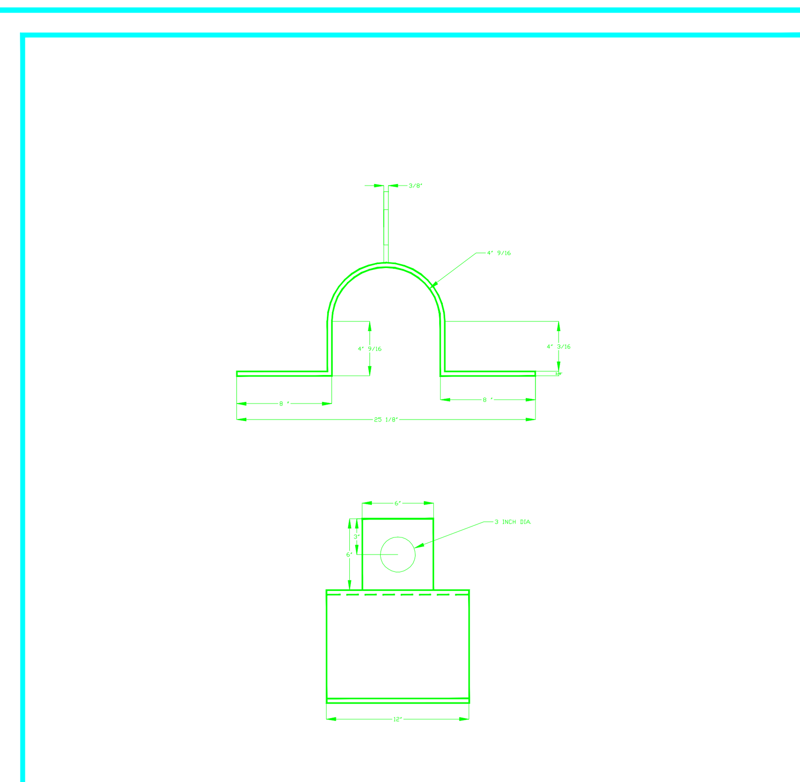

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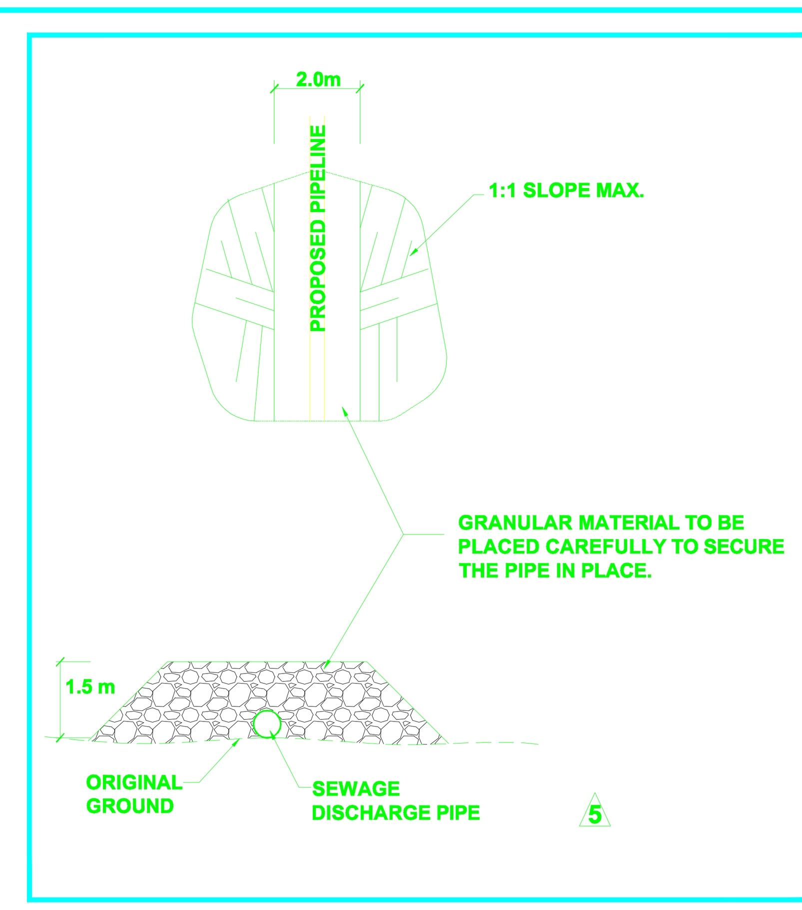

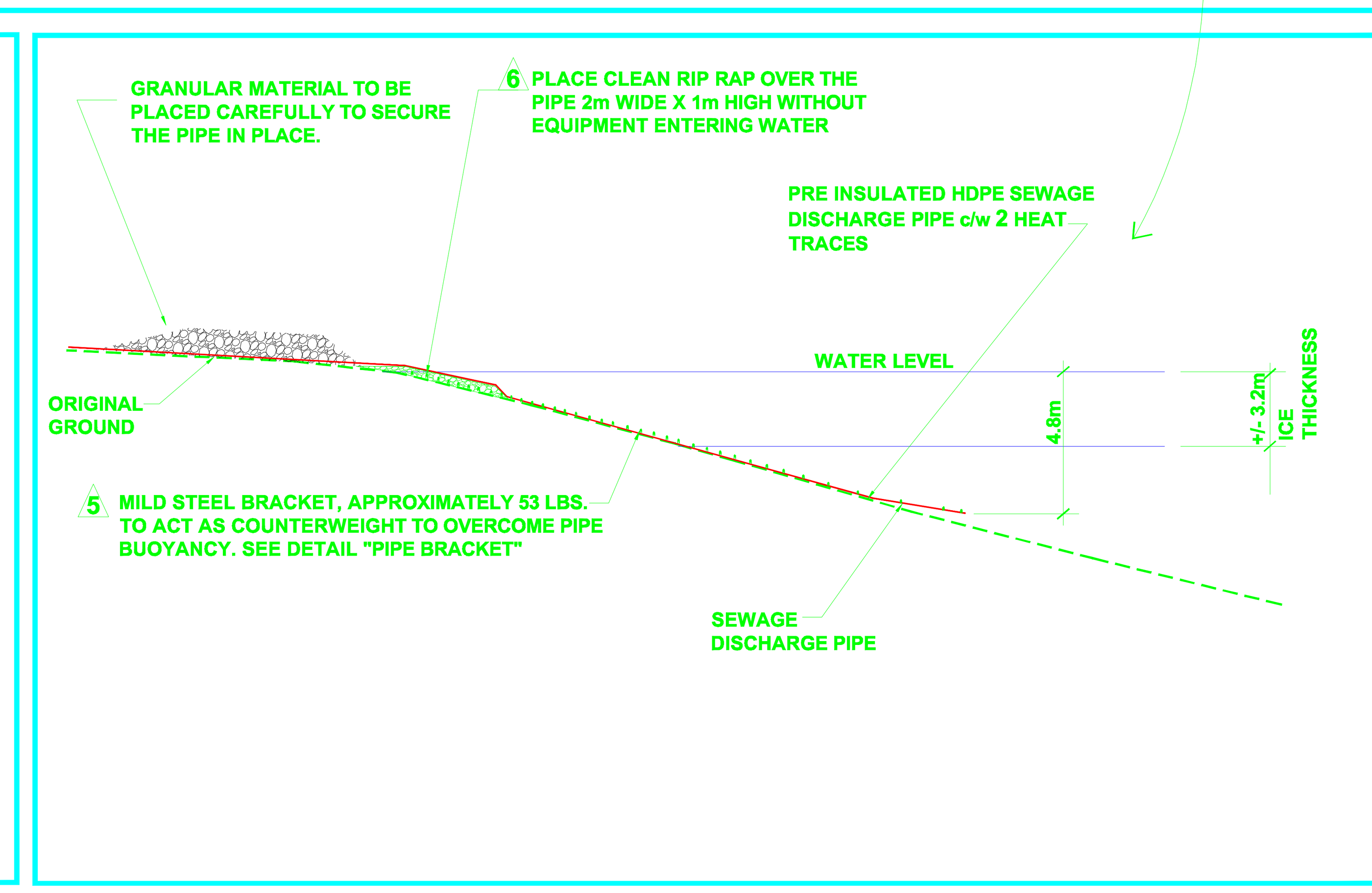

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Description	Date	No.
RIP RAP ADDED	Aug. 29/08	6
RIP RAP REMOVED AND BRACKET ADDED	Jul. 29/08	5
NEW DETAIL	Oct. 29/07	4
REVISED PIPE INSTALLATION	Oct. 9/07	3
ISSUED FOR CONSTRUCTION	July 03,2007	1
ISSUED FOR TENDER/REVIEW	May 24,2007	0

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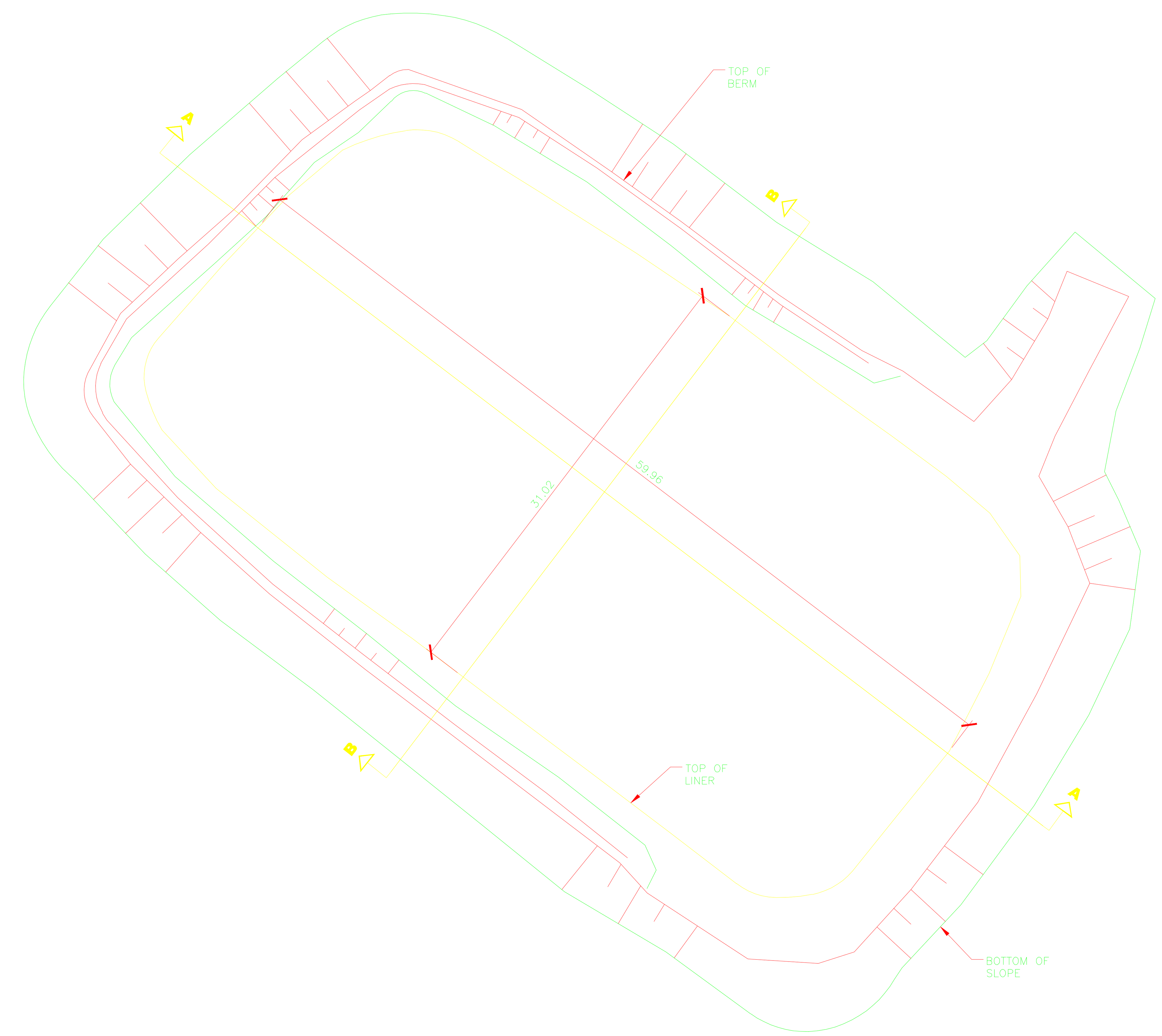
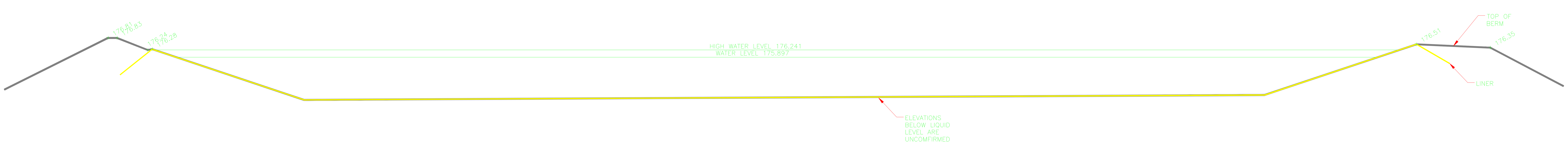
Drawing
**MARY RIVER CAMP
SEWAGE DISCHARGE
PLAN/PROFILE & DETAILS**

Date: JULY 2008
CADD File Number
Scale: AS NOTED
Job Number: 09-058
Drawn: rjr/SO
Checked: BHM
Drawing Number: 004
Approved

PWSP #1 AS BUILT PLAN VIEW





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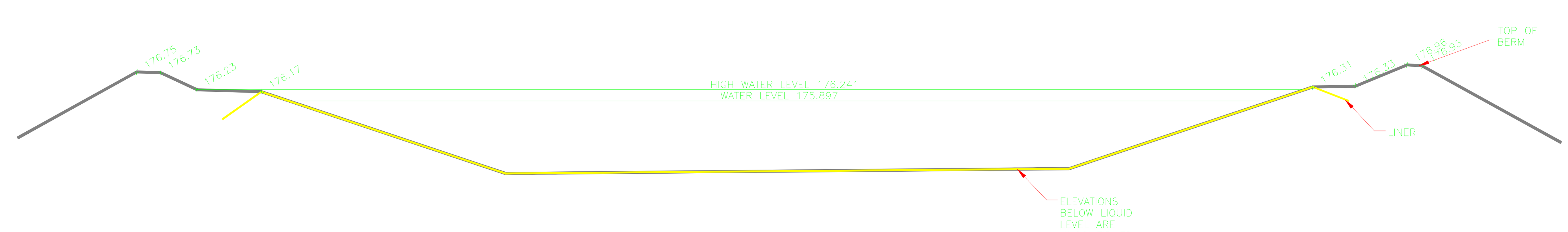

PWSP SECTION

Description	Date	No.
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AS CONSTRUCTED MARY RIVER PWSP 1 PLAN AND SECTIONS

Date: MARCH 2009	CADD File Number: REPORT/WWMPDRAWINGS/
Scale: AS NOTED	Job Number: 09-058
Drawn: AB	
Checked:	Drawing Number: 005
Approved:	

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Description	Date	No.
2nd Pond	Nov 4_08	1

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Project
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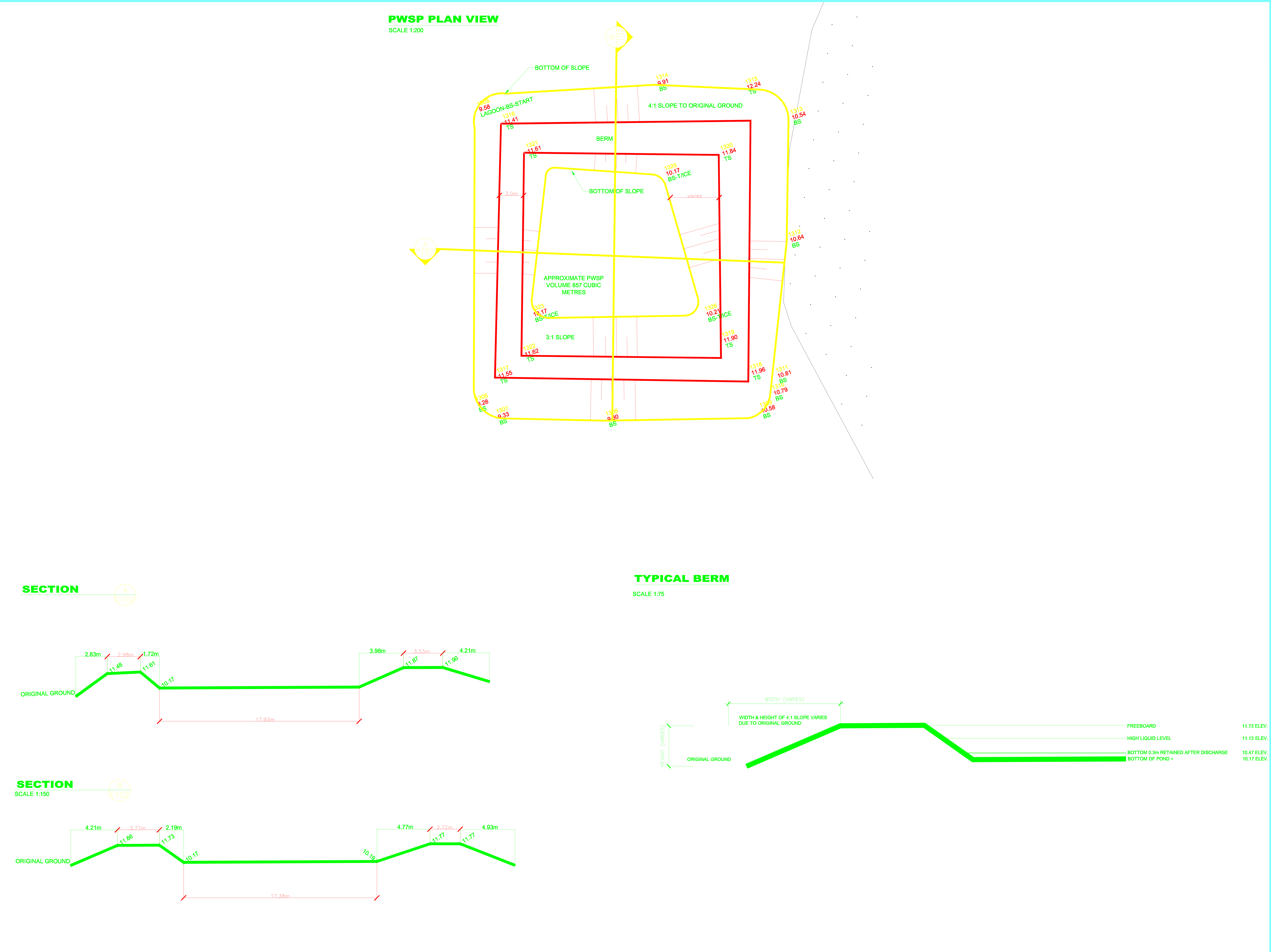
BAFFINLAND IRON MINES CORPORATION
BAFFIN ISLAND | NUNAVUT

Drawing
AS CONSTRUCTED MARY RIVER PWSP2 & PWSP3 PLAN AND SECTIONS

Date: MARCH 2009	CADD File Number: REPORT/WMP DRAWINGS/
Scale: AS NOTED	Job Number: 09-058
Drawn: SS/SO	
Checked: M.K	Drawing Number: 006
Approved: M.K	



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Drawing
AS CONSTRUCTED MILNE INLET PWSP PLAN AND PROFILES

Date: MARCH 2009	CADD File Number: REPORT/WWMP DRAWINGS/
Scale: AS NOTED	Job Number: 09-058
Drawn: AB	
Checked:	Drawing Number: 007
Approved:	

APPENDIX A

BIM RESPONSES TO COMMENTS FROM REGULATORY/GOVERNMENT AGENCIES

Appendix A.1

Response to Comments - December 9, 2007

2007-December-9

Phyllis Beaulieu
Licensing Administrator
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU X0A 1J0

Re: October 18th, 2007 Comments on 2BB-MRY0710/Wastewater Management Plan/Mary River Project/Baffinland Iron Mine Corporation

We thank you for your comments in your response dated October 18th with regards to Baffinland Iron Mine Corporations (BIMC) Wastewater Management Plan. Responses to comments are found below in numerical order corresponding with the INAC letter.

1. **The proponent should identify if the Mary River and Milne Inlet Waste Water Treatment Facilities will be operated by people with appropriate training and experience in wastewater management. Project personnel designated to manage these facilities should be referenced within the Waste Water Management Plan and copies of their respective resumes should be included and regularly updated within the Plan's appendices.**

   The manufacturers of the Waste Water Treatment Facilities were on-site to provide direction as part of the initial start-up and commissioning process. As part of this work, the manufacturer provided the level of training to Baffinland site supervisors that it recommends to clients of their equipment.

   To enhance management capabilities and enable continuity of operation, Baffinland has currently retained dedicated operators for Waste Water Treatment Facilities. These operators have undergone intensive on-site training by the manufacturer, Seprotech. The equipment manufacturer will provide on-going training and expert advice, as required. In addition to the use of contract operators and as a contingency, Baffinland supervisors have received additional training.

2. **The proponent to explain how the design of the Mary River Camp's effluent discharge pipeline will prevent the freezing of treated wastewater en route to Sheardown Lake. Section 3.2 of the submitted Plan states the freeze protection measures include having a pipeline constructed of high density polyethylene, polyurethane insulation, and a heat traced electric thermocable. The proponent should explain why it intends to have the portion of pipe within the lake's ice depth to be insulated but not heat traced and why the portion of the pipe below 4 meters depth of the typical water/ice surface will be un-insulated. Having insulation and heat tracing throughout the entire discharge pipeline may be a prudent freeze protection strategy.**

   An upgraded design of the sewage outflow pipe into Sheardown Lake includes the heat tracing and insulation to 300mm below the nominal ice level. This will prevent the freezing of the treated wastewater discharged into Sheardown Lake. The attached Drawing Number E104-R3 illustrates the new design of the sewage outflow line at Mary River and will ensure that a freeze protection strategy is in place.

3. **Erosion protection measures are not clearly noted for all treated wastewater discharge points. Treated wastewater from the Milne Inlet site will be discharged to a local drainage ditch which drains into Milne Inlet. The discharge outfall will be armoured with rip-rap as an erosion protection measure, but according to Section 3.2 of the submitted Plan, the winter discharge point will not be armoured with rip-rap. The proponent should have erosion protection measure in place at the winter discharge point.**

   To prevent erosion occurring at the winter discharge point at Milne Inlet, rip rap will be placed within the drainage ditch during winter months prior to discharge. During spring thaw, this section will be inspected to ensure erosion does not occur. Should erosion occur, although not forseen, protection measures will be implemented as per the Site Water Management Plan, such as the use of silt fences. While discharging into the drainage ditch, inspections will be conducted to ensure erosion, should it occur, is mitigated.

4. **BIMC intends to convert its polishing waste stabilization ponds at the Mary River and Milne Inlet sites into sludge management areas after completion of its bulk sampling program. The consideration of alternative sludge management strategies is recommended. INAC understands that these ponds are used as contingency measures for wastewater storage and treatment should the RBC treatment systems become in-operational. In addition, if these ponds, were to be used to dry sludge, any modifications required to allow continual decant of pooled water which will accumulate from precipitation runoff and the RBC treatment facilities when they are in-operational should be identified.**

   BIMC will take into consideration alternative sludge management systems once volumes of sludge have been calculated at the end of the bulk sampling period. Water that may pool from precipitation in the polishing waste stabilization pond (PWSP) will be returned, if required to the RBC via a vacuum truck to ensure effluent quality prior to discharge into Sheardown Lake or Milne Inlet.

5. **The Wastewater Management should include a detailed description of the drainage ditch situated at the Milne Inlet site. Section 9.3 refers to this ditch as being large, wide and several hundred meters in length. Approximate dimensions of the ditch, observed vegetation, and recorded water levels would allow a better understanding of the receiving environment.**

   A detailed description of the ditch is included as a Figure 2 attached to this letter. The dimensions of the ditch are as follows: average width of the drainage ditch is 15 meters, average depth (not water levels but depth of land) is 1.9 meters and approximate length is 275 meters.

6. **The Wastewater Management Plan should describe whether surface erosion caused by releases from the polishing waste stabilization ponds at the Mary River and Milne Inlet sites will be minimized. This is term of the 2BB-MRY0710 licence set in Part D, Item 14.**

Releases from the Milne Inlet polishing waste stabilization pond at Milne Inlet will occur via vacuum truck into the rip rapped drainage ditch. Erosion is not expected to occur due to rip rap protecting underlying ground while slowing the velocity of the effluent discharged. Should erosion occur, mitigation measures included in the Site Water Management Plan will be implemented such as the use of silt fencing. Effluent from the Mary River polishing waste stabilization pond will be re-directed into the RBC unit, if required. As submitted, the piping detail for the connection of the pond to the Sheardown pipeline from the RBC is shown. The pipeline from the Mary River RBC unit will be constructed to drain directly into Sheardown Lake negating any possible erosion concerns.

7. **The Wastewater Management Plan should include as-built design drawings of the polishing waste stabilization ponds and the Mary River Camp effluent pipeline. Topographic maps of the drainage where effluent will be discharged from the Milne Inlet Waste Water Treatment Facility and the Mary River Camp pipeline should be included as well. All maps and design drawings should be set an appropriate scale.**

   As-builts of the waste water management plants as well as ponds will be submitted within the required dates in BIMC's water license. Upon the completion of the pipeline construction at both Milne Inlet and Mary River, as builts will be submitted, as requested above including topographic data.

8. **INAC recommends that the Proponent agree to set timeline for the installation and commissioning of the Tanks-a-lot and RBC units to be used at Mary River and Milne Inlet.**

   The construction of the Mary River tanks-a-lot system was completed on October 5th. Effluent from the Tank-a-lot system will continue to be discharged into the polishing waste stabilization pond and re-treated in the RBC unit should it be required prior to discharge. The installation and commissioning of the RBC unit at Mary River is currently planned for the end of January 2008 when the 200 man all season weather haven camp is in construction.

   The construction of the Milne Inlet RBC unit was completed on October 29th. Commissioning is continuing and discharge will not occur until effluent parameters set out in the BIMC water license are met. Until this point, effluent will continue to be discharged into the polishing waste stabilization pond.

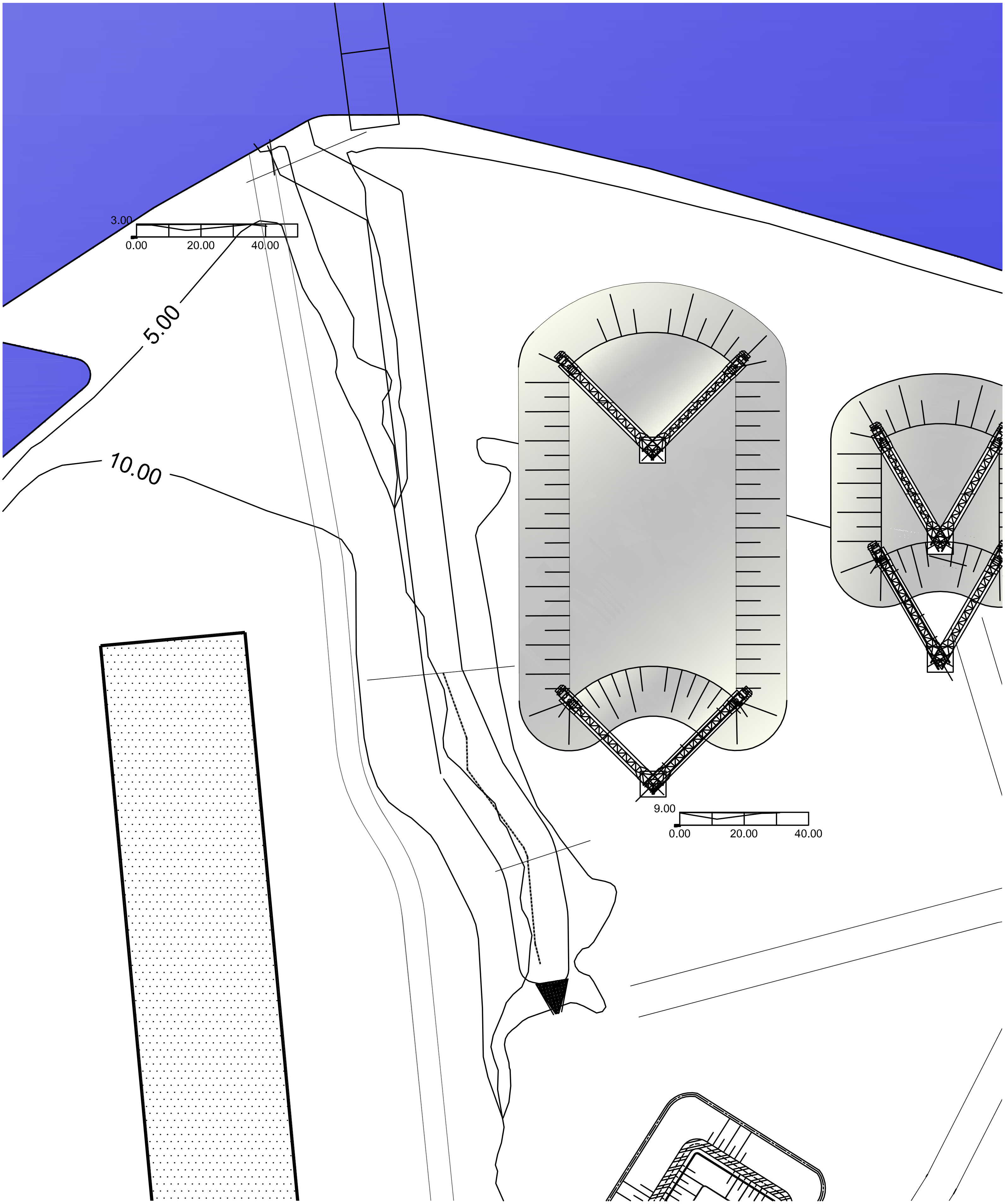
Yours sincerely,

Cheryl Wray
Environmental Superintendent
Baffinland Iron Ore Mines

Dave McCann
Assistant Project Manager
Baffinland Iron Ore Mines

cc. Derek Chubb, VP, Sustainable Development

Attachments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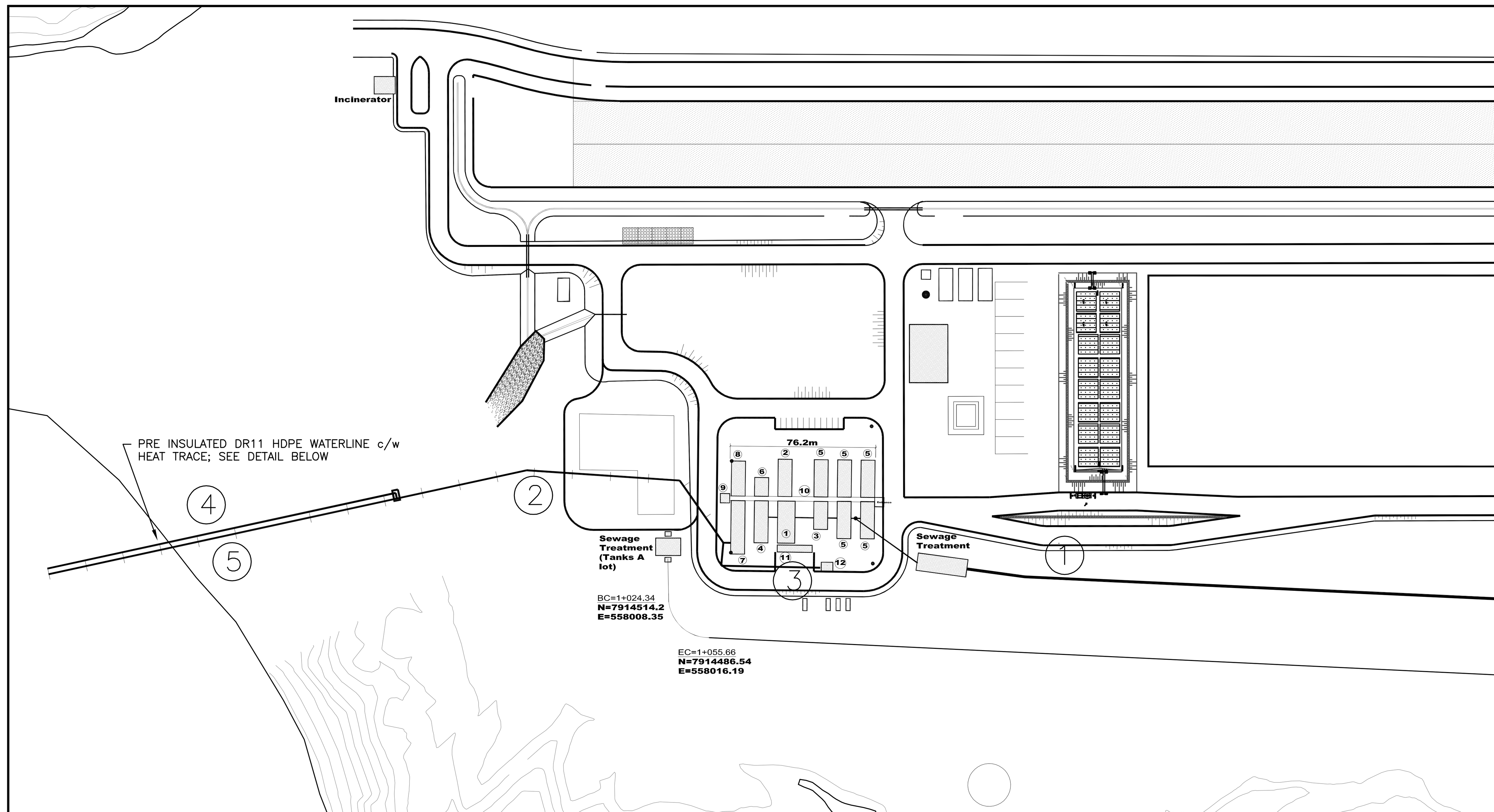


HEAT TRACE PLAN

SCALE 1:2000

(1) **Sewage Forcemain**

Scope

Freeze protection of approximately 1850m (6070ft) x 3" DR26 HDPE – laid directly on grade (above ground) @ -45°C ambient temperature.
Pre-insulated and heat traced with series type heat cable. 600V 3-phase power provided at one end only.

Pre-Insulated Pipe

Nominal 2" thick, factory applied U.I.P.® urethane insulation c/w 8.00" OD x ….175" wall black seamless PE casing, one (1) integral standard channel for the heating cable, and one (1) Slipjoint ® joint insulation kit per 50ft length of 3" DR26 HDPE pipe.
Nominal 2" thick polymer coated insulation kits supplied with accessories to be field installed by others on 3" DR26 HDPE elbows and fittings.

Heat Tracing

Assuming:
2" thick factory applied urethane insulation
Minimum ambient: -45°C
Maintain temperature: 5°C
Voltage available: 600 volts 3 phases
Feed point location: at one end of the pipe
Series connections: at 600 feet (183 m) intervals
*2000m x Flexible multi-conductor, **series type heating cable**, 600 volts rated fluoropolymer insulation. One run of heating cable is required along the pipe. Circuit length would be 2,000 meters. For ease of installation, the circuit could be broken down into segments of approximately 183 meters being series connected in between each of them. The total connected load is 29kW @ 600 volts 3 phase.*
*1 pc x Electronic thermostat model **# UTC-6340-03** with ground fault detection circuitry, 600 Vac, 40 A, 3-pole circuit breaker and contactor in a Nema 4 painted steel enclosure. Factory set @; control: 5 oC, high limit: 65 oC for protection of plastic piping.*
2pcs x cold lead connection kit
1pc x End of line termination kit
10pcs x In-Line splice kit
1pc x 100 ohms RTD temperature sensor # URTD-30-G with 30 meters of grey PVC lead wire
1pc x 100 ohms RTD temperature sensor # URTD-30-R with 30 meters of red PVC lead wire

(2) **Water Line #1 – camp domestic water reservoir to header building at lake**

Scope

Freeze protection of approximately 200m (656ft) x 3" DR11 HDPE – laid directly on grade (above ground) @ -45°C ambient temperature.
Pre-insulated and heat traced with Thermocable® heat cable. 208V power provided at one end only.

Pre-Insulated Pipe

Nominal 2" thick, factory applied U.I.P.® urethane insulation c/w 8.00" OD x .175" wall black seamless PE casing, one (1) integral standard channel for the heating cable, and one (1) Slipjoint ® joint insulation kit per 50ft length of 3" DR11 HDPE pipe.
Nominal 2" thick polymer coated insulation kits supplied with accessories to be field installed by others on 3" DR26 HDPE elbows and fittings.

Heat Tracing

One run x ***THERMOCABLE*** *C13-240-COJ heating cable with an output of 13 watts/meter @ 240 volts and a maximum circuit length of 245 meters.*
1pc x Electronic thermostat model # ***UTC-2030-01*** *with ground fault detection circuitry, 120-240 Vac, 30 A, 2 poles in a Nema 4 painted steel enclosure. Factory set @; control: 3°C, high limit: 65°C for protection of plastic piping.*
1pc x 100 ohms RTD temperature sensor # URTD-30-G with 30 meters of grey PVC lead wire
1pc x 100 ohms RTD temperature sensor # URTD-30-R with 30 meters of red PVC lead wire
1pc x Urecon power feed kit model ***PFK-4***

(3) **Water Line #2– camp domestic water reservoir to fire water reservoir**

Scope

Freeze protection of approximately 70m (230ft) x 3" DR11 HDPE – laid directly on grade (above ground) @ -45°C ambient temperature.
Pre-insulated and heat traced with Thermocable® heat cable. 208V power provided at one end only.

Pre-Insulated Pipe

Nominal 2" thick, factory applied U.I.P.® urethane insulation c/w 8.00" OD x .175" wall black seamless PE casing, one (1) integral standard channel for the heating cable, and one (1) Slipjoint ® joint insulation kit per 50ft length of 3" DR11 HDPE pipe.
Nominal 2" thick polymer coated insulation kits supplied with accessories to be field installed by others on 3" DR26 HDPE elbows and fittings.

Heat Tracing

One run x ***THERMOCABLE*** *C13-240-COJ heating cable with an output of 13 watts/meter @ 240 volts and a maximum circuit length of 245 meters.*
1pc x Electronic thermostat model # ***UTC-2030-01*** *with ground fault detection circuitry, 120-240 Vac, 30 A, 2 poles in a Nema 4 painted steel enclosure. Factory set @; control: 3°C, high limit: 65°C for protection of plastic piping.*
1pc x 100 ohms RTD temperature sensor # ***URTD-06-G*** *with 6 meters of grey PVC lead wire*
1pc x 100 ohms RTD temperature sensor # ***URTD-06-R*** *with 6 meters of red PVC lead wire*
1pc x Urecon power feed kit model ***PFK-4***

(4) **Water Line #3 – Intake from lake to header building**

Scope

Freeze protection of approximately 190m (623ft) x 3" DR11 HDPE water intake – 15m will be submerged and 15m will be laid directly on grade (above ground) @ -45°C ambient temperature.
Pre-insulated and heat traced with Thermocable® heat cable. 208V power provided at one end only.

Pre-Insulated Pipe

SUBMERGED SECTION: 50ft length x nominal 2" thick U.I.P.® urethane insulation c/w 8.00" OD x .175" wall black seamless PE casing, one (1) integral channel made from ¾" copper for heat cable - capped at wet/submerged end (to guard against water ingress), one (1) factory applied tapered insulation kit complete with (1) WLOX HiRatio heat shrink sleeve to seal the submerged end below ice cap; and one (1) Canusa Superseal joint insulation kit per 50ft length on 3" DR11 HDPE pipe.
ABOVE GROUND SECTION: 50ft length x nominal 2" thick U.I.P.® urethane insulation c/w 8.00" OD x .175" wall black seamless PE casing, one (1) integral channel made from ¾" copper for heat cable, one (1) integral standard channel for the sensors (on "dry" pipe length), compression couplings for copper conduit and one (1) Slipjoint ® joint insulation kit per 50ft length on 3" DR11 HDPE pipe.
Note: to guard against water ingress, the copper heat trace channels are coupled together over the joints and capped on the far "wet" end. The cables and sensors are fed through the conduits from "dry" end closest to controller at the header building.

Heat Tracing

One run x ***THERMOCABLE*** *C13-240-COJ heating cable with an output of 13 watts/meter @ 240 volts and a maximum circuit length of 245 meters.*
1pc x Electronic thermostat model # ***UTC-2030-01*** *with ground fault detection circuitry, 120-240 Vac, 30 A, 2 poles in a Nema 4 painted steel enclosure. Factory set @; control: 3°C, high limit: 65°C for protection of plastic piping.*
1pc x 100 ohms RTD temperature sensor # ***URTD-06-G*** *with 6 meters of grey PVC lead wire*
1pc x 100 ohms RTD temperature sensor # ***URTD-06-R*** *with 6 meters of red PVC lead wire*
1pc x Urecon power feed kit model ***PFK-4***

(5) **Water Line #4 – Intake from lake to header building** *<same as #3>*

Scope

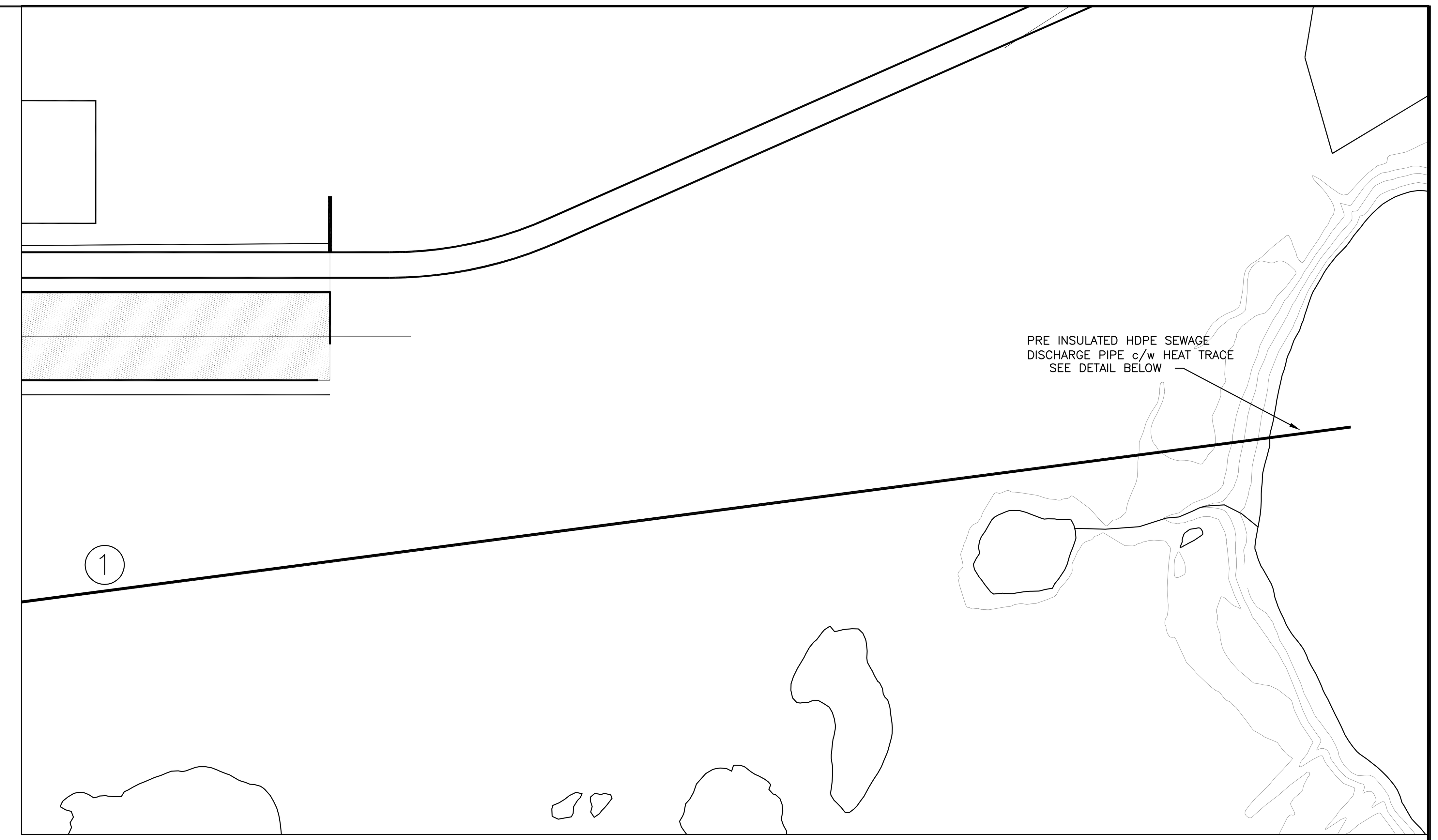
Freeze protection of approximately 185m (607ft) x 3" DR11 HDPE water intake – 15m will be submerged and 15m will be laid directly on grade (above ground) @ -45°C ambient temperature.
Pre-insulated and heat traced with Thermocable® heat cable. 208V power provided at one end only.

Pre-Insulated Pipe

SUBMERGED SECTION: 50ft length x nominal 2" thick U.I.P.® urethane insulation c/w 8.00" OD x .175" wall black seamless PE casing, one (1) integral channel made from ¾" copper for heat cable - capped at wet/submerged end (to guard against water ingress), one (1) factory applied tapered insulation kit complete with (1) WLOX HiRatio heat shrink sleeve to seal the submerged end below ice cap; and one (1) Canusa Superseal joint insulation kit per 50ft length on 3" DR11 HDPE pipe.
ABOVE GROUND SECTION: 50ft length x nominal 2" thick U.I.P.® urethane insulation c/w 8.00" OD x .175" wall black seamless PE casing, one (1) integral channel made from ¾" copper for heat cable, one (1) integral standard channel for the sensors (on "dry" pipe length), compression couplings for copper conduit and one (1) Slipjoint ® joint insulation kit per 50ft length on 3" DR11 HDPE pipe.
Note: to guard against water ingress, the copper heat trace channels are coupled together over the joints and capped on the far "wet" end. The cables and sensors are fed through the conduits from "dry" end closest to controller at the header building.

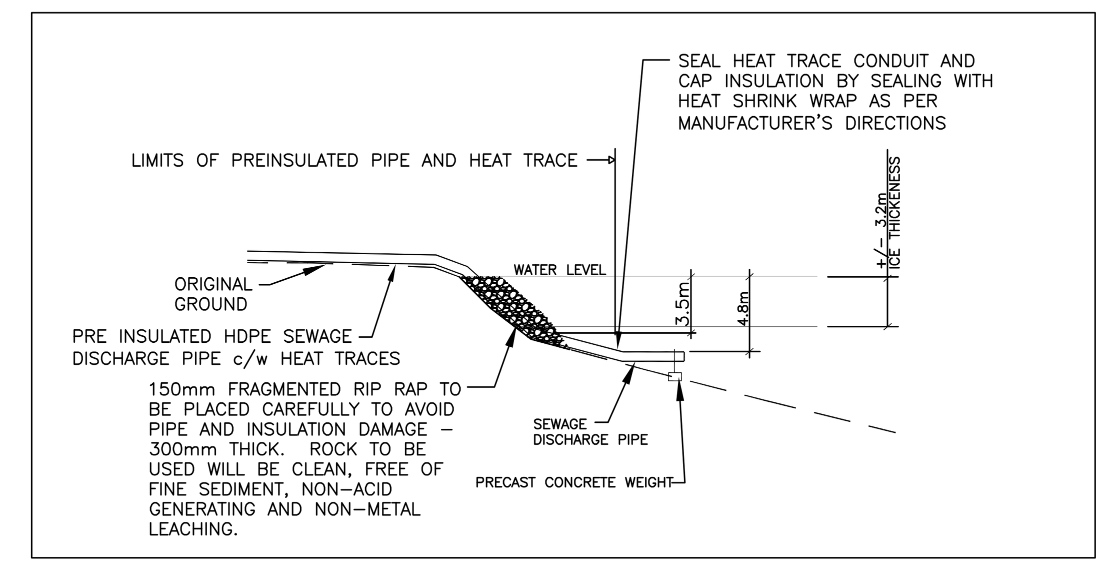
Heat Tracing

One run x ***THERMOCABLE*** *C13-240-COJ heating cable with an output of 13 watts/meter @ 240 volts and a maximum circuit length of 245 meters.*
1pc x Electronic thermostat model # ***UTC-2030-01*** *with ground fault detection circuitry, 120-240 Vac, 30 A, 2 poles in a Nema 4 painted steel enclosure. Factory set @; control: 3°C, high limit: 65°C for protection of plastic piping.*
1pc x 100 ohms RTD temperature sensor # ***URTD-06-G*** *with 6 meters of grey PVC lead wire*
1pc x 100 ohms RTD temperature sensor # ***URTD-06-R*** *with 6 meters of red PVC lead wire*
1pc x Urecon power feed kit model ***PFK-4***



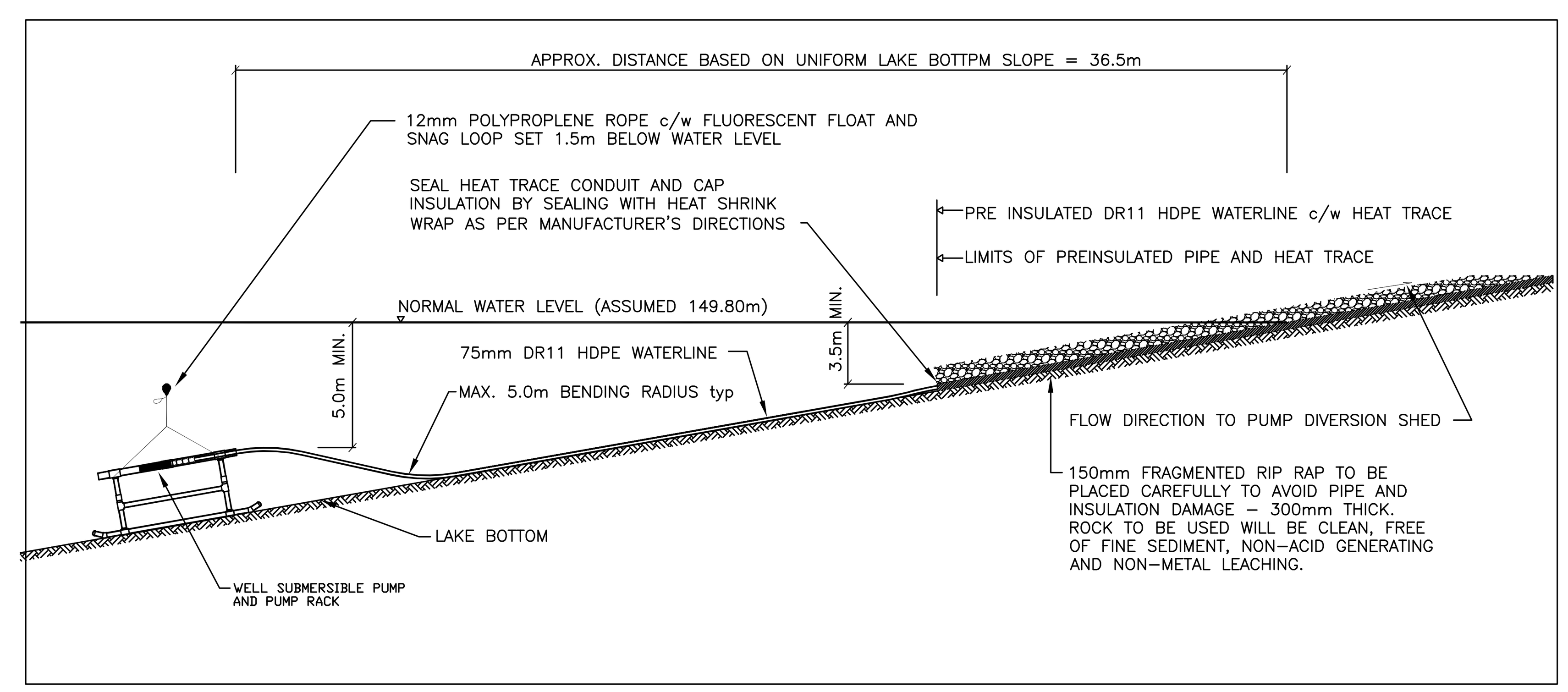
HEAT TRACE PLAN

SCALE 1:2000



HEAT TRACE DETAIL AT SEWAGE DISCHARGE

NO SCALE



HEAT TRACE DETAIL AT WATER INTAKE

NO SCALE

Description	Date	No.
REVISED HEAT TRACE DETAILS	NOV 09/07	3
REVISED HEAT TRACE DETAILS	NOV 07/07	2
ISSUED FOR CONSTRUCTION	JULY 13/07	1
ISSUED FOR TENDERS	MAY 25/07	0

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Drawing
HEAT TRACE PLAN AND DETAILS

Date: FEBRUARY 2007	CADD File Number: ELEC\E104-R3.DWG
Scale: AS NOTED	Job Number: **06-090**
Drawn: MEB/R.S.P.	
Checked: MEB/NRL	Drawing Number: **E104-R3**
Approved: NRL	

Appendix A.2

Response to Comments Received in 2008

Table A.2: Regulator/Government Comments and BIM's Response

REGULATOR COMMENT	BIM RESPONSE / ACTION
Comments/Questions related to BIM's April 2008 Request for Modification to Waste Disposal Facilities Environmental Canada	
1 Releases of inadequately treated sewage should be avoided. Meeting the requirements of the Fisheries Act is mandatory, irrespective of any other regulatory orpermitting system. Section 36(3) of the Fisheries Act specifies that unless authorized by federal regulation, no person shall deposit or permit the deposit of deleterious substances of any type in water frequented by fish, or in any place under any conditions where the deleterious substance, or any other deleterious substance that results from the deposit of the deleterious substance, may enter any such water. The legal definition of deleterious substance provided in subsection 34(1) of the Fisheries Act, in conjunction with court rulings, provides a very broad interpretation of deleterious and includes any substance with a potentially harmful chemical, physical or biological effect on fish or fish habitat.	BIM is committed to minimizing potential impacts to the receiving environment as described in the updated Wastewater Management Plan There will be no discharge of effluent to the receiving environments until it can be demonstrated that effluent streams are acutely non toxic and that all Water Licence parameters meet effluent criteria. BIM have made a commitment to apply target levels for phosphorus in treated effluent to Sheardown Lake that will limit the potential for eutrophication.
2. According to the available information the proposed ponds will provide sufficient capacity to avoid releases of inadequately treated sewage during the ramp-up of the sewage treatment facility and during any future treatment upsets. Though it is logical for a reader to assume that once the treatment facilities are operational BIMC intends to pump out the contingency ponds and then to release the treated waste, the text does not explicitly state so. Environment Canada recommends that, as much as is practical, the ponds be maintained in an empty state so that the holding capacity is available in the event of need.	Section 6 of the updated Wastewater Management Plan provides a technical strategy and work plan that is focussed on discharging stored effluent from the PWSPs during 2009.
3. The diagrams provided make it difficult to assess the location of the proposed ponds relative to surrounding water bodies. EC recommends that the ponds be located and constructed in such a manner as to prevent the untreated contents from entering any water body or watercourse frequented by fish.	The PWSPs are engineered structures with impermeable HDPE liner systems designed to contain effluent and prevent leakage. The PWSPs are inspected regularly with sign-off annually by an engineer registered in Nunavut. PWSPs at Mary River and Milne Inlet Camps are located a distance of over one kilometre from to Sheardown Lake and Milne Inlet, respectively.

INAC – Water Resources Division	
1. INAC supports the Licensee's Waste Disposal Facilities Modification Request. This is an acceptable means of treating domestic wastewater effluent with the aim of satisfying quality standards specified in Part D, Items 10 and 11 of the 2BB-MRY0710 licence.	No comment.
2. Pending the Board's approval of this modification request, the Licensee should revise its Waste Water Management Plan to take into account changes to the Mary River Camp and Milne Inlet Camp wastewater treatment facility designs.	The Wastewater Management Plan has been revised to reflect these changes.
3. The Licensee should ensure that the Board has approved the September 17, 2007 Waste Water Management Plan. An approval letter for this plan cannot be located in the online public registry.	BIM intends to work proactively to ensure that the revised Wastewater Management Plan is approved in a timely fashion.
4. The Licensee should ensure that terms and conditions applicable to the Mary River Camp and Milne Inlet Camps Wastewater Treatment Facilities specified in Part I of the 2BB-MRY0710 licence are addressed in the project's Environmental Monitoring Plan.	The Site Water Management Plan has been updated to address Part I of the water licence.
5. INAC cannot locate a copy of the Environmental Monitoring Plan required by Part I, Item 1 of the 2BB-MRY0710 in the online public registry. If this plan has been approved, an approval letter should be posted on this registry.	BIM intends to work proactively to ensure that the revised Site Water Management Plan is approved in a timely fashion.
Comments/Recommendations on wastewater management related to BIM's submission of the 2007 Annual Water Licence Report (dated March 31, 2008)	
Environment Canada	
1. EC also notes that the impacts of nutrient addition to Sheardown Lake as a result of sewage input are not assessed. Loadings form a 100 person camp could be significant, and the lake appears to be large enough to support a fish population, so conforming with section 36(3) of the Fisheries Act is required. Appendix C-2 indicates the proponent plans to use alum to remove phosphorus but no target levels for phosphorus are specified. The report is also unclear if the existing polishing ponds will continue to provide contingency storage for the new system. Is there a backup plan for sewage treatment/disposal in case of system upset?	The revised Wastewater Management Plan addresses the concerns brought forward by Environment Canada. The 2007 Wastewater Management plan assessed the potential for impacts to Sheardown Lake due to sewage effluent. The revised plan presented herein provides an update to this assessment based on existing conditions and 2009 operating plans (Section 10). The revised plan provides a target level for total phosphorus. A technical strategy and work plan have been developed to continue to effectively manage the PWSPs. In the meantime, the PWSPs continue to provide a contingency for effluent storage.
2. Assess of the impact of the addition of nutrient (treated sewage) into Sheardown	The assessment of nutrient addition to Sheardown Lake has been updated in

Lake and the planned target level of phosphorus removal by alum.	the revised Wastewater Management Plan (Section 10) and a target level for phosphorus has and continues to be established.
3. Provide details of contingency plan for managing sewage in the event of system upsets at treatment/disposal facilities.	The PWSPs continue to provide capacity in the event of upsets at the treatment facilities.

APPENDIX B

TABLES FROM COLD REGIONS UTILITIES MONOGRAPH

APPENDIX “B”

- **Tables 10.1 to 10.4 from “Cold Regions Utilities Monograph, 3rd Edition**

TABLE 10-3 TYPICAL QUANTITITES OF SEWAGE FLOW

Source		Quantity L/(p•d)
1. Communities and Permanent Military Bases		
a. 1,000 population with conventional piped water and sewage		
Thule Air Force Base, Greenland		303
College, AK		265
Fairbanks, AK		303
Ski resorts in Colorado and Montana		345
	Average	300
b. 1,000 population with conventional piped water and sewage		
Bethel, AK		265
DEW Line, Greenland		208
	Average	240
c. with truck-haul systems, conventional internal plumbing	Average	140
d. with truck-haul systems, low-flush toilets	Average	90
e. no household plumbing, water tanks and honey-bucket toilet	Average	1.5
f. same as (e) above but with central bathhouse and laundry	Average	15
2. Construction Camps		
North Slope, Ak (1971)		189
"Typical" Canadian		227
Alaska Pipeline (1976)		258
	Average	220
3. Remote Military with Limited Availability of Water		
McMurdo, Antarctica		151
Barrow, AK (DES Sta)		114
"Typical" Army Field Camp		129
	Average	130

wastes and extra amounts of garbage and grease from institutional kitchens.

10.3.1 Quantity. The resulting quantities of sewage flow depend on the type of installation and its permanence. Table 10-3 summarizes typical sewage flows for various cold-regions situations.

Separate facilities such as schools, laundries, restaurants, and hotels with conventional plumbing tend to have loadings similar to those in conventional temperate zone practice.

Projected data for the community should be used to establish a design value for per-person flow. The average values given in Table 10-3 may be used to

TABLE 10-4 CHARACTERISTICS OF BASIC WASTEWATER CATEGORIES

Parameter	Units	Undiluted (Heinke, 1973)	Moderately Diluted (Eggener & Tomlinson, 1978)	Conventional Diluted (Metcalf & Eddy Inc., 1979)	Greatly Diluted (Bethell, 1981)	Greywater (Hrudey & Raniga, 1981)
BOD_5	mg/L	–	460 280 to 700	220 110 to 400	55 40 to 60	–
COD	mg/L	110,400 80,800 to 134,800	1,000 700 to 1,300	500 250 to 1,000	–	(TOC) 210 40 to 900
Suspended solids (NFR)	mg/L	78,200 66,000 to 85,000	490 370 to 820	220 100 to 350	50 20 to 150	290 40 to 2,000
Total nitrogen	mg/L as N	8,100 7,300 to 9,500	–	40 20 to 90	(NH_3) 10 6 to 30	(NH_3/N) 1.4 8
Phosphorus	mg/L as P	1,200 1,100 to 1,400	–	8 4 to 15	3 2 to 6	9 4 to 20
Calculated flow*	L/(p•d)	1.2 1.1 to 1.4	170 110 to 290	360 200 to 730	1,500 1,300 to 2,000	310 50 to 2,300

All values rounded off from published data.

* Calculated based on 80 g BOD_5 per person per day and 90 g suspended solids (SS) per person per day (where applicable), modified activated sludge, and septic tanks. In some instances, lagoon treatment is followed by land disposal.

TABLE 13-1 WATER DEMAND VALUES FOR VARIOUS CAMPS

Camp Type	Population	Water Demand	
		Range*	Average*
Drilling camp		83 to 227	132
Base camp (Trink, 1981)		121 to 348	200
Exploration base (Murphy et al., 1977)	40 to 100 w/o bleeding		250
	40 to 100 with bleeding		445
Alaska pipeline construction (Eggener and Tomlinson, 1978)	200 to 1,300		265
Alaska pipeline construction (Murphy et al., 1977)	200 to 400		257
Alaska drilling camp (Alaskan Dept. of Health & Welfare, 1969)			212
Correctional camp (Grainge et al., 1973)	44		
Hydro generation construction camp (Belanger and Bodineau, 1977)	4,000 summer 2,000 winter		340**
Artificial island (Heuchert, 1974)			108**
U.S. military camps (Lufkin and Tobiasson, 1969)			
Main base	3,000 to 6,000	442 to 514	514
Ice research camp	25		79
Other camp with snow melt for water supply	96 to 227		121
Other camp with steam to melt snow for water supply	85 to 200		189
Alaska drilling rig camps (North Slope) (Tilsworth and Damron, 1973)			313
Value most frequently quoted	44	227 to 681	149**

* flow rate (L/(p•d))
** wastewater flow rate (L/(p•d))

vary from 1.4 to 1.77 (Lufkin and Tobiasson, 1969; Murphy et al., 1977; Given, 1978). These values do not represent a drastic change from those found for the households in small communities.

In addition to life support, water requirements specific to the work camp activity, for example, equipment washdown, pressure testing, and fire protection must be included in the estimate of total camp water supply.

An evaluation of water usage of various facilities at an Alaskan drilling camp and base camp is shown in Tables 13-2 and 13-3. The percentage of water

APPENDIX C

SEPROTECH DESIGN BRIEFS FOR MODELS N70 (MARY RIVER CAMP) AND N30 (MILNE INLET CAMP) RBC UNITS

APPENDIX C.1

MODEL N70 – MARY RIVER CAMP RBC

Seprotech
Water. Pure and Simple

DESIGN BRIEF

BAFFINLAND - N70

May 25 2007

1. HYDRAULIC DESIGN: (AVERAGE DAILY FLOW)

1 unit at	34	**m3/day =**	34	**m3/day = Q**
Peak Flow (to EQ tank)	101			
design based on a	24	hour day.		

2. INFLUENT PARAMETERS:

BOD (biochemical oxygen demand) =	519	mg/l
SS (suspended solids) =	519	mg/l
TKN =	65	mg/l
Phosphorus =	10	mg/l

Ontario Application?	n	y/n
Designated Model?	y	y/n
What Model?	N	70

3. TREATED EFFLUENT QUALITY:

BOD (biochemical oxygen demand) =	10	mg/l
SS (suspended solids) =	10	mg/l
NH3-N =	2	mg/l
Phosphorus =	0.5	mg/l

4. R.B.C. SURFACE AREA REQUIRED (AO):

a) Removal in Primary Settling Tank (P.S.T.)

Primary BOD Removal =	10%				(Ref.1)
Primary Tank. Eff. BOD =	519	mg/l x	90%		
to RBC =	467.1	mg/l			

b) RBC BOD Loading.

Applied Load =	467.1	mg/l	**34**	**m3/day**
	15.76	kg BOD/day		

c) Area required to reduce BOD to 10 mg/l (AO)

Applied Load =	15.76	kg BOD/day	**15.76**	**kg BOD/ day**	
For	10	mg/l* use	1.93	kg/day/100m2	
	817	m2			(*in a nitrification application, reduce BOD to 30 mg/l, the nitrification

d) NH3-N to be removed

(Assume Organic Nitrogen is converted to Ammonia NH3)

Removed to	5	mg/l	=	65	less	5	times	33,750	litres/day
=	2.03	kg/day	=	4.46	lb/day				
Area Required to reduce NH3-N to	5	mg/l							
=	2.03	kg/day	over	0.147	kg NH3-N/day/100 m2		**(Ref. 12)**		
=	1378	m2	=						
Residual NH3-N to be removed below 5 mg/l =	5	mg/l	less	2	mg/l	times	33,750	litres/day	
=	0.101	kg/day							
Area Required to reduce NH3-N to	2								
=	0.101	kg/day	over	0.068	kg NH3-N/day/100 m2				
=	149	m2	=						
Total Nitrification Area Required =	1526	m2	=						

e) Total Surface Media Required

Total Surface Media Required = 2343 m2

f) Staging

Hydraulic Loading	0.15	L/d/m2
B.O.D.post primary	15.76	kg BOD/day
Media req'd(B.O.D)	817	m2
Media req'd(nitrfct'n)	1,526	m2
Total req'd	2,343	m2
Min req'd to prevent 1st st. overload	509	m2
Min req'd to prevent 2nd st. overload	509	m2

	ACTUAL AREA (m2)
First Stage	495
Second Stage	205
Third Stage	822
Fourth Stage	822
TOTAL	2,344

	ACTUAL AREA (ft2)	
First Stage	5,328	21%
Second Stage	2,207	9%
Third Stage	8,848	35%
Fourth Sytage	8,848	35%
TOTAL	25,230	

Minimum First Stage Media Area

Maximum loading to prevent first stage overload =	3.1	kg/day/100 m2
=	15.76	kg of post primary BOD/day divided by max. loading times 100 m2
=	509	m2

=

BOD remaining for 2nd Stage =	15.76	kg/day
Minimum Media 2nd Stage =	508.54	m2

5. PRIMARY SETTLING TANK (P.S.T.) (per RBC unit):

a) Primary Settling Tank Influent Flows (per RBC unit)

Average Daily Flow =	**33,750**	**litres/day**		
Recycle at	203%	% =	68584	litres/day
Total Average Flow =	102,334	litres/day		
Peak Daily Flow =	101,250	litres/day		
Peak Flow including Recycle =	169,834	litres/day		

b) Loading Rates

Average Overflow Rate =	16,000	Litres/day/m2	max from	(Ref.5)
Peak Overflow Rate =	24,000	Litres/day/m2 (rounded)		(Ref.7)
Detention Time =	4	hours	use 4 hrs	(Ref.6)

c) Surface Area Required

i) by Average Overflow Rate = Total Average Flow divided by Average Overflow Rate
= 6.40 m2
ii) by Peak Flow Rate = Peak Flow divided by Peak Overflow Rate
= 7.08 m2
Therefore, use 7.08 m2 to compare with actual area of P.S.T.

P. S. T. Surface Area for Model N 6.25 m x 3.35 m = 20.9 m2

Safety factor of: 2.96 times supplied.
Therefore **Surface Area Acceptable**

d) Volume Required = Q x Detention Time / 24 hrs / day
= 5.6 m3
P.S.T. Tank Capacity for this N is 44 m3
(after allowance for sludge) 7.7 **safety factor**
Therefore **Volume Acceptable**

6. FINAL SETTLING TANK (F.S.T.):

a) Loading Rates

Average Overflow Rate =	24000	Litres/day/m2	[Ref. 10]
Peak Overflow Rate =	44822	Litres/day/m2	[Ref. 10]
Detention Time =	3	hours	

b) Surface Area Required

i) by Average Overflow Rate = Average Flow divided by Average Overflow Rate
= 1.41 m2
ii) by Peak Flow Rate = Peak Flow divided by Peak Overflow Rate
= 2.26 m2
Therefore, use 2.26 m2 to compare with actual area of F.S.T.

F. S. T. Surface Area for Model N 3.35 m x 3.0 m = **10** m2

Safety factor of 4.41 times supplied.
Therefore **Surface Area Acceptable**

c) Volume Required = Q x Detention Time / 1000 / 24 hrs / day
= 4.2 m3 =
F.S.T. Tank Capacity for this N is 10.9 m3
(after allowance for sludge) **2.6** safety factor
Therefore **Volume Acceptable**

7. ALUM DOSING CALCULATIONS:

Alum Dosing

$Al_2(SO_4)_3 + 2\ PO_4^{3-} = 2\ AlPO_4 + 3\ SO_4^{2-}$

Molecular Weights

Al	27	g/mol
P	31	g/mol
$AlPO_4$	122	g/mol
Al_2O_3	102	g/mol
$Al(OH)_3$	78	g/mol
$Al_2(SO_4)_3$	342	g/mol
$Al_2(SO_4)_3 \cdot 14H$	594	g/mol

mol Al per mol Al_2O_3:	2
mol AlPO4 per mol P:	1
mol Al per mol P in $AlPO_4$:	1
mol Al per mol $Al(OH)_3$:	1
mol Al per mol $AlPO_4$:	1

Assumptions

Conc. Al_2O_3 in comm. alum sol.: 8.1 %

Density comm. alum sol.: 1.328 kg/l

Data specific to site

Conc. P PST: 10 mg/l

Conc. P Out: 0.5 mg/l

Required P removal: 9.5 mg/l

95 %

Black and Veach suggested Al:P molar ratio: 2.3

ADF 33,750 l/day

Required tank autonomy: 28 days = 4 weeks

Dosing Calculations

Conc. Al_2O_3 needed = 37.8 mg/l

Conc. comm. alum sol. needed = 467.1 mg/l

Relative volume comm. alum sol. Needed = 0.000351765 l comm. alum/l wat.

Daily comm. alum consumption = 11.9 l/day

(dosing pump sizing): 0.49 l/h

Volume tank required = 332 l

73 imp. gal.

88 US gal.

Black and Veach (with interpolations)			
P Reduction	Mole Ratio	Weight Ratio	Weight Ratio
Required (%)	Al:P	Al:P	Alum:P
75	1.38	1.2	13
76	1.41	1.23	13.3
77	1.45	1.26	13.6
78	1.48	1.29	13.9
79	1.52	1.32	14.2
80	1.55	1.35	14.5
81	1.58	1.38	14.8
82	1.62	1.41	15.1
83	1.65	1.44	15.4
84	1.69	1.47	15.7
85	1.72	1.5	16
86	1.78	1.55	16.6
87	1.84	1.6	17.2
88	1.89	1.65	17.8
89	1.95	1.7	18.4
90	2	1.75	19
91	2.05	1.79	19.5
92	2.1	1.83	19.9
93	2.17	1.89	20.6
94	2.24	1.94	21.3
95	2.3	2	22
96	2.38	2.05	22.6
97	2.45	2.1	23.2
98	2.47	2.15	23.8
99.7	2.57	2.235	24.82

7. SLUDGE CALCULATIONS:

Assumptions Used for Calculation of Sludge Accumulation

1. Inlet TSS:	519	mg/l
2. Outlet TSS:	10	mg/l
3. Inlet BOD5:	519	mg/l
4. Outlet BOD5:	10	mg/l
5. Average Daily Flow:	34	m3/day
6. Proportion of inlet BOD5 soluble:	70%	
7. Total incoming solids	17.52	kg/d
8. Inert portion of solids (30%)	5.25	kg/d
9. Remaining organic solids (70%)	12.26	kg/d
11. Assuming Aerobic digester removal efficiency 50%.	6.13	kg/d
12. BOD removed in secondary treatment	15.09	kg/d
13. Sludge produce due to BOD removal	4.53	kg/d
15. Aerobic digester removal efficiency 50%.	2.26	kg/d
16. Total sludge produced per day	13.65	kg/d

Information Pertaining to the ROTORDISK Used in Calculation of Sludge Accumulation

1. All sludge accumulates in the PST (sludge settled in the FST is pumped back to the PST).		
2. PST Surface Area:	20.9	m2
3. PST Volume:	43.6	m3
4. PST Sludge Storage Capacity:	21.8	m3
TOTAL Mass of sludge produced that accumulates in the PST:	**13.6**	**kg/day**
Volume of Wet Sludge produced Daily:	0.2730	m3/day
Depth of Wet Sludge produced Daily:	0.0130	m/day
Frequency of Pump-Outs:	80	days

SUMMARY OF REFERENCES

Ref.1
excerpt from "Design of Municipal Wastewater Treatment Plants Volume 1", Chapters 1-12, WEF Manual of Practice No. 8, ASCE Manual and Report on Engineering Practice No. 76, p. 475, which states, " Sedimentation with coagulation may remove 60 to 90% of the TSS, 40 to 70% of BOD5, 30 to 60% of COD, 70 to 90% of the Phosphorus, and 80 to 90% of the bacteria loadings. In comparison, sedimentation without coagulation, may remove only 40 to 70% of the TSS, 25 to 40% of the BOD5, 5 to 10% of the Phosphorus loadings, and 50 to 60% of the bacteria loadings."

Ref.2
excerpt from "Manual of Policy, Procedures and Guidelines for Private Sewage Disposal Systems, Ontario Regulation 374/81 under part VII of the Environmental Protection Act", May 1982, ISBN 0-7743-7303-2, section 12.7.1, which states, "if it is a system operating on the rotating biological disc or similar principle involving contact of the biomass with air, provide a disc area so that the daily loading of sewage will not be in excess of 1.25 kg of BOD5 per 100 sq.m. of disc area, or a hydraulic loading in excess of 45 l/sq.m. of disc area".

Ref.3
excerpt from "Pilot Plant Studies of Rotating Biological Contactors treating municipal Wastewater", by: K.L. Murphy and R.W. Wilson, International Environmental Consultants Ltd., Toronto Ontario, prepared for Central Mortgage and Housing Corporation, Ottawa, Ontario.

Ref.4
excerpt from "Design of Municipal Wastewater Treatment Plants Volume 1", Chapters 1-12, WEF Manual of Practice No. 8, ASCE Manual and Report on Engineering Practice No. 76, p. 776, which states, "...whenever the first stage loading limit exceeded 3.1 kg BOD5/100 sq.m.day(6.4 lbs. BOD5/d/1000 sq.ft.), the system was associated with the presence of sulfur-oxidizing organisms".

Ref.5
excerpt from "EPA Process Design Manual, On-site Wastewater Treatment and Disposal Systems", Oct 1980, EPA 625/1-80-012, section 6.4.2.4.e., p.149, which states, "...average flow design values normally range from 200 to 400 gpd/sq.ft.(8 to 16 cu.m./d/sq.m.)".

Ref.6
excerpt from " O&M of Trickling Filters, RBC's, and Related Processes, Manual of Practice OM-10, 1988, Water Pollution Control Federation, p. 105, which states, " Weir overflow rates typically range from 125 to 250 cu.m./m.d (10,000 to 20,000 USgpd/ft.)...The wastewater detention time in a settling basin is normally between 1 to 3 hours, but has been as high as 10 hours with excellent results". [use 4 hours]

Ref.7
excerpt from "EPA Process Design Manual, Wastewater Treatment Facilities for Sewered Small Communities", Oct 1977, EPA-625/1-77-009, section 6.4.2., which states, " the peak overflow rate may be 2,500 to 3,000 USgpd/sq.ft. (100 to 120 cu.m./sq.m.d) for primary clarifiers followed by biological treatment processess".
" Clarifiers handling chemical flocs, such as aluminum or iron coagulants, should be designed for peak overflow rates no longer than 600 and 800 USgpd/sq.ft.(24 and 32 cu.m./sq.m.d)".

Ref.8
excerpt from "Design of Municipal Wastewater Treatment Plants Volume 1", Chapters 1-12, WEF Manual of Practice No. 8, ASCE Manual and Report on Engineering Practice No. 76, p. 484, which states, " TSS removal efficiencies in primary sedimentation tanks usually range between 50 and 65%. Many designers assume a removal efficiency of 60% for estimation purposes".

Ref.9
excerpt from "Wastewater Engineering Treatment, Disposal, and Reuse", 3rd ed., Metcalf and Eddy Inc., revised by George Tchobanoglous and Franklin L. Burton, p.808, table 12-14, which shows,"...typical concentrations of thickened sludge for a rotating biological contactor is 2 to 5%".

Ref.10
excerpt from "Design Information on Rotating Biological Contactors", by Richard C. Brenner, EPA-600/2-84-106, section 2.10, which states, " Murphy and Wilson recommend surface overflow rates less than 600 gpd/sq.ft. to maximize solids removal... DeCarlo recommends that peak hydraulic rates be limited to 1000 to 1200 gpd/sq.ft.".

Ref.11
excerpt from "EPA Process Design Manual, Wastewater Treatment Facilities for Sewered Small Communities", Oct 1977, EPA-625/1-77-009, section 9.2.4.6, p.9-43, which states, " Sludge produced by the RBC unit is similar to humus sludge from a trickling filter. The amount of sludge produced will depend on waste characteristics and loading rates. An RBC unit designed for 80% BOD5 removal would produce about 0.7 lb. of sludge per lb. of BOD5 removed; 95% percent removal would produce about 0.3 lb. of sludge."

Ref.12
excerpt from "Design Information on Rotating Biological Contactors", by Richard C. Brenner, EPA-600/2-84-106, section 5.5.2.2, which states, "Figure 5-19 represents data for one day for a given stage...The zero-order removal rate above bulk liquid ammonia nitrogen concentrations of 5 mg/l in Figure 5-19 is projected at 0.3 lb. NH3-N/day/1000 sq.ft., same as the Autotrol design". (Figure 5-19 attached)

Ref.13
excerpt from Ministry of Environment and Energy - Ahlberg & Kwong Report - "Winter Operation"
No process or operating problems were experienced throughout the winter. The minimum temperature encountered in the unit, with a raw sewage feed rate of 320 gpd, was 4 oC. Process performance remained good during the winter even under conditions of intermittent operation.

Ref.14
excerpt from the Forgie study
For the RBC unit and wastewater tested, the effect of temperature on removal efficiency over the 15 oC to 5 oC range was relatively low (theta = 1.001 to 1.02)

Ref.15
excerpt from Trinh - Environment Canada "Exploration Camp Wastewater Characterization and Treatment Plant Assessment"
It [the RBC] also operated at a low liquid temperature of 4 oC during one week without the effluent quality deteriorating.

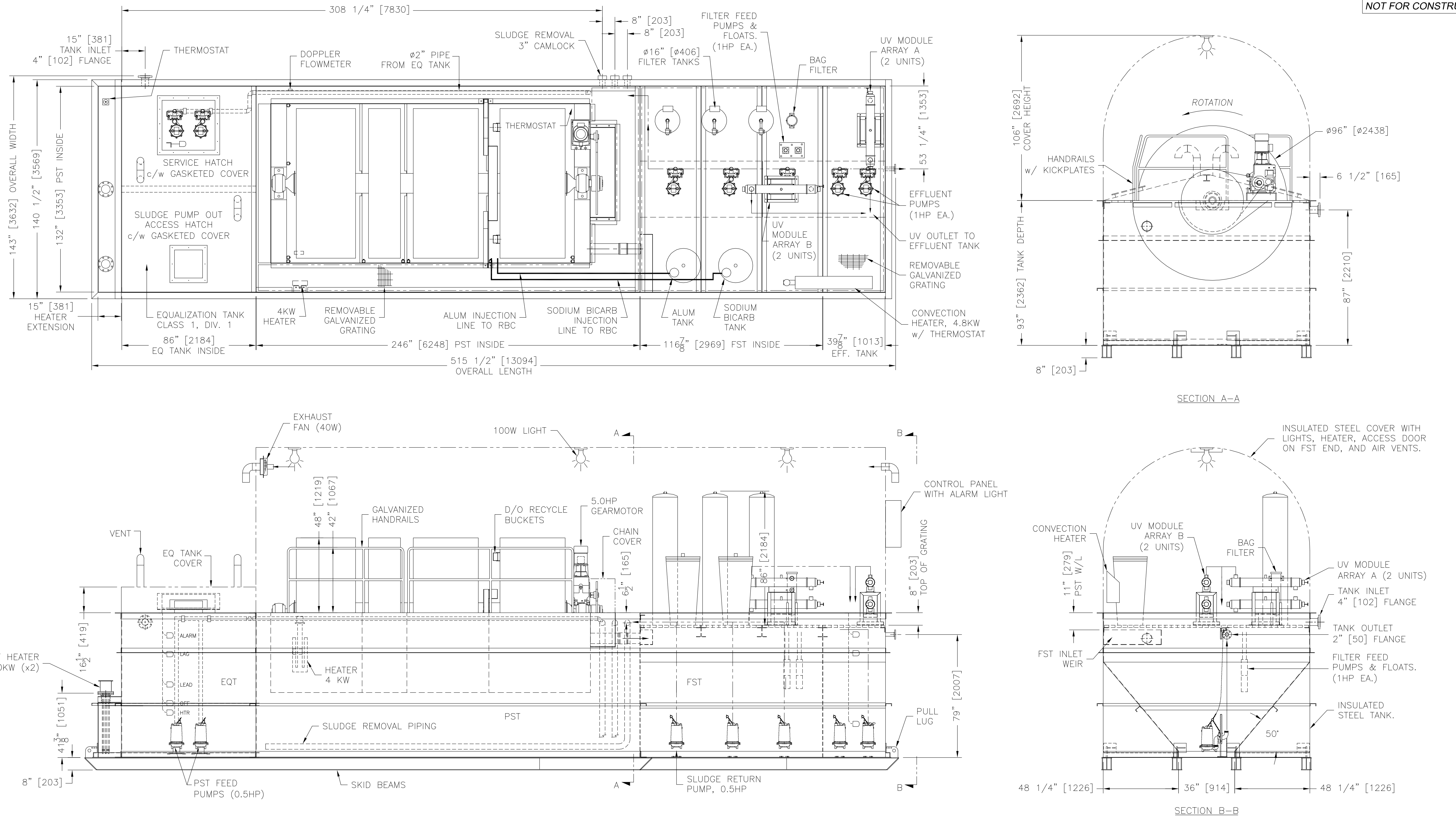
Ref.15
WEF MOPNo. 8, p913 Oxygen recovery is 2.86 mg O2/mg NO3-N reduced."

Ref.16
excerpt from "Design Information on Rotating Biological Contactors", by Richard C. Brenner, EPA-600/2-84-106,
section 2.9.3, which states, " The observed denitrification rate at 550F was approximately 0.85 lb NO3-N /day/1000sq. ft.."

Ref.17
excerpt from "Design Information on Rotating Biological Contactors", by Richard C. Brenner, EPA-600/2-84-106,
section 2.9.2, which states, " The commonly used design value for the required methanol dosage is 3 mg/mg NO3-N reduced."

Ref.18
WEF MOPNo. 8, p913 states that "Oxygen recovery is 2.86 mg O2/mg NO3-N reduced." and that Heterotrophic biomass production is approximately 0.4 mg VSS/mg COD removed"

PRELIMINARY
NOT FOR CONSTRUCTION



NOTES:
1. UNIT TO BE PLACED LEVEL ON CONCRETE OR WELL COMPACTED GRAVEL. (PAD DESIGN BY OTHERS)
2. ALL DIMENSIONS IN BRACKETS ARE IN MILLIMETERS.
3. TANKS, RBC TROUGH, & SHAFT SANDBLASTED AND PAINTED WITH DEVTAR 5A FINISH.
4. INLET/OUTLET ARE STD. 150# ANSI B16.5 RAISED FACE FLANGES.

NOTES:
5. WEIGHT SHOWN IS DRY WEIGHT ONLY.
6. TANKS ARE EQUIPPED WITH DRAIN PORTS FOR SHIPPING PURPOSES ONLY.
7. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION WITHOUT PRIOR APPROVAL OF SEPROTECH SYSTEMS INC.

REV	DESCRIPTION	YY/MM/DD	BY
1	AS BUILT CONFIGURATION	09/03/06	XX

PROJECT:
BAFFINLAND IRON MINES
MARY RIVER, NUNAVUT

ALL TOLERANCES ARE +/- 1/32" UNLESS OTHERWISE SPECIFIED. DIMENSIONS ARE IN INCHES.

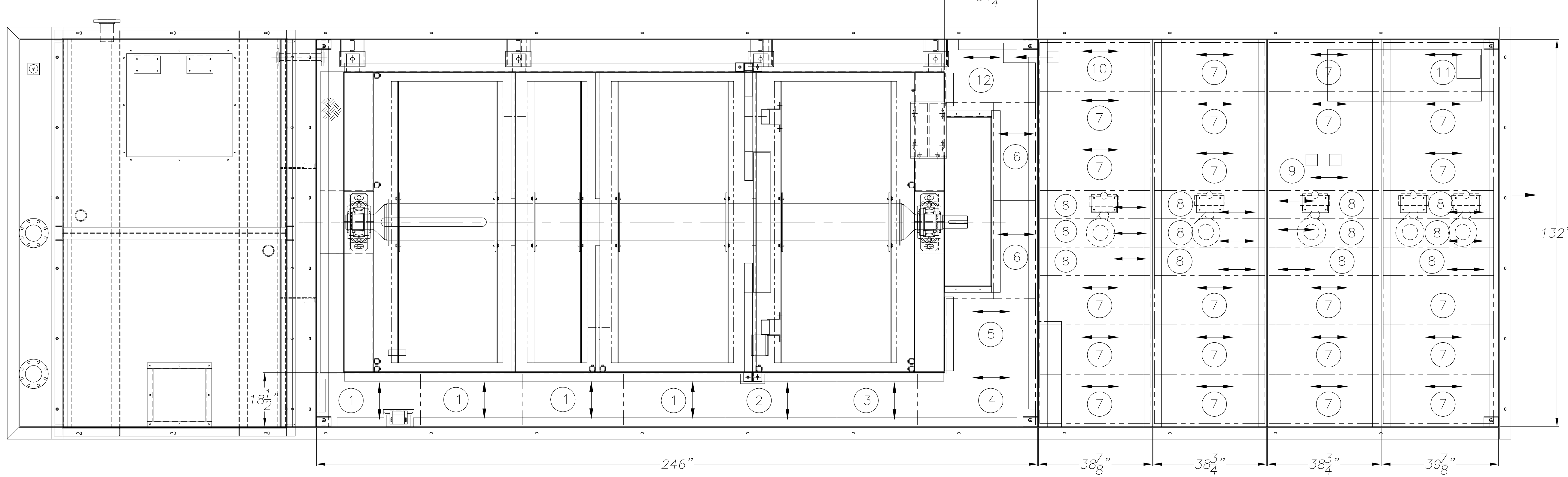
DO NOT SCALE. IF IN DOUBT, ASK

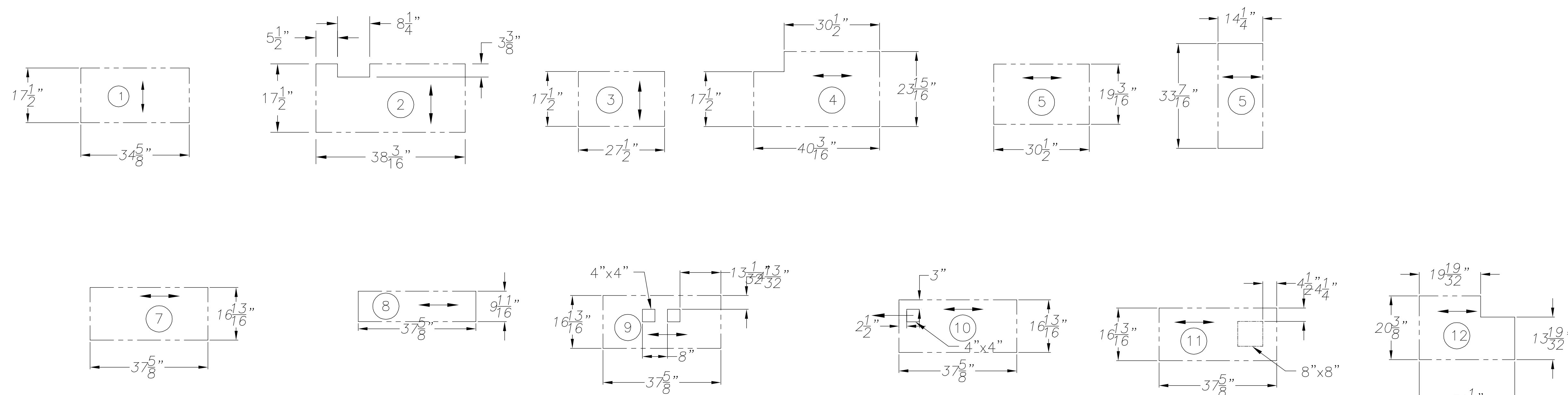
Seprotech
Water. Pure and Simple

SEPROTECH SYSTEMS INC.
2378 HOLLY LANE OTTAWA, ONTARIO, CANADA K1V 7P1
TEL: (613) 523-1641 FAX: (613) 731-0851
Email: contact@seprotech.com Web: http://www.seprotech.com

DESCRIPTION
MODEL N70, GENERAL ARRANGEMENT
FULL STEEL, w/ FILTERS, EQT & EFFLUENT TANK

DRAWN	CHECKED						
AH							
DATE	SIZE	SCALE	WEIGHT	SHEET	DWG NO.	REV	
28-MAY-2007	B	1:60	50000 LB.	1 OF 1	60052-L01	1	





PANEL DETAILS
SCALE = 1:32

BANDED GALVANIZED GRATING

GRATINGS 1 – 6 & 12 = W/B–6
1 1/4" X 3/16" (8.9 LB/SQ FT)

GRATING 7 – 11 = W/B–8
1 1/2" X 3/16" (10.6 LB/SQ FT)

SADDLE CLIPS INCLUDED.
2 PER PANEL. 94 TOTAL.

GRATING	QTY
1	4
2	1
3	1
4	1
5	1
6	2
7	21
8	12
9	1
10	1
11	1
12	1

NOTES:
1. SADDLE CLIPS INCLUDED, 2 PER PANEL.

NOTES:

REV	DESCRIPTION	YY/MM/DD	BY
XX	XXXXX	YY/MM/DD	XX

ALL TOLERANCES ARE +/– 1/32" UNLESS OTHERWISE SPECIFIED. DIMENSIONS ARE IN INCHES.

Seprotech Water. Pure and Simple
SEPROTECH SYSTEMS INC.
2378 HOLLY LANE OTTAWA, ONTARIO, CANADA K1V 7P1
TEL: (613) 523–1641 FAX: (613) 731–0851
Email: contact@seprotech.com Web: http://www.seprotech.com

DESCRIPTION: GRATING, N70 – SPECIAL E70S/F70 w/ FILTERS & EFF. TANK

DRAWN	CHECKED	DATE	SIZE	SCALE	WEIGHT	SHEET	DWG NO.	REV
SA		30–MAY–2007	B	1:40	1980 LB.	1 OF 1	60052–S03	0

APPENDIX C.2

MODEL N30 – MILNE INLET CAMP RBC

Seprotech
Water. Pure and Simple

DESIGN BRIEF
SHANCO NUNAVUT - RETRO-FIT
*Note that since this is a retro-fit that has not been tested in the field, effluent values are target values.

1. HYDRAULIC DESIGN: (AVERAGE DAILY FLOW)

1	unit at	14	m3/day =	14	m3/day = Q
	Peak Flow	41			
	design based on a	24	hour day.		

2. INFLUENT PARAMETERS:

BOD (biochemical oxygen demand) =	491	mg/l
SS (suspended solids) =	491	mg/l
TKN =	70	mg/l
Phosphorus =	n/a	mg/l

Ontario Application?	n	y/n
Designated Model?	y	y/n
What Model?	B30	MODIFIED with extra media
In concrete tank?	Full Steel	

3. TREATED EFFLUENT QUALITY:

BOD (biochemical oxygen demand) =	20	mg/l
SS (suspended solids) =	20	mg/l
NH3-N =	2	mg/l
Phosphorus =	n/a	mg/l

this effluent concentration is expected after the retro-fit

4. R.B.C. SURFACE AREA REQUIRED (AO):

a) Removal in Primary Settling Tank (P.S.T.)

Primary BOD Removal =	10%			(Ref.1)
Primary Tank. Eff. BOD =	490.9090909	mg/l x	90%	
to RBC =	441.8181818	mg/l		

b) RBC BOD Loading.

Applied Load =	441.8181818	mg/l	14	m3/day
	5.96	kg BOD/day		

c) Area required to reduce BOD to 20 mg/l (AO)

Applied Load =	5.96	kg BOD/day		5.96	kg BOD/ day
For	20	mg/l*	use	1.95	kg/day/100 m2
	306	m2			

(*in a nitrification application, reduce BOD to 30 mg/l, the nitrification process completes the BOD reduction)

TABLE #1
BOD REMOVAL RATES
Seprotech Curve

Req. effl.	lbs/day/1000 ft2	kg/day/100 m2
5	1.25	0.61
10	2.65	1.29
15	2.00	0.98
20	2.65	1.29
25	3.35	1.64
30	4.00	1.95
35	4.60	2.25
40	5.15	2.52
50	6.00	2.92
60	7.15	3.52
70	8.28	4.05
80	9.40	4.59
90	10.53	5.13
	USE	1.95

* For effluent strengths less than 20 mg/l, filtration is required. Filtration removes the sloughed biomass 50% of which is BOD. Therefore, to obtain effluent strengths of 5 and 10 mg/l BOD use the loading rates for 10 and 20 mg/l respectively with filtration.

No temperature correction required
Refs. 13,14,&15

d) NH3-N to be removed
(Assume Organic Nitrogen is converted to Ammonia NH3)

Removed to	5	mg/l	=	70	less	5	times	13,500	litres/day
=	0.88	kg/day	=	1.93	lb/day				
Area Required to reduce NH3-N to	5	mg/l							
=	0.88	kg/day	over	0.147	kg NH3-N/day/100 m2		(Ref. 12)		
=	597	m2	=						
Residual NH3-N to be removed below 5 mg/l =	5	mg/l	less	2	mg/l	times	13,500	litres/day	
=	0.041	kg/day							
Area Required to reduce NH3-N to	0								
=	0.041	kg/day	over	0.089	kg NH3-N/day/100 m2		(Ref. 12)		
=	46	m2	=						
Total Nitrification Area Required =	642	m2	=		(Ref. 12)				

e) Total Surface Media Required

Total Surface Media Required = 948 m2

f) Staging

Hydraulic Loading	0.13	L/d/m2
B.O.D.post primary	5.96	kg BOD/day
Media req'd(B.O.D)	306	m2
Media req'd(nitrfct'n)	642	m2
Total req'd	948	m2
Min req'd to prevent 1st st. overload	192	m2
Min req'd to prevent 2nd st. overload	71	m2

TABLE # 2 - Brenner

Req'd NH3-N concentratio (mg/l)	Removal Rate (kg/day/ 100m2)
1	0.037
1.5	0.061
2	0.089
2.5	0.110
3	0.123
3.5	0.135
4	0.147
4.5	0.147
5	0.147

No temperature correction required
Refs. 13,14,&15

Media Distribution After Retro-fit

	ACTUAL AREA (m2)
First Stage	205
Second Stage	140
Third Stage	784
Fourth Stage	0
TOTAL	1,129

Minimum First Stage Media Area
Maximum loading to prevent first stage overload = 3.1 kg/day/100 m2
= 5.96 kg of post primary BOD/day divided by max. loading times 100 m2
= 192 m2

BOD remaining for 2nd Stage = 2.21 kg/day
Minimum Media 2nd Stage = 71.38 m2

5. PRIMARY SETTLING TANK (P.S.T.) (per RBC unit):

a) Primary Settling Tank Influent Flows (per RBC unit)

Average Daily Flow =	**13,500**	**litres/day**			
Recycle at	507%	%	=	68472	litres/day
Total Average Flow =	81,972	litres/day			
Peak Daily Flow =	40,500	litres/day			
Peak Flow including Recycle =	108,972	litres/day			

The actual volume per bucket may change in the field depending on how much wastewater each bucket picks up

b) Loading Rates

Average Overflow Rate =	16,000	Litres/day/m2	max from	(Ref.5)
Peak Overflow Rate =	24,000	Litres/day/m2 (rounded)		(Ref.7)
Detention Time =	4	hours	use 4 hrs	(Ref.6)

c) Surface Area Required
i) by Average Overflow Rate = Total Average Flow divided by Average Overflow Rate
= 5.12 m2
ii) by Peak Flow Rate = Peak Flow divided by Peak Overflow Rate
= 4.54 m2
Therefore, use 5.12 m2 to compare with actual area of P.S.T.

P. S. T. Surface Area for Model B30 3.35 m x 4.19 m = 14.0 m2

Safety factor of: 2.74 times supplied.
Therefore **Surface Area Acceptable**

d) **Volume Required** = Q x Detention Time / 24 hrs / day
= 2.3 m3
P.S.T. Tank Capacity for this B30 is 27 m3
(after allowance for sludge) 12.0 **safety factor**
Therefore **Volume Acceptable**

6. FINAL SETTLING TANK (F.S.T.):

a) Loading Rates

Average Overflow Rate =	24000	Litres/day/m2	[Ref. 10]
Peak Overflow Rate =	44822	Litres/day/m2	[Ref. 10]
Detention Time =	3	hours	

b) Surface Area Required
i) by Average Overflow Rate = Average Flow divided by Average Overflow Rate
= 0.56 m2
ii) by Peak Flow Rate = Peak Flow divided by Peak Overflow Rate
= 0.30 m2
Therefore, use 0.56 m2 to compare with actual area of F.S.T.

F. S. T. Surface Area for Model B30 3.35 m x 1.0 m = **3** m2

Safety factor of 5.75 times supplied.
Therefore **Surface Area Acceptable**

c) **Volume Required** = Q x Detention Time / 1000 / 24 hrs / day
= 1.7 m3 =
F.S.T. Tank Capacity for this B30 is 4.0 m3
(after allowance for sludge) **2.4** safety factor
Therefore **Volume Acceptable**

7. SLUDGE CALCULATIONS:

Assumptions Used for Calculation of Sludge Accumulation

1. Inlet TSS:	491	mg/l
2. Outlet TSS:	20	mg/l
3. Inlet BOD5:	491	mg/l
4. Outlet BOD5:	20	mg/l
5. Average Daily Flow:	34	m3/day
6. Proportion of inlet BOD5 soluble:	70%	
7. Total incoming solids	16.57	kg/d
8. Inert portion of solids (30%)	4.97	kg/d
9. Assuming Aerobic digester removal efficiency, 50%.	5.80	kg/d
10. BOD removed in secondary treatment	14.24	kg/d
11. Sludge produce due to BOD removal	4.27	kg/d
12. Aerobic digester removal efficiency 50%.	2.14	kg/d
13. Total sludge produced per day	12.90	kg/d

Information Pertaining to the ROTORDISK Used in Calculation of Sludge Accumulation

1. All sludge accumulates in the PST (sludge settled in the FST is pumped back to the PST).		
2. PST Surface Area:	14.0	m2
3. PST Volume:	27.0	m3
4. PST Sludge Storage Capacity:	13.5	m3
TOTAL Mass of sludge produced that accumulates in the PST:	**12.9**	**kg/day**
Volume of Wet Sludge produced Daily:	0.2581	m3/day
Depth of Wet Sludge produced Daily:	0.0184	m/day
Frequency of Pump-Outs:	52	days

SUMMARY OF REFERENCES

Ref.1
excerpt from "Design of Municipal Wastewater Treatment Plants Volume 1", Chapters 1-12, WEF Manual of Practice No. 8, ASCE Manual and Report on Engineering Practice No. 76, p. 475, which states, " Sedimentation with coagulation may remove 60 to 90% of the TSS, 40 to 70% of BOD5, 30 to 60% of COD, 70 to 90% of the Phosphorus, and 80 to 90% of the bacteria loadings. In comparison, sedimentation without coagulation, may remove only 40 to 70% of the TSS, 25 to 40% of the BOD5, 5 to 10% of the Phosphorus loadings, and 50 to 60% of the bacteria loadings."

Ref.2
excerpt from "Manual of Policy, Procedures and Guidelines for Private Sewage Disposal Systems, Ontario Regulation 374/81 under part VII of the Environmental Protection Act", May 1982, ISBN 0-7743-7303-2, section 12.7.1, which states, "if it is a system operating on the rotating biological disc or similar principle involving contact of the biomass with air, provide a disc area so that the daily loading of sewage will not be in excess of 1.25 kg of BOD5 per 100 sq.m. of disc area, or a hydraulic loading in excess of 45 l/sq.m. of disc area".

Ref.3
excerpt from "Pilot Plant Studies of Rotating Biological Contactors treating municipal Wastewater", by: K.L. Murphy and R.W. Wilson, International Environmental Consultants Ltd., Toronto Ontario, prepared for Central Mortgage and Housing Corporation, Ottawa, Ontario.

Ref.4
excerpt from "Design of Municipal Wastewater Treatment Plants Volume 1", Chapters 1-12, WEF Manual of Practice No. 8, ASCE Manual and Report on Engineering Practice No. 76, p. 776, which states, "...whenever the first stage loading limit exceeded 3.1 kg BOD5/100 sq.m.day(6.4 lbs. BOD5/d/1000 sq.ft.), the system was associated with the presence of sulfur-oxidizing organisms".

Ref.5
excerpt from "EPA Process Design Manual, On-site Wastewater Treatment and Disposal Systems", Oct 1980, EPA 625/1-80-012, section 6.4.2.4.e., p.149, which states, "...average flow design values normally range from 200 to 400 gpd/sq.ft.(8 to 16 cu.m./d/sq.m.)".

Ref.6
excerpt from " O&M of Trickling Filters, RBC's, and Related Processes, Manual of Practice OM-10, 1988, Water Pollution Control Federation, p. 105, which states, " Weir overflow rates typically range from 125 to 250 cu.m./m.d (10,000 to 20,000 USgpd/ft.)...The wastewater detention time in a settling basin is normally between 1 to 3 hours, but has been as high as 10 hours with excellent results". [use 4 hours]

Ref.7
excerpt from "EPA Process Design Manual, Wastewater Treatment Facilities for Sewered Small Communities", Oct 1977, EPA-625/1-77-009, section 6.4.2., which states, " the peak overflow rate may be 2,500 to 3,000 USgpd/sq.ft. (100 to 120 cu.m./sq.m.d) for primary clarifiers followed by biological treatment processess".
" Clarifiers handling chemical flocs, such as aluminum or iron coagulants, should be designed for peak overflow rates no longer than 600 and 800 USgpd/sq.ft.(24 and 32 cu.m./sq.m.d)".

Ref.8
excerpt from "Design of Municipal Wastewater Treatment Plants Volume 1", Chapters 1-12, WEF Manual of Practice No. 8, ASCE Manual and Report on Engineering Practice No. 76, p. 484, which states, " TSS removal efficiencies in primary sedimentation tanks usually range between 50 and 65%. Many designers assume a removal efficiency of 60% for

estimation purposes".

Ref.9
excerpt from "Wastewater Engineering Treatment, Disposal, and Reuse", 3rd ed., Metcalf and Eddy Inc., revised by George Tchobanoglous and Franklin L. Burton, p.808, table 12-14, which shows,"...typical concentrations of thickened sludge for a rotating biological contactor is 2 to 5%".

Ref.10
excerpt from "Design Information on Rotating Biological Contactors", by Richard C. Brenner, EPA-600/2-84-106, section 2.10, which states, " Murphy and Wilson recommend surface overflow rates less than 600 gpd/sq.ft. to maximize solids removal... DeCarlo recommends that peak hydraulic rates be limited to 1000 to 1200 gpd/sq.ft.".

Ref.11
excerpt from "EPA Process Design Manual, Wastewater Treatment Facilities for Sewered Small Communities", Oct 1977, EPA-625/1-77-009, section 9.2.4.6, p.9-43, which states, " Sludge produced by the RBC unit is similar to humus sludge from a trickling filter. The amount of sludge produced will depend on waste characteristics and loading rates. An RBC unit designed for 80% BOD5 removal would produce about 0.7 lb. of sludge per lb. of BOD5 removed; 95% percent removal would produce about 0.3 lb. of sludge."

Ref.12
excerpt from "Design Information on Rotating Biological Contactors", by Richard C. Brenner, EPA-600/2-84-106, section 5.5.2.2, which states, "Figure 5-19 represents data for one day for a given stage...The zero-order removal rate above bulk liquid ammonia nitrogen concentrations of 5 mg/l in Figure 5-19 is projected at 0.3 lb. NH3-N/day/1000 sq.ft., same as the Autotrol design". (Figure 5-19 attached)

Ref.13
excerpt from Ministry of Environment and Energy - Ahlberg & Kwong Report - "Winter Operation"
No process or operating problems were experienced throughout the winter. The minimum temperature encountered in the unit, with a raw sewage feed rate of 320 gpd, was 4 oC. Process performance remained good during the winter even under conditions of intermittent operation.

Ref.14
excerpt from the Forgie study
For the RBC unit and wastewater tested, the effect of temperature on removal efficiency over the 15 oC to 5 oC range was relatively low (theta = 1.001 to 1.02)

Ref.15
excerpt from Trinh - Environment Canada "Exploration Camp Wastewater Characterization and Treatment Plant Assessment"
It [the RBC] also operated at a low liquid temperature of 4 oC during one week without the effluent quality deteriorating.

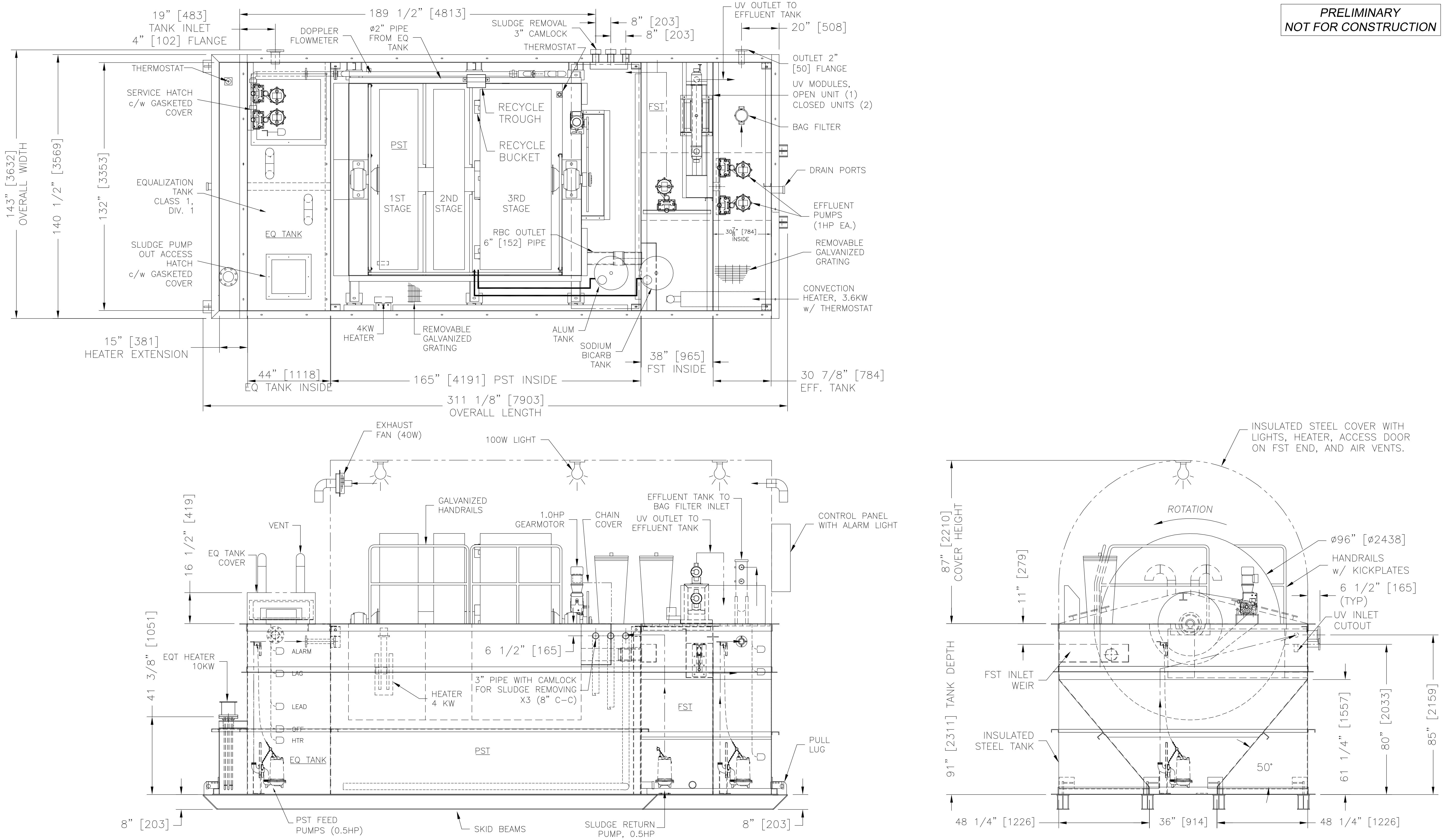
Ref.15
WEF MOPNo. 8, p913
Oxygen recovery is 2.86 mg O2/mg NO3-N reduced."

Ref.16
excerpt from "Design Information on Rotating Biological Contactors", by Richard C. Brenner, EPA-600/2-84-106, section 2.9.3, which states, " The observed denitrification rate at 550F was approximately 0.85 lb NO3-N /day/1000sq. ft.."

Ref.17
excerpt from "Design Information on Rotating Biological Contactors", by Richard C. Brenner, EPA-600/2-84-106, section 2.9.2, which states, " The commonly used design value for the required methanol dosage is 3 mg/mg NO3-N reduced."

Ref.18
WEF MOPNo. 8, p913 states that "Oxygen recovery is 2.86 mg O2/mg NO3-N reduced." and that Heterotrophic biomass production is approximately 0.4 mg VSS/mg COD removed"

PRELIMINARY NOT FOR CONSTRUCTION



NOTES:
1. UNIT TO BE PLACED LEVEL ON CONCRETE OR WELL COMPACTED GRAVEL. (PAD DESIGN BY OTHERS)
2. ALL DIMENSIONS IN BRACKETS ARE IN MILLIMETERS.
3. TANKS, RBC TROUGH, & SHAFT SANDBLASTED AND PAINTED WITH DEVTAR 5A FINISH.
4. INLET/OUTLET ARE STD. 150# ANSI B16.5 RAISED FACE FLANGES.

NOTES:
5. WEIGHT SHOWN IS DRY WEIGHT ONLY.
6. TANKS ARE EQUIPPED WITH DRAIN PORTS FOR SHIPPING PURPOSES ONLY.
7. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION WITHOUT PRIOR APPROVAL OF SEPROTECH SYSTEMS INC.

REV	DESCRIPTION	YY/MM/DD	BY
2	AS BUILT CONFIGURATION	09/03/06	DC
1	RETROFIT FROM B30 TO N30, RECYCLE SYSTEM CHANGED	07/11/21	AH

ALL TOLERANCES ARE +/- 1/32" UNLESS OTHERWISE SPECIFIED. DIMENSIONS ARE IN INCHES.

Seprotech Water. Pure and Simple

SEPROTECH SYSTEMS INC.
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DESCRIPTION
GENERAL ARRANGEMENT, N30 – SPECIAL E15/N30/F30 w/o FILTERS – SHANCO NUNAVUT

DRAWN	CHECKED	DATE	SIZE	SCALE	WEIGHT	SHEET	DWG NO.	REV
SA	AH	29-MAY-2007	B	1:24	34200 LB.	1 OF 1	60069-L00	2

APPENDIX D

MARY RIVER RBC DESIGN PROCESS EVALUATION

Technical Memorandum

To:	Jim Millard Environmental Superintendent Baffinland Iron Mines Corporation	Project:	W01391.001
From:	Dave Ellis, P.Eng., AMEC Geomatrix Limited Jered Munro, AMEC Geomatrix Limited		
Date:	March 27, 2009		

Subject: Mary River RBC Process Design Evaluation

AMEC Geomatrix Limited (AMEC) has completed a third party review of the Mary River sewage treatment plant for Baffinland Iron Mines Corporation (BIM) and has summarized the findings of the review in this technical memorandum.

The memo discusses the original design basis provided from Seprotech Systems Inc. (Seprotech), actual 2008 operating conditions, and provides a recommendation on the treatment capacity of the installed system at Mary River. The treatment capacity recommendation is based on the estimated original design capacity and the actual loading data recorded during the 2008 operating season. AMEC has also prepared a process flow diagrams (attached) which provides information on proposed enhancements to the existing system for provisional future improvements in site treatment capacity.

Recommendations

Using the hydraulic and ammonia loading rates generated during 2008 at Mary River, AMEC recommends that BIM limit the maximum on-site staff at Mary River to 123 people for the existing treatment system. This recommendation is based on the assumption that the daily per capita hydraulic and organic loadings remain the same as the 2008 operating season and is conservative.

If in the future, BIM requires more than 123 employees on site, it is recommended that the additional media provided by Seprotech (Shaft #2) be installed in series with the existing Shaft #1 (current RBC unit). This will increase the nitrification capacity of the system to allow for up to 236 people. The increased capacity, however, does not allow for increased hydraulic loadings, i.e, the total water usage cannot be increased above current maximum average daily design flowrate.

AMEC Geomatrix

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Wastewater Treatment System Review Assumptions

This wastewater treatment system review is based on the following general assumptions.

- We have assumed that 100% of the organic nitrogen measured in the total Kjeldahl nitrogen (TKN) test hydrolyzes to form ammonia-nitrogen (NH_3-N).
- A 10% removal across the primary clarifier section is assumed.
- The minimum wastewater system operating temperature of 15 deg C is maintained in the treatment sections throughout the operating season
- The specific BOD removal rates used by Seprotech in the design calculations are valid for their systems based on their experience with arctic installations..

Biological System Design Basis

The design basis for the Mary River wastewater treatment system was developed by Seprotech in 2007. The subsequent system design was required to produce treated effluent that would meet the regulated requirements established by the Nunavut Water Board (NWB). A summary of regulatory requirements specified in Baffinland's NWB Licence No. 2BB-MRY0710 are listed in Table 1.

Table 1: NWB Sewage Discharge Requirements

Parameter	Units	Maximum Average Concentration
BOD_5	mg/L	30
Total Suspended Solids (TSS)	mg/L	35
Faecal Coliform	CFU/100mL	1000
pH	-	6.5-9.0
Oil and Grease	-	No visible sheen
Acute Toxicity	-	Non acutely toxic*

* Acute lethality to Rainbow Trout, Oncorhynchus mykiss (as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/13); and Acute lethality to Daphnia magna (as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/14).

Although the limits do not specifically identify the effluent ammonia concentration, the requirement for acute toxicity testing provides an inherent effluent ammonia limit. Work completed by Knight Piesold and North/South Consultants Inc. in 2007 (Wastewater Management Plan) and confirmed in recent study (Section 10 of the revised Wastewater Management Plan herein), showed that effluent toxicity is generally expected to occur at ammonia-nitrogen concentrations above 15 mg/L.

A rotating biological contactor (RBC) was selected for treatment of the Mary River domestic wastewater and was commissioned in January 2008. During 2008, effluent quality did not consistently meet the criteria identified in Table 1, and hence did not permit discharge of treated effluent to the receiving environment.

AMEC Geomatrix completed a review of the original design basis used by Seprotech for the BIM system. The estimated hydraulic and organic loading rates are identified in Table 2.

Table 2: Mary River RBC Design Basis

Parameter	Units	MR Design Basis
BOD_5	mg/L	519[1]
TSS	mg/L	519[1]
TKN	mg/L	65[1]
People in camp	-	150[2]
Water Consumption	L/person/day	225[3]
Daily Average Flow	m^3	33.75

1. Estimated by Seprotech using Table 10-4: Characteristics of Basic Wastewater Categories “Cold Regions Utilities Monograph” Third Edition,1996 assuming “moderately diluted wastewater”
2. Estimation provided by BIM in July 2008.
3. Estimated by Seprotech using Table 10-3: Typical Quantities of Sewage Flow , Item 2 ”Construction camps”, “Cold Regions Utilities Monograph”, Third Edition 1996

Using the data from Table 2, the resulting mass loadings were calculated and are summarized in Table 3.

Table 3: Mary River RBC Design Basis Mass Loading

Parameter	Mass Loading Rates (mg/L)	Mass Loading Rates (g/day)
BOD_5	519	17,517
TSS	519	17,517
TKN	65	2,194

This loading data was used by Seprotech to design and develop the system as installed at the Mary River Camp. From a review of *Wastewater Management Plan for Mary River and Milne Inlet Camp Sites* (September 2007), Seprotech used typical published RBC design parameters to determine the size of the system. For general background, it is important to understand that RBC design is based on hydraulic and organic loading rates across a surface area and that increases or decreases in surface area increase the fundamental treatment capacity of the system. The variability in surface area is provided by the configuration of the media (spacing and diameter) and promotes biofilm growth. The biofilm is responsible for removal of organic and nutrient constituents. Once the sludge reaches a certain thickness it sloughs off of the media for removal.

AMEC has reviewed the design parameters used by Seprotech against accepted published values and have summarized this review in Table 4.

Table 4: Comparison of Typical Design Parameters

		Design Information on Rotating Biological Contactors, EPA Design Manual No. 600[1]		Metcalf and Eddy, Wastewater Treatment and Design, 4th Edition[2]		Mary River Design by Seprotech
		Minimum	Maximum	Minimum	Maximum	Design
Hydraulic Loading	m^3/m^2*d	0.01	0.04	0.03	0.08	0.014
Organic Loading	g $sBOD_5/m^2*d$ g $tBOD_5/m^2*d$		 17	2.5 5	8 16	9.4 19.3
Maximum 1st Stage Organic Loading	g $sBOD_5/m^2*d$ g $tBOD_5/m^2*d$	5 10	17 31	12 24	15 30	16 32
NH_3 Loading	g N/m^2*d	0.75	1.5	0.75	1.5	1.45
Hydraulic Retention	Hours	1.5	4	1.5	4	4
Effluent tBOD5 Effluent NH4-N	mg/L mg/L	7 <2	15 <2	7 <2	15 <2	10 <2

Review of published design data suggests that the hydraulic capacity of the Mary River RBC is conservative (0.014 m^3/m^2/day used for design compared with published values of 0.01 to 0.08 m^3/m^2/day), however a recycle stream of 200% or 68 m^3/day is employed to re-oxygenate the influent water which results in a total hydraulic loading of approximately 0.042 m^3/m^2. This is still in the mid-range of published values. Since the primary treatment tank has been designed to accommodate the internal recycle flow of 68 m^3/day it is expected that the system will perform as intended at the maximum average daily design flowrate of 33.75 m^3/day.

The organic loading capacity of the system was designed using 19.3 g $tBOD_5/m^2$/day The maximum 1st stage loading rate was calculated using a rate of 31 g $tBOD_5/m^2$/day which agrees with the maximum value published in Metcalf and Eddy of 30 g/m^2/day. The design calculations identify that 509 m^2 of media are required to prevent first stage overloading and it is suspected that the 495m^2 installed in the first stage may have been due to physical equipment constraints. If treatment issues arise due to overloading of the first stage, installation of a small bypass to the second stage will reduce the loading to be within acceptable ranges. An overloaded first stage, where loading rates are consistently at or above design rates, may experience reduced treatment efficiency during peak loading which would likely result in increased effluent concentrations.

The total nitrification area available is 1527 m^2. The design ammonia loading rate is below the maximum published removal rates of 1.5 $g/m^2/day$ and the calculated surface area required to produce an effluent ammonia concentration of 2 mg/L is 1509 m^2.

Efficient nitrification requires removal of BOD_5 to 30mg/l in order for nitrifying bacteria to thrive. At maximum loading rates, any reduction in BOD_5 removal efficiency will limit the surface area available for nitrification and could result in increased ammonia concentrations in the effluent.

A summary of the installed design is summarized in Table 5

Table 5: Mary River Design

	Units	Design
Daily per capita consumption	L/person/day	225
Mary River Staff on-site	people	150
Flowrate	m^3/day	33.75
BOD_5 Concentration	mg/L	519
BOD_5 after primary clarifier (10% removal)	mg/L	467
Total Organic Removal Area Required	m^2	817
Total Organic Removal Area Actual	m^2	817
1st Stage Area Required	m^2	508.5
1st Stage Area Actual	m^2	495
Nitrogen (TKN) Concentration	mg/L	65
Total Nitrification Area Req'd	m^2	1526
Total Nitrification Area Actual	m^2	1527
Total Surface Required	m^2	2343
Total Surface Area Actual	m^2	2344

In summary, although the system has been designed to operate within published loading criteria, little flexibility or safety factor has been designed into the system. It is possible that small changes in wastewater characteristics will have a significant impact on treatment efficiency, particularly the ability of the system to nitrify ammonia.

2008 Operating Treatment Capacity

Two independent sets of data were gathered during the 2008 operating season. One set of data was gathered by BIM staff while another was collected by Seprotech during a review of the treatment system during late spring 2008

Analytical wastewater treatment data, staffing records and monthly sewage effluent quantities gathered from BIM record data have been summarized to develop an “MR 2008 Average” data set consisting of annual averages, although data from January 2008 was not included in the average due to unrepresentative start-up conditions. The August 2008 data was also not included in the average, because of sludge removal activities that occurred near the time of the sampling event. The data generally shows that the nitrogen influent concentrations in wastewater were double what was expected but other parameters were generally consistent with the original design basis.

Lab analysis data from the Seprotech 2008 review provided representative average wastewater concentrations measured during the course of their late spring 2008 sampling program. The average data presented in the Seprotech report has been identified as the "2008 Seprotech data set for the purposes of this technical memorandum. The data collected by Seprotech between May 5 and June 8 2008 was during a period with an increased average number of staff on-site (182 compared with 150 as used for the design basis).

AMEC's review indicates that the 2008 Seprotech data is an accurate representation of the loadings on-site. This is due in large part to the sampling intensity during Seprotech's spring 2008 monitoring program and the larger-than-usual number of samples that were collected during that time.

Table 5: Actual 2008 Measured Wastewater Loading Data

Parameter	Units	Design Basis (Table 2)	2008 Seprotech Data,	MR 2008 Average[1] Data, Baffinland
BOD_5	mg/L	519[1]	664	520
TSS	mg/L	519[1]	500	225
TKN	mg/L	65[1]	125	135
People in camp	-	150	182	160
Water Consumption	L/person/day	225[3]	143	138
Daily Average Flow	m^3/day	33.75	26	26

[1]Average for 2008 operating period excluding Jan 2008 (start-up) and August 2009 (sludge removal event) data

A review of the average values from the two data sets against the design basis data identifies significantly lower flowrates than estimated in the design basis (26 m^3/day compared with 33.75 m^3/day in design basis). It is suspected that the daily habits of camp crews have impacted the overall flowrates to the wastewater treatment system in that some flows of dilute wastewater have not been entering the system. The higher concentration material has continued to enter the system which has resulted in overall wastewater concentrations that are higher (particularly nitrogen) than in the original design basis.

The resulting mass loading rates as outlined in Table 6 were similar to design mass loading rates although TKN loading was higher than original estimates.

Table 6: 2008 Actual Mass Loading

Parameter	Units	Mary River Average Loading Design Basis	Actual 2008 Operating Data Seprotech
People	-	150	182
Water Consumption	L/person	225	143
Daily Flow	m^3/day	33.8	26.0
BOD	mg/L	519	664
	g/day/person	116.8	95.0
	g/day	17,516	17,281
TSS	mg/L	519	500
	g/day/person	116.8	71.5
	g/day	17,516	13,013
TKN	mg/L	65.0	125.0
	g/day/person	14.6	17.9
	g/day	2194	3253

The analytical data from the sampling program conducted by Seprotech in 2008 has been used to determine the maximum operating capacity of the installed treatment system based on the number of employee's on-site.

Maximum Operating Capacity of Current System

It has been identified that TKN is the limiting design parameter for the current RBC system currently operating at Mary River. The treatment system was designed with a maximum ammonia loading of 2194 g/day. To produce effluent meeting the water licence criteria in the current RBC configuration (1 shaft, 4 stages) the recommended average number of staff on-site is 123 people based on per capita loading rates of 16.9 g of nitrogen/person/day that would provide sufficient surface area for nitrification. The operational parameters are summarized below.

Table 7: Revised Capacity and Operating Scenario

	Units	TKN Limited
Daily per capita consumption	L/person/day	143
Mary River Staff on-site	people	123
Flowrate	m^3/day	17.6
BOD_5 Concentration	mg/L	664
BOD_5 after primary (10% removal)	mg/L	598
BOD_5 loading	g/day	10525
Total Organic Removal Area Required	m^2	545[1]
Total Organic Removal Area Actual	m^2	817
1st Stage Area Required[2]	m^2	386.2
1st Stage Area Actual	m^2	495
Nitrogen (TKN)	mg/L	125
Nitrogen loading	g/day	2200
Total Nitrification Area Required[3]	m^2	1517
Total Nitrification Area Actual	m^2	1527
Total Surface Required	m^2	2137
Total Surface Area Actual	m^2	2344

[1] based on 19,3 gBOD/m^2/day
[2] based on 30 gBOD/m^2/day
[3] based on 1.45 gN/m^2/day

Provisional Treatment Capacity

BIM has an additional RBC component system available at the Mary River site that was purchased from Seprotech in 2008. The component system, which has not yet been installed, includes a complete, high density packaged unit designed specifically for nitrification with a total treatment surface area of 3038 m^2.

Specifically, the components consist of a four stage, single shaft RBC system with an effluent break tank. The unit is not equipped with any other tankage or treatment equipment and as a result will not increase the hydraulic capacity of the existing system. The unit, however, is well suited for increasing the nitrification capacity of the current RBC system.

A review of the additional component system indicates that the plates, or media, spacing in the first stage is much closer than in the existing system. The spacing of the media is important to the treatment capacity of the system since bridging of the biofilm can result in reduced treatment efficiency. For this reason in particular, the new unit is not suitable for installation in parallel with the existing unit and can only be installed in series.

The suggested system layout would consist of connecting the existing 4-stage Shaft #1 in series with the 4-stage shaft Shaft #2 for a total of two shafts and eight stages. A summary of the physical layout is listed below and conceptual process flow diagrams are attached..

Table 8: Provisional treatment configuration

Shaft	Stage	Actual Area (m^2)
1	Stage One	495
1	Stage Two	205
1	Stage Three	822
1	Stage Four	822
2	Stage Five	736
2	Stage Six	736
2	Stage Seven	783
2	Stage Eight	783
	Total Surface Area	5382 m^2

As part of the retrofit, AMEC suggests removing the baffle between Stages One and Two on Shaft #1 in order to provide sufficient first stage surface area to prevent organic overload.

In the proposed configuration, the first four stages of Shaft #1 would be used for BOD removal and the remaining 4 stages on Shaft #2 would be used for nitrification. Although the additional RBC will not increase the existing hydraulic capacity it will allow the existing system to operate at maximum capacity instead of the current “TKN limited” hydraulic capacity. The maximum hydraulic loading would be limited by the current system hydraulic loading of 33.75 m^3/day. The additional shaft would increase the existing treatment capacity and result in a more robust system capable of treating a maximum of 236 people at 143 L/person/day. The tanks, pumps, alum system and filter systems will not need to be upgraded as the hydraulic capacity will not change.

The treatment capacity calculations are summarized in Table 9. For the purposes of determining a maximum number of staff that the Mary River facility can support the sizing calculations were performed based on the “Actual 2008” data presented in Table 6 and available surface area A surplus of 1119 m3 of treatment capacity is expected to be available under these conditions.

Seprotech provided a design basis for the provisional system with peak loadings that were observed during their sampling program. The loading rates were calculated using a single data set captured during the 2008 sampling program that were approximately double the average rates observed during the course of the sampling program and have been included in the final column of the table as “Maximum Loading”. This scenario was provided to be representative of potential changes in the wastewater characteristics due to future changes in work activities on-site. As demonstrated the provisional system has sufficient capacity to accommodate process variations.

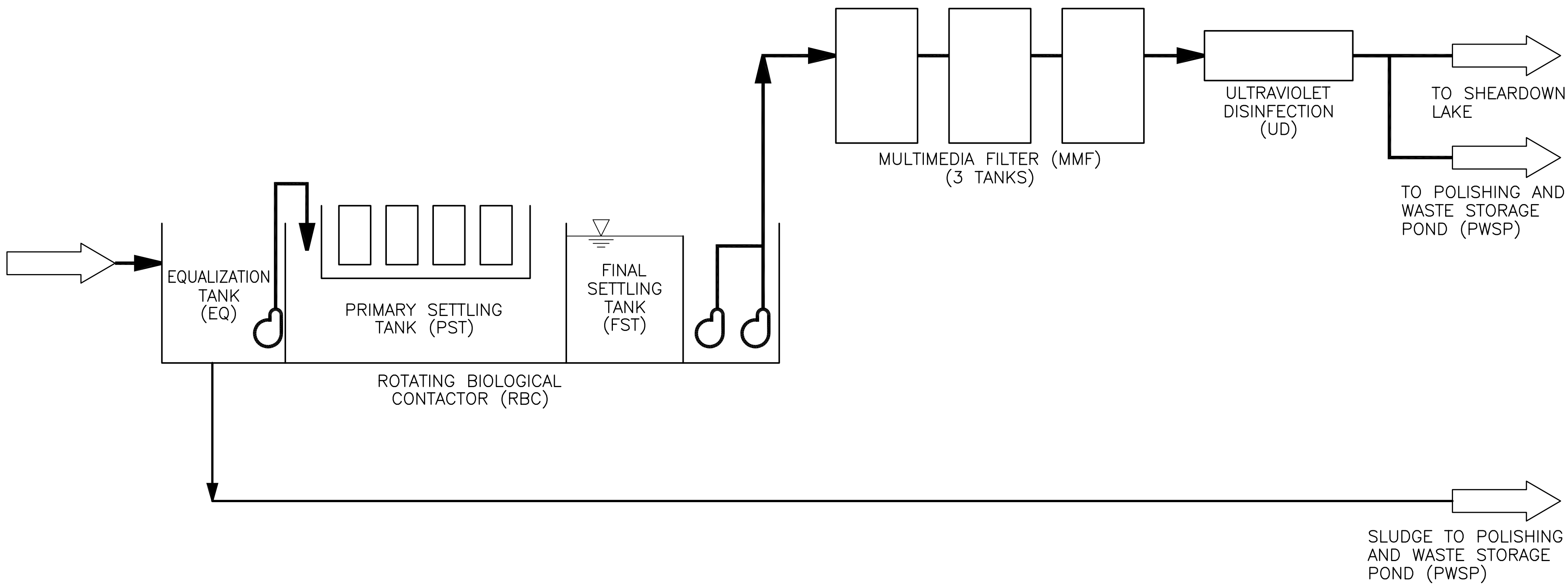
Table 9: Provisional Treatment Capacity

	Units	Actual Observed Loading (2008)	Maximum Observed Loading (2008)
Daily per capita consumption	L/person/day	143	143
Mary River Staff on-site	people	236	234
Flowrate	m^3/day	33.75	33.5
BOD_5 concentration	mg/L	664	1204
BOD_5 after primary (10% removal)	mg/L	598	1083
BOD_5 loading	g/day	20183	36281
Total Organic Removal Area Required[1]	m^2	1046	2035
Total Organic Removal Area Actual	m^2	2344	2344
1st Stage Area Required[2]	m^2	672	1209
1st Stage Area Actual	m^2	700	1522
Nitrogen (TKN)	mg/L	125	152
Nitrogen loading	g/day	4219	5092
Total Nitrification Area Req'd[3]	m^2	2910	3500
Total Nitrification Area Actual	m^2	3038	3038
Total Surface Required	m^2	4183	5382
Total Surface Area	m^2	5382	5382

[1] based on 19.3 gBOD/m^2/day
[2] based on 30 gBOD/m^2/day
[3] based on 1.45 gN/m^2/day

It should be noted that to avoid first stage overload using the “maximum loading” condition, provisions would be required to remove sufficient baffles in order to avoid first stage organic overload. The physical arrangement of the plate spacing would also need to be reviewed. It is possible that plates would need to be removed in stage three and four on the first shaft to accommodate biofilm growth associated with organic removal in these stages.

If the per capita water usage on-site increases, a resulting reduction in staff will be required to avoid exceeding the daily effluent volume of 33.75 m^3/day. If the provisional system were to be installed an increase in sludge removal frequency would also be required.



March 17, 2009–4:48pm

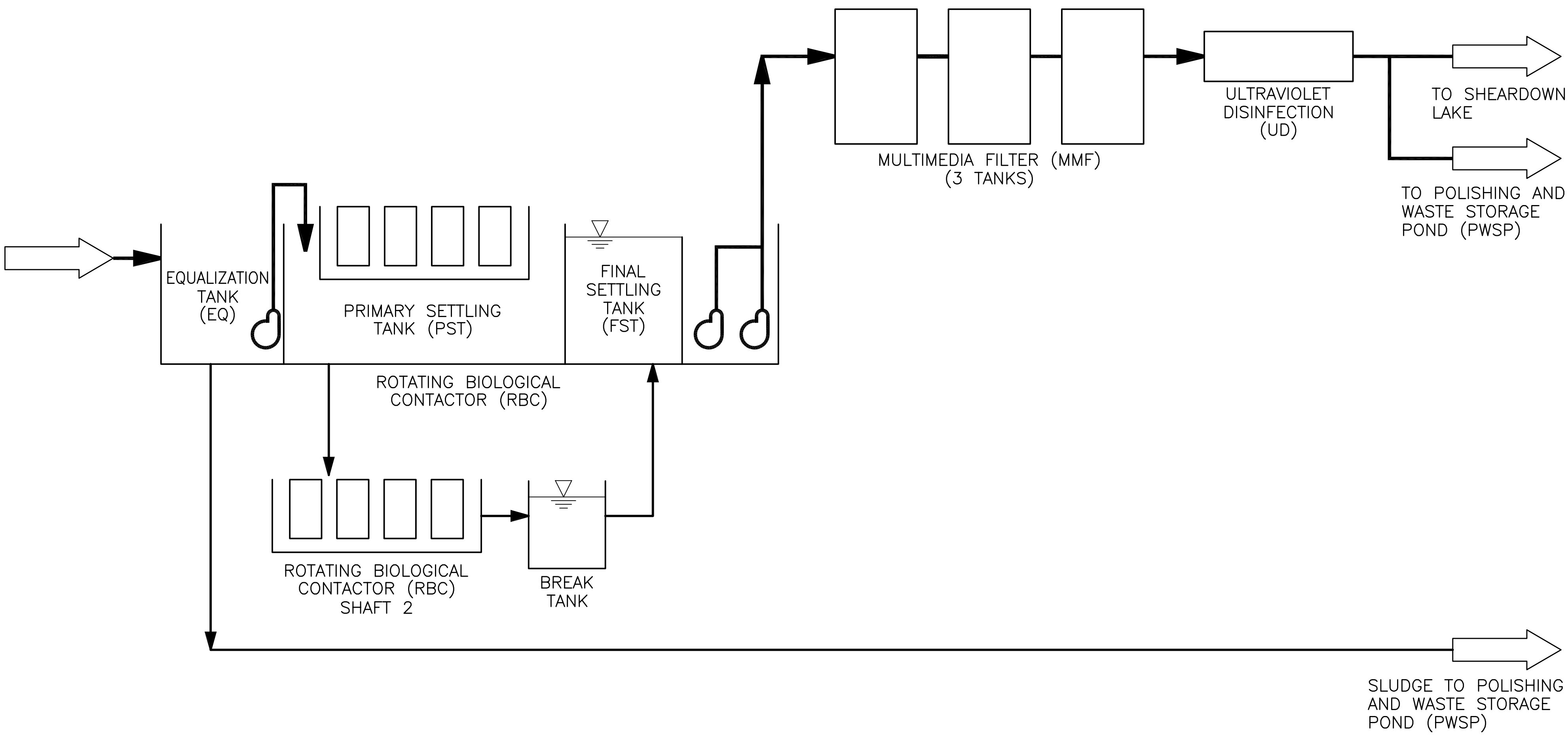
AMEC Geomatrix

AMEC Geomatrix Limited
420 Weber Street, North, Unit G
Waterloo, Ontario N2L 4E7
(519) 886-7500

PROCESS FLOW DIAGRAM
MARY RIVER WWTP

BAFFINLAND IRON MINES
BAFFIN ISLAND, NUNAVUT TERRITORY

DATE MARCH 2009	PROJ. NO. W01391.001
FILE NO. W01391–PFD	DWG. NO. PFD-01



March 17, 2009–4:48pm

AMEC Geomatrix AMEC Geomatrix Limited 420 Weber Street, North, Unit G Waterloo, Ontario N2L 4E7 (519) 886-7500	PROCESS FLOW DIAGRAM MARY RIVER WWTP ADDITIONAL CAPACITY RETROFIT BAFFINLAND IRON MINES BAFFIN ISLAND, NUNAVUT TERRITORY	DATE MARCH 2009	PROJ. NO. W01391.001
		FILE NO. W01391–PFD	DWG. NO. PFD-01a

DESIGN BRIEF

DATE: July 8, 2008
PROJECT NAME: Mary River

1. HYDRAULIC DESIGN: (AVERAGE DAILY FLOW)

1 units each at 29 m3/day = 29 m3/day = Q
design based on a 24 hour day.

2. INFLUENT PARAMETERS:

BOD (biochemical oxygen demand) =	1204	mg/l
SS (suspended solids) =	N/A	mg/l
TKN =	152	mg/l
Phosphorus =	N/A	mg/l

3. TREATED EFFLUENT QUALITY:

BOD (biochemical oxygen demand) =	20	mg/l
SS (suspended solids) =	N/A	mg/l
NH3-N =	2	mg/l
Phosphorus =	N/A	mg/l

4. R.B.C. SURFACE AREA REQUIRED (AO):

a) Removal in Primary Settling Tank (P.S.T.)

Primary BOD Removal = 10% (Ref.1)
Primary Tank. Eff. BOD = 1204 mg/l x 90%
to RBC = 1083,6 mg/l

b) RBC BOD Loading.

Applied Load = 1083,6 mg/l 29 m3/day
30,88 kg BOD/day

c) Area required to reduce BOD to 20 mg/l (AO)

Applied Load = 30,88 kg BOD/day 30,88 kg BOD/ day
For 20 mg/l* use 1,29 kg/day/100 m2
2394 m2

(*in a nitrification application, reduce BOD to 30 mg/l, the nitrification

d) NH3-N to be removed

(Assume Organic Nitrogen is converted to Ammonia NH3)

Removed to 5 mg/l = 152 less 5 times **28 500** **litres/day**
= 4,19 kg/day = **9,22** **lb/day**
Area Required to reduce NH3-N to 5 mg/l
= 4,19 kg/day over 0,147 kg NH3-N/day/100 m2 **(Ref. 12)**
= 2850 m2 =
Residual NH3-N to be removed
below 5 mg/l = 5 mg/l less 2 mg/l times **28 500** **litres/day**
= 0,086 kg/day
Area Required to reduce NH3-N to 2
= 0,086 kg/day over 0,089 kg NH3-N/day/100 m2 **(Ref. 12)**
= 96 m2 =
Total Nitrification Area Required = 2946 m2 =

(Ref. 12)
TABLE # 2 - Brenner

Req'd NH3-N concentration (mg/l)	**Removal Rate (kg/day/ 100m2)**
1	0,037
1,5	0,061
2	0,089
2,5	0,110
3	0,123
3,5	0,135
4	0,147
4,5	0,147
5	0,147

No temperature correction required Refs. 13,14,&15

e) Total Surface Media Required

Total Surface Media Required = 5340 m2

f) Staging

Hydraulic Loading	5,30	L/d/m2
B.O.D.post primary	30,88	kg BOD/day
Media req'd(B.O.D)	2 394	m2
Media req'd(nitrfct'n)	2 946	m2
Total req'd	5 340	m2
Min req'd to prevent 1st st. overload	996	m2
Min req'd to prevent 2nd st. overload	582	m2

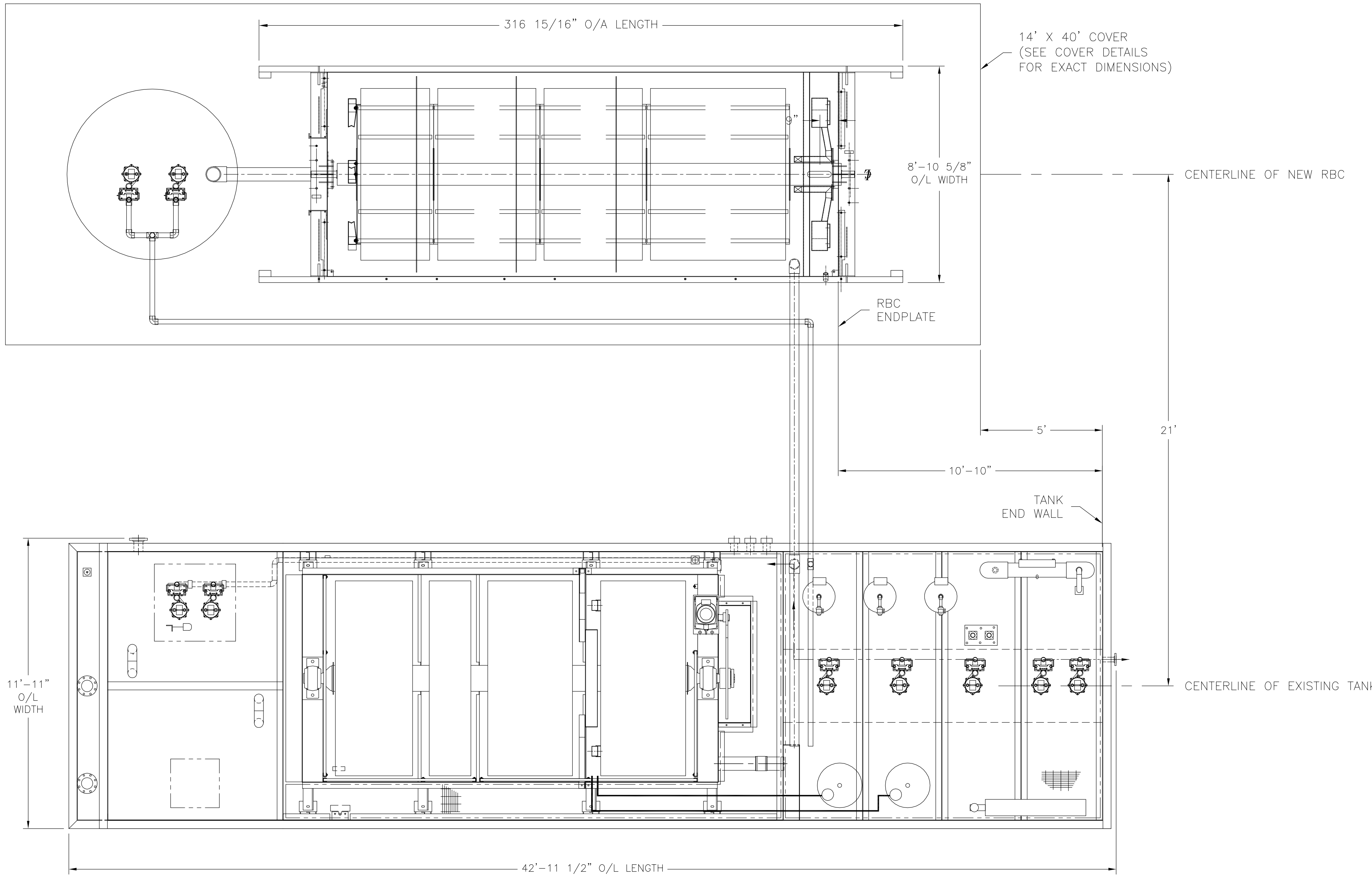
	ACTUAL AREA (m2)
First Bank	495
Second Bank	205
Third Bank	822
Fourth Bank	822
Fifth Bank	736
Sixth Bank	736
Seventh Bank	783
Eighth Bank	783
TOTAL	**5 382**

Minimum First Stage Media Area
Maximum loading to prevent first stage overload = 3,1 kg/day/100 m2
= 30,88 kg of post primary BOD/day divided by max. loading times 100 m2
= 996 m2

BOD remaining for 2nd Stage = 18,03 kg/day
Minimum Media 2nd Stage = 582 m2

OPR.	DESCRIPTION

ITEM	PART #	DESCRIPTION	QTY



NOTES:
1. XXXXX

NOTES:

REV	DESCRIPTION	YY/MM/DD	BY
XX	XXXX XXXXX	YY/MM/DD	XX

ALL TOLERANCES ARE
+/- 1/32"
UNLESS OTHERWISE SPECIFIED.
DIMENSIONS ARE IN INCHES.

Seprotech
Water. Pure and Simple
SEPROTECH SYSTEMS INC.
2378 HOLLY LANE OTTAWA, ONTARIO, CANADA K1V 7P1
TEL: (613) 523-1641 FAX: (613) 731-0851
Email: contact@seprotech.com Web: http://www.seprotech.com

DRAWN	CHECKED	DESCRIPTION
DC		GENERAL ARRANGEMENT, N70 – SPECIAL BAFFINLAND ADDITION

DATE	SIZE	SCALE	WEIGHT	SHEET	DWG NO.	REV
15-OCT-2008	B	1:60	50000 LB.	1 OF 1	60052-L04	0

APPENDIX E

SEPROTECH RBC INSTALLATION, OPERATION, AND MAINTENANCE MANUALS

Appendix E.1

RBC Wastewater Treatment Inspection Logs

Baffinland
Iron Mines Corporation

DATE: ____________

MARY RIVER N70 RBC WASTEWATER TREATMENT INSPECTION LOG

Submit daily the completed log to Baffinland Camp Manager

System Performance Checks

	Yes	No	N/A	Corrective Action Taken
Are there any alarms?	☐	☐	☐	
Are ice and other obstructions removed from doorway?	☐	☐	☐	
Are ice and other obstructions removed from ventilation ports?	☐	☐	☐	
Are influent, effluent & RBC vent heat trace warm?	☐	☐	☐	
Are the floats clear of debris?	☐	☐	☐	
Are the UV lights operating?	☐	☐	☐	
Are all the pumps set in auto?	☐	☐	☐	
Is there more than 2" of foam on PST? (Skim it clean)	☐	☐	☐	
Wipe grease off of bearings?	☐	☐	☐	
Lube oil level at top of chain?	☐	☐	☐	
Is bacteria growing on walls of FST & lift station	☐	☐	☐	

UV Lamps: Intensity: ______ Sheaths require cleaning?: Yes ☐ No ☐ Intensity after cleaning: ______

Sodium Hypochlorite: Pump stroke: ______ Stroke percent: ______ Volume remaining: ______ Batch Mixed? ______

Alum: Pump stroke: ______ Stroke percent: ______ Volume remaining: ______ Batch Mixed? ______

Process Performance Checks

	Value	Unit	Acceptable Range	Corrective Action Taken
pH		None	Minimum 7.6	
24 hour Total Flow Rate		Litres	Maximum 33,750 L	
Temperature		°C	Minimum 17°C	
PST sludge level		Feet	Maximum depth = 2'	PST sludge pumped ☐
Odour		Smell	Musty	
Colour on primary disk		Colour	Medium brown	
Colour on secondary disk		Colour	Medium brown	
Colour on final disk		Colour	Medium brown	
Effluent Clarity Test		Solids	Clear – No solids	

Adjustments/Corrective Action/Comments (Document if instructions provided by 3rd party): ______

Chemical Performance Checks: **Monday Operator Analysis Completed** ☐ **UV light Cleaned** ☐

Influent	Value	Unit	Maximum Limit	*Effluent*	Value	Unit	Acceptable Range
pH		None		pH		None	6.0 to 9.5
Temperature		°C		Temperature		°C	N/A
COD		mg/L		COD		mg/L	N/A
TSS		mg/L	490	TSS		mg/L	Maximum 35 mg/L
TKN		mg/L	65	TKN		mg/L	N/A
TP		mg/L	10	TP		mg/L	N/A

Monthly Lab Sample Taken by Technician: Check box to indicate sample taken ☐

Weekly Ops PM checklist complete on Monday ☐ **Monthly Ops PM checklist complete 1st day of the month** ☐

Adjustments/Corrective Action/Comments (Document if instructions provided by 3rd party): ______

OPERATOR (please print): ______________ SIGN OFF: ______________

Baffinland
Iron Mines Corporation

DATE: ____________

MARY RIVER N30 RBC WASTEWATER TREATMENT INSPECTION LOG

Submit daily the completed log to Baffinland Camp Manager

System Performance Checks

	Yes	No	N/A	Corrective Action Taken
Are there any alarms?	☐	☐	☐	
Are ice and other obstructions removed from doorway?	☐	☐	☐	
Are ice and other obstructions removed from ventilation ports?	☐	☐	☐	
Are influent, effluent & RBC vent heat trace warm?	☐	☐	☐	
Are the floats clear of debris?	☐	☐	☐	
Are the UV lights operating?	☐	☐	☐	
Are all the pumps set in auto?	☐	☐	☐	
Is there more than 2" of foam on PST? (Skim it clean)	☐	☐	☐	
Wipe grease off of bearings?	☐	☐	☐	
Lube oil level at top of chain?	☐	☐	☐	
Is bacteria growing on walls of FST & lift station	☐	☐	☐	

UV Lamps: Intensity: _______ Sheaths require cleaning?: Yes ☐ No ☐ Intensity after cleaning: _______

Sodium Hypochlorite: Pump stroke: _____ Stroke percent: _____ Volume remaining: _____ Batch Mixed? _____

Alum: Pump stroke: _____ Stroke percent: _____ Volume remaining: _____ Batch Mixed? _____

Process Performance Checks

	Value	Unit	Acceptable Range	Corrective Action Taken
pH		None	Minimum 7.6	
24 hour Total Flow Rate		Litres	Maximum 33,750 L	
Temperature		°C	Minimum 17°C	
PST sludge level		Feet	Maximum depth = 2'	PST sludge pumped ☐
Odour		Smell	Musty	
Colour on primary disk		Colour	Medium brown	
Colour on secondary disk		Colour	Medium brown	
Colour on final disk		Colour	Medium brown	
Effluent Clarity Test		Solids	Clear – No solids	

Adjustments/Corrective Action/Comments (Document if instructions provided by 3rd party): ____________

Chemical Performance Checks: **Monday Operator Analysis Completed** ☐ **UV light Cleaned** ☐

Influent	Value	Unit	Maximum Limit	*Effluent*	Value	Unit	Acceptable Range
pH		None		pH		None	6.0 to 9.5
Temperature		°C		Temperature		°C	N/A
COD		mg/L		COD		mg/L	N/A
TSS		mg/L	490	TSS		mg/L	Maximum 35 mg/L
TKN		mg/L	65	TKN		mg/L	N/A
TP		mg/L	10	TP		mg/L	N/A

Monthly Lab Sample Taken by Technician: Check box to indicate sample taken ☐

Weekly Ops PM checklist complete on Monday ☐ **Monthly Ops PM checklist complete 1st day of the month** ☐

Adjustments/Corrective Action/Comments (Document if instructions provided by 3rd party): ____________

OPERATOR (please print): ____________ SIGN OFF: ____________

Appendix E.2

Model N70 – Mary River Camp

ROTORDISK®
Aerobic Wastewater Treatment Plant

Model N70

BAFFINLAND
Project #60052

ROTORDISK®
Aerobic Wastewater Treatment Plant
Model N70

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

BAFFINLAND
Project #: 60052

Seprotech
Water. Pure and Simple

ROTORDISK®

Wastewater Treatment Plant
Model N70

INSTALLATION, OPERATION & MAINTENANCE MANUAL

AUGUST 2007

SEPROTECH SYSTEMS INC.
2378 HOLLY LANE
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K1V 7P1
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Fax: (613)-731-0851

Seprotech Systems Incorporated
2378 Holly Lane, K1V 7P1
Ottawa, Ontario, Canada
Telephone (613) 523-1641
Fax (613) 731-0851

INSTALLATION, OPERATION AND MAINTENANCE

MANUAL

TABLE OF CONTENTS

IMPORTANT: READ THIS INSTALLATION PROCEDURE PRIOR TO START-UP.

1.0 SITE INSTALLATION OF ROTORDISK® SEWAGE TREATMENT PLANTS:

1.1 (applies to Steel Tankage only)

When there is a complete ROTORDISK® unit supplied, site preparation is as follows:

A level concrete or well-compacted gravel base is to be supplied by Customer/Contractor.

Unit to be lifted only at lifting points by use of hooks and spreader bars.

All anchoring and levelling of ROTORDISK® on site to be done by customer/contractor. Check alignment of shaft and sprockets and clearances of couplings where applicable prior to start-up, failure to do so may void manufacturer's warranty. Refer to this ROTORDISK® manual for details. If required, the contractor must perform levelling.

All hydraulic piping, to and from the unit, is to be supplied and installed by customer/contractor.

All input electric and hydro hook-ups to be done by customer/contractor to local governing regulations and a signed approval sent to SEPROTECH SYSTEMS INCORPORATED. Under no circumstances must electrical connections, junction boxes or equipment pertaining to the electrical function of the unit be installed in the ROTORDISK® tank.

SEPROTECH SYSTEMS INCORPORATED GROUP INC. will supply a man on-site to assist customer/contractor at a specified rate and at customer/contractor discretion.

If unit is not shipped completely assembled assembly instructions and drawings will be supplied.

<u>IMPORTANT: READ THIS INSTALLATION PROCEDURE PRIOR TO START-UP.</u>

1.2 - (applies to Concrete Tankage for ROTORDISK® only)

If the ROTORDISK® unit supplied is to be encased in concrete tankage, the site preparation is as follows:

The unit is lowered into the concrete tankage, the pipe at the end of the unit is placed into the opening of the intermediate wall between the primary and final settlement chambers and lowered onto the anchor bolts (contractors supply).

Unit to be lifted only at lifting points by use of hooks and spreader bars.

All anchor bolts (contractors supply) should be correctly located in concrete in a vertical position. In addition, all bolts should include a levelling nut.

All anchoring and levelling of ROTORDISK® on site to be done by customer/contractor. When the unit is set onto the anchor bolts in the concrete tank, it must be levelled to a slope of no more than 3/4” in 20’ along the length. The unit is then centred in the tank and completely bolted down.

After the unit has been bolted down, check alignment of shaft and sprockets and clearances of couplings where applicable prior to start-up, failure to do so may void manufacturer's warranty. Refer to this ROTORDISK® manual for details. If required, the contractor must perform levelling.

All hydraulic piping, to and from the unit, is to be supplied and installed by customer/contractor.

All input electric and hydro hook-ups to be done by customer/contractor to local governing regulations and a signed approval sent to SEPROTECH SYSTEMS INCORPORATED. Under no circumstances must electrical connections, junction boxes or equipment pertaining to the electrical function of the unit be installed in the ROTORDISK® tank.

SEPROTECH SYSTEMS INCORPORATED will supply a man on-site to assist customer/contractor at a specified rate and at customer/contractor discretion.

If unit is not shipped completely assembled assembly instructions and drawings will be supplied. (As shown)

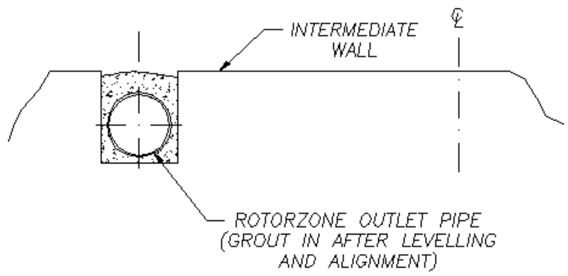


Figure a - **ROTORDISK®** tank outlet through intermediate wall between settlement tank chambers.

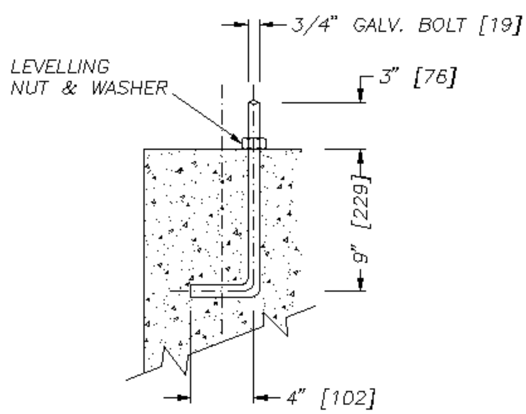
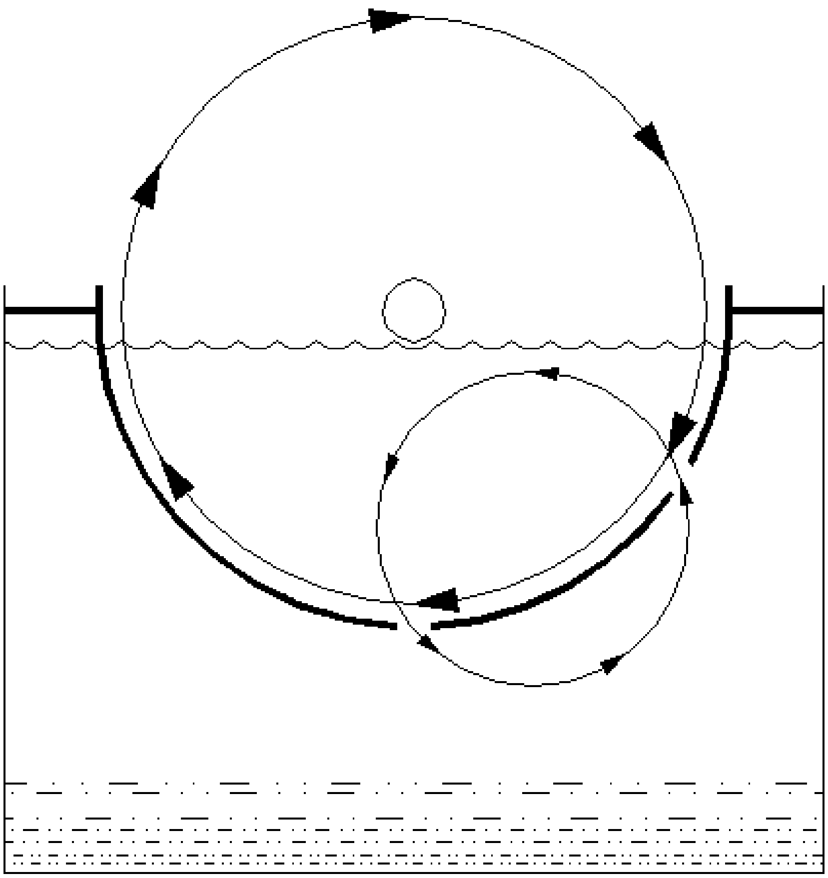


Figure b - anchor bolt detail for **ROTORDISK®** tank.

1.3 - DIRECTION OF SHAFT ROTATION



The direction of shaft rotation should be such that disks mounted on shaft will enter water on the side where inlet to "Rotorzone" is located. The electric motor driving the shaft should be wired accordingly.

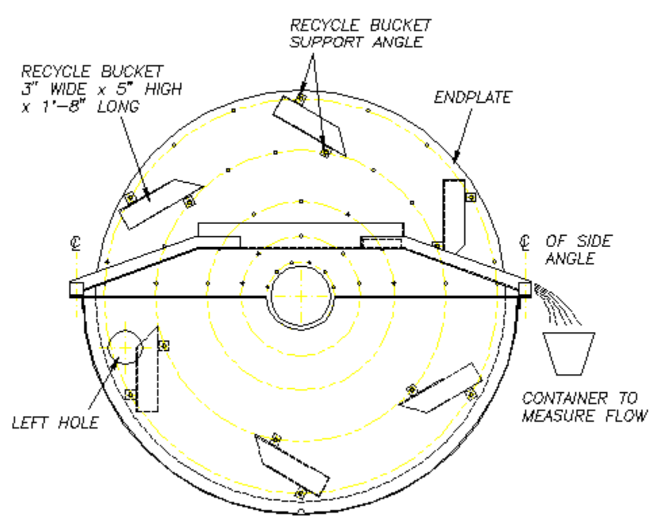
1.4 - DISSOLVED OXYGEN (D.O.) RECYCLE for ROTORDISK®

1.4.1 Recycle buckets are mounted on the last stage of the ROTORDISK®. These buckets rotate at the same speed as the disks. See the attached elevation view of the recycle buckets and trough on the Rotorzone tank.

1.4.2 As the disks rotate, the buckets scoop-up treated wastewater. As this wastewater falls into the recycle trough, it is exposed to the atmosphere, where it absorbs fresh oxygen. The wastewater then cascades on one side of the trough through a narrow steel channel and mixes back with the contents of the Primary Clarifier, thereby introducing fresh dissolved oxygen in the Primary Clarifier. See the section of diskbank assembly showing buckets and recycle trough.

1.4.3 The set-up described above is comprised of the recycle buckets and recycle trough, is what we term as our D.O. re-circulation device. This is especially advantageous to preventing septic conditions from occurring in the Primary Clarifier in small flow or low flow situations.

1.4.4 It is **important** to measure the **actual recycle rate** on the **ROTORDISK®**. This data is compared to our theoretical recycle rate designed. This is advantageous prior to connecting and setting-up for service. Using a container (5 gallon bucket is ideal) and a stopwatch, record the water flowing out of the effluent channel of the recycle trough. Make 3-5 readings, and report this data to SEPROTECH SYSTEMS INCORPORATED for future reference.



SECTION OF DISKBANK ASSEMBLY
SHOWING 6 BUCKETS
AND RECYCLE TROUGH

1.5 - SUMMARY OF OPERATION

(ROTORDISK® systems designed for BOD/SS/Ammonia/Nitrate removal)

A). The sewage plant (as supplied by SEPROTECH SYSTEMS INCORPORATED) is comprised of five (5) main components: the primary settling tank, the RBC tank, the denitrification tank, the secondary settling tank and the multi-media filters.

B). The RBC tank is the aerobic section of the treatment plant divided into four (4) stages.

Raw sewage is pumped and/or gravity flows into the primary settling tank (PST). When the sewage is pumped into the plant, pumping must simulate conditions encountered in gravity fed systems. Indeed, over a 24-hour period, the plant is designed to handle a flow rate corresponding to the Average Daily Flow (ADF) and can accommodate for two Peak Daily Flow (PDF) periods of two (2) hours per day. Each PDF event can be at a maximum of three times ADF.

In the PST, sedimentation separates heavy solids from the bulk of the liquid and the supernatant enters the aerobic section through the inlet slot located at the front section of the RBC tank.

The aerobic section is made up of four stages. The 1st stage is mounted on one common shaft. This 1st stage is comprised of one (1) to three (3) disk banks. The normal colour of the bacteria in the 1st stage is dark brown. This is the stage where most of the BOD removal by biological oxidation occurs. The succeeding 2nd, 3rd, and 4th stages are mounted on the rest of the shaft or another common shaft. Each stage has one (1) to three (3) disk banks. It is in the 2nd stage that further BOD is removed, and nitrifying bacteria (those which convert ammonia (NH_3) in the form of ammonium ions (NH_4^+) into nitrite (NO_2^-) and, ultimately, nitrate (NO_3^-)) start to predominate in the 3rd and 4th stages. The 4th and last aerobic stage has recycle buckets that introduce both fresh dissolved oxygen into the primary settling tank and nitrifying bacteria present in the recycled water.

The rotation of the disks in and out of the water provides a mean of air and heat transfer from the ambient air to the water. The transfer of air to the water is important for aerobic bacteria to remove BOD and ammonia. The transfer of heat to the water is important to maintain the water at an optimum temperature of 15 °C and above such that BOD and ammonia removal rates by the bacteria are maximised (removal rates are a function of the water temperature). Because maintaining a temperature that provides acceptable removal rates is important to the process, RBC's are installed indoors and ambient air is maintained at 15 °C and above.

C). The media in the denitrification section is completely submerged since denitrifying bacteria convert nitrate (NO_3^-) to nitrogen gas (N_2) in an anoxic (i.e., in the absence of dissolved oxygen (DO)) environment.

(Text missing pending completion of patent application process.)

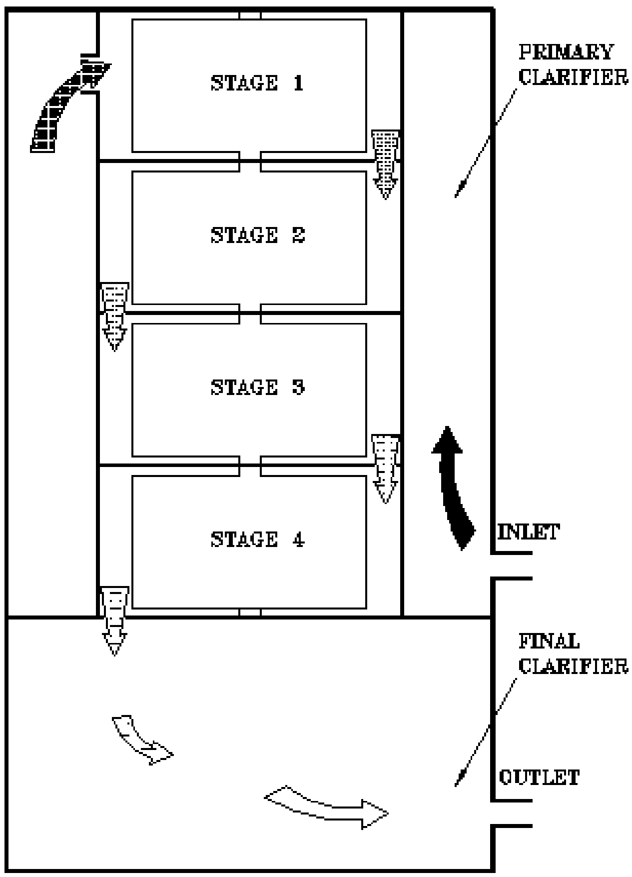
The denitrification section is comprised of two stages separated by a baffle. An equal amount of media is provided in both stages.

D). Partially treated water from the denitrification section then enters the secondary settling tank. Sloughed off biomass from the disks and media bundles and other suspended solids is further settled in this chamber.

E). The partially treated water is then fed to three (3) multi-media filters using one of two (2) submerged pumps. The purpose of these filters is to further reduce the concentration of suspended solids in the final effluent.

2.0 - ROUTINE VISUAL CHECKS ON PHYSICAL AND BIOLOGICAL FUNCTIONING OF ROTORDISK® & DESCRIPTION OF TREATMENT PROCESS

ROTORDISK® sewage treatment plants have three major steps in the purification process. In the primary settling tank, gross solids separate from the flow by either sinking or floating. In the Rotorzone, dissolved pollutants are broken down to simple, non-pollutant compounds by the bacteria ("biomass") which grows on the rotating disks. The final settling tank permits gravity separation of spent biological growth, which continually sloughs off the disks in the Rotorzone preceding it.



2.1 - PRIMARY SETTLING TANK (PST OR PRIMARY "CLARIFIER")

The accumulation of floating scum on the surface of the primary clarifier is normal. It is proportional to the accumulation of settle-able solids at the bottom of the tank. Periodic (9-12 months) removal of sludge at the bottom of the tank is required for proper operation of the Unit.

If no sludge measuring device is available, the accumulation of 9"-12" depth of scum on the surface is a good indication that it is time to remove the accumulated deposits of sludge from the bottom of the tank(s).

2.2 - ROTORZONE

The Rotorzone is subdivided into four sections, with disk banks in each. The wastewater first enters the Rotorzone in the section marked "1" in the sketch (furthest away from the inlet to the plant). The flow then proceeds through sections 2, 3, and 4 before entering the denitrification zone.

The accumulation of biological growth will be greatest in section 1, and gradually decrease through subsequent sections. Generally, the growth will be thick, and often filamentous ("stringy"), in section 1, becoming thinner and more compact through sections 2-4.

The colour of the growth will typically be dark brown to black in Section 1. Some grey growth may also be noticed, depending on the relative load and type of wastewater being treated. Growth in sections 2-4 will typically vary from medium brown to a light brown or tan growth in section 4.

In a well-functioning unit with the appropriate feed of wastewater, there will be an earthy, humus-like ("musty") smell inside the unit. A substantial sour, "sewage" smell may be an indication of sub-optimal conditions in the treatment process.

2.2.1 - 'BATHTUB RING'

The wastewater flows by gravity within a ROTORDISK® Plant thus the water level is relatively constant. Changes in water level of 1" to 2" are not unusual due to surge flows entering the unit. The evidence of this is a 'bathtub ring' 1" - 2" above the normal level. A 'bathtub ring' higher than this suggests that partial or complete flooding of the unit has occurred since the last check. If so, the (gravity or pump) discharge system should be checked for blockages or mechanical malfunction. Another condition which can lead to the level of water rising to greater levels than 1" – 2" is if the plant is fed by pumps that exceed the design limits of the plant (i.e., ADF over a period of 24 hours including a maximum of two (2) PDF events no longer than 2 hours each).

2.3 – ACETIC ACID INJECTION SYSTEM

One of the most important building blocks of life is carbon. The bacteria responsible for denitrification need carbon in an organic form to grow and thus convert nitrate to nitrogen gas. Most soluble organic carbon (often measured in terms of Biochemical Oxygen Demand or BOD) has been consumed in the aerobic section of the wastewater treatment plant and there is thus very little left for the denitrifiers by the time the wastewater reaches the denitrification section of the plant. It is for this reason that acetic acid (vinegar), an easily biodegradable organic carbon source, is injected at the inlet of the denitrification zone.

The system provided consists in a 125 imp. gal. storage tank (ϕ=30", H=49") equipped with a mixer and of a dosing pump of maximum capacity 12.3 l/h mounted on a skid.

The dosing pump can be controlled in either of two ways: by a 4-20 mA signal coming from the flowmeter located on the effluent outlet pipe (the system is programmed to be operated that way by default) or by a dry contact (by others) located outside SEPROTECH SYSTEMS INCORPORATED's main control panel. For example, that dry contact (by others) could be closed when the pumps (by others) feeding the wastewater treatment plant are running and opened when they are not.

The target dose of pure acetic acid (CH_3COOH) in the water is: 175 mg/litre. Assuming that commercial acetic acid is at a concentration of 12% by weight, this means that the target dose of commercial acetic acid at the inlet of the denitrification section would be 1460 mg of commercial acetic acid per liter of water. At ADF (i.e., 49,000 litres per day), this corresponds to a dosing rate of 2.9 litres of commercial acetic acid per hour. If the 4-20 mA signal from the flowmeter is used to control the dosing pump (again, this is the default mode), then the actual dosing rate will be $3 \times 2.9 = 8.7$ litres of commercial acetic acid per hour one third of the time since the flow exiting the plant (via the flowmeter) is pumped from the FST to the multi-media filters at a rate of $3 \times$ ADF = PDF (i.e., 147,000 litres per day).

The average daily quantity of commercial acetic acid necessary has been estimated at 70 l/day (15.4 imp. gal per day) based on an ADF of 49,000 litres/day.

2.4 – DENITRIFICATION ZONE

(Text missing pending completion of patent application process.)

In the denitrification zone, the media is completely submerged such that anoxic conditions (i.e., the absence of Dissolved Oxygen (DO) in the water) prevail and thus the denitrification process (i.e., the conversion of nitrate (NO_3^-) to nitrogen gas (N_2)) can take place. The denitrification zone includes two (2) stages that are separated by a baffle.

2.5 – FINAL SETTLING TANK (FST OR FINAL "CLARIFIER")

The effluent near the outlet at the backside of the final clarifier should be relatively clear and colourless and relatively free of suspended matter. Clarity can best be judged by scooping a small volume of the final effluent into a clear glass container. This is particularly true of larger units where the depth and dark colour of the tank walls may make clarity hard to determine. (Note: Although the risk of infection is very small, the wearing of rubber gloves is a rational safety precaution when hand-scooping the effluent for a clarity check. This is particularly true if there are open cuts on the hands.)

Although the final effluent itself should be relatively clear, some floating matter may accumulate on the surface of the final clarifier. This is normal, and will typically be much less than the accumulation of floating scum in the primary clarifier.

2.6 – FILTERS FEED PUMPS LOGIC AND LEVELS IN THE FST

The level in the FST is controlled in the following manner:

- Level Switch Low (LSL or float #1): both filter feed pumps (each of capacity = 3 × ADF) stop when this level is reached;
- Level Switch High (LSH or float #2): lead filter feed pump starts when this level is reached;
- Level Switch High High (LSHH or float #3): lag filter feed pump starts (lead filter feed pump is maintained in operation) and an alarm goes off when this level is reached (i.e., the alarm light is activated);
- Overflow: the FST is equipped with an outlet that can be connected directly to the storm sewer in the exceptional case that the plant is overflowed (piping between this outlet and the storm sewer is out of SEPROTECH SYSTEMS INCORPORATED' scope of supply).

2.7 – POST FILTRATION SYSTEM

The clarified water is pumped from the FST to three multi-media filters operating in parallel. The purpose of these multi-media filters is to reduce further the concentration of suspended solids in the treated wastewater.

The three filters operated in parallel are designed to treat peak low rates (PDF) of 3 times the design average daily flow (ADF) and are fed at this flow rate since each filter feed pump also has a capacity of PDF.

Each of the three filters is filled with anthracite, sand and garnet with gravel underbedding. The water is filtered from top to bottom of each filter with the coarser filtration media placed on top and the finer on the bottom of the filter. Each vessel is made of fibreglass. In normal operation (i.e., when all 3 filters operate in parallel), the filtration velocity is about 10 m/h on each filter.

A backwash of one of the three filters is performed approximately every 4 hours. The filters are backwashed alternately, i.e., filter no. 2 gets backwashed approximately 4 hour (exactly 4 hours + the time it takes to backwash and rinse a filter) after filter no. 1 gets backwashed and filter no. 3 gets backwashed approximately 4 hour after filter no. 2 gets backwashed. These operating parameters are adjustable on the plant's main control panel (see Section 2.9). When a backwash occurs, the water pumped at PDF from the FST is fed to two of the filters and the filtrate from these is used to backwash the third filter from bottom to top (inverse direction than in filtration mode). The two filters used to produce the filtrate operate at velocities of approximately 15 m/h while the third filter gets backwashed at a velocity of approximately 30 m/h.

The filtration system is controlled by the main control panel for the plant. The automatic diaphragm valves installed on the filtration unit are pneumatic and are thus opened and closed using compressed air. A compressor is provided with the plant. The compressed air transits through a filters solenoid valves panel.

2.8 – MONITORING OF DISCHARGE FLOW RATE

The plant is equipped with a magnetic flow meter located on the clean effluent's discharge pipe. This instrument is equipped with a counter that allows tracking of the total volume of clean effluent discharged by the plant. As mentioned in paragraph 2.3, the flow meter is also used to control the injection rate of acetic acid. A thermal chart recorder was also provided in order to produce hardcopies of the flow measurements taken by the flowmeter.

2.9 – OPERATING PARAMETERS ADJUSTABLE ON THE CONTROL PANEL

The following operating parameters were set as default in the Programmable Logic Control (PLC) panel provided with the plant but are adjustable within the ranges shown below. Making changes and adjustments to the default plant's operating parameters requires a good understanding of the wastewater treatment process and should therefore only be performed by qualified and trained staff. Please contact SEPROTECH SYSTEMS INCORPORATED if assistance is needed to optimise the operation of the plant.

	T1 Time between backwashes	T2 Time for a backwash	T3 Time for rinse	T4 Time between sludge pumping	T5 Time for sludge pumping
Factory Setting	4 h	10 min	5 min	1.0 h	0.25 min
Minimum	1 h	5 min	2 min	0.5 h	0.10 min
Maximum	18 h	30 min	30 min	12.0 h	1.00 min

2.10 - FREQUENCY OF INSPECTION

Visual checks every week should be sufficient. However, for better preventative maintenance of the wastewater treatment plant and thus the capital investment, a daily walk through is often the preferred frequency of visit. Many owners prefer the visual and audible (look and listen) walk through. A standard operator checklist should be prepared and used by the person responsible for periodic maintenance of the plant at every visit. SEPROTECH SYSTEMS INCORPORATED can assist in preparing such checklist upon request.

The acetic acid storage tank should be topped off every time the plant is being visited.

The pressure loss on every filter should also be controlled. Two pressure gauges were provided for this purpose, one on the inlet pipe and one on the outlet pipe of each filter. The pressure drop across a filter shouldn't exceed 15 PSI. If it does even after a filter has been backwashed, the frequency and/or duration of backwashes should be increased.

3.0 - STANDARD RECOMMENDATIONS AND PROCEDURES FOR SLUDGE REMOVAL

3.1 - STORAGE CAPACITIES

A design feature of ROTORDISK®, which contributes greatly to overall simplicity of the process, is the sizing of clarifiers to accommodate static internal sludge storage for extended periods. Depending on such factors as raw wastewater solids concentrations, and design organic loading in a given application, maximum sludge storage levels will typically be reached in 6-9 months of operation.

This period is based on calculated rates of initial decomposition of raw and biological solids, and, upon operating experience, indicating the degree of auto-digestion/compacting, which proceeds during the storage period. The 6-9 month period will be shortened to the extent that design hydraulic and waste loads are exceeded. It will be lengthened to the extent that flows and waste load are less than those designed for.

3.2 - DETERMINATION OF ACCUMULATED SLUDGE VOLUMES

The accumulation of maximum storage capacities can be indirectly monitored through visual observation of the thickness of the scum blanket on the surface of the primary clarifier. When the scum blanket has matured to a height of approximately 7"-10", this is a good indication that sludge accumulations at the bottom of both clarifiers are at or near maximum levels, and that sludge withdrawal is indicated.

A more accurate procedure of determining sludge levels is to directly measure actual accumulations, and compare these to the maximum storage capacities listed on the "Details" section of the general arrangement drawing for the ROTORDISK® model in question.

A variety of sludge measuring devices is commercially available. The two most common are the weighted hollow tube type, and, the (electronic) turbidity-change detector type. The former is less costly, relatively easy to use, and more appropriate because of the low frequency with which measurements need to be made in a ROTORDISK® unit.

Whatever means of measuring the sludge may be selected, it must be kept in mind that the sludge is <u>not</u> a firm solids substance. Domestic wastewater sludge is mostly trapped water and other liquids. Only to determine sludge levels by "feeling" for a solid layer with a stick or pole. The settled sludge is far more liquid than the surface scum, which is perhaps 30-40% solids by volume.

Irrespective of the type of device used, sludge levels should be measured at several locations in each settlement tank to ensure a reasonably accurate calculation of accumulated volumes. This is required since sludge accumulation levels are not uniform; being highest at the inlet ends of both clarifiers, and, below the slot at the bottom of the first section of the Rotorzone trough.

Once an average sludge height has been determined, multiply by the surface area of the clarifier in question to determine the existing volume of stored sludge. Compare to maximum design capacity listed on the general arrangement drawing. If the accumulated levels equal or exceed design values, it is time to remove the sludge from the unit.

3.3 - SLUDGE REMOVAL

A pump-out truck of the same type that pumps out septic tanks normally does the sludge removal. For smaller ROTORDISK® units, the entire liquid contents of the treatment plant can be withdrawn. For larger installations, the haulage contractor should be instructed to get the suction hose directly to the bottom of the tanks and withdraw the sludge only, while taking as little of the supernatant as possible. Once the primary sludge is withdrawn from the primary settlement tank, the supernatant of the secondary clarifier can be transferred to the primary settlement tank to expose the secondary sludge. The suction hose should be placed down at a multiple number of points to help ensure complete removal of accumulated sludge deposits. Floating surface scum should also be removed. Haulage contractors should be given a brief description of the unit and its operation if they are not already familiar with it. A particular point to emphasise is that the biological growth on the disks should <u>not</u> be washed off, but should be left in place. The exception to this is if the disks have accumulated excess biomass due to sludge pump out being delayed past the indicated intervals.

Sludge removed from the unit is normally hauled away by the pumping truck and disposed of at municipal facilities, or, by controlled spreading on farmland. On-site disposal in shallow trenches and/or some form of on-site volume reduction (prior to export) may be feasible or desirable depending on the specific opportunities and limitations afforded by the site of a given installation.

3.4 - POTENTIAL CONSEQUENCES OF OPERATING ROTORDISK® UNITS PAST DESIGNATED MAXIMUM SLUDGE STORAGE LEVELS

Sludge accumulations should be removed once they reach indicated maximum storage levels, because failure to do so could result in lowered treatment efficiency, and possibly cause serious damage to the structure of the Rotating Assembly and drive unit. The potential for problems is as described below and depicted in the attached sketches.

Figure (c) shows a unit operating with sludge build-ups at or near maximum storage levels. This will cause no problem since the storage heights are designated so that flows through the primary clarifier will not disturb the sludge layer. Characteristics of wastewater reaching the Rotorzone at this time (and since start-up) will be in the range of 180-200 mg BOD/1 and 50-250 mg SS/1. The supporting structure of the rotating assembly is over designed for the amount of biological build-up which will occur on the disks under this operating condition, and the shear force of the rotation through the trough water will limit the thickness of growth.

However, if sludge is allowed to accumulate past designated storage heights, flow through the primary clarifier will begin to disturb the sludge blanket, and thus carry loads of solids and dissolved organic matter into the Rotorzone which are not anticipated in the design of the unit (Figure d). The pollutant load reaching the biomass on the first stage of disks will overload that biomass (in terms of F:M ratio), and force a change in its activity and growth. The biomass becomes more gelatinous, and does not shear off as well with disk rotation. Additionally, the biomass will readily adsorb and entrap the extra solids with the sum effect being an increase in weight on the rotating assembly that considerably exceeds that which its design is based on.

This tendency reaches its extreme if sludge is allowed to accumulate to the point where it will be disturbed by-, and caught up in -, the re-circulation pattern created by the two slots in the trough on the first section of the Rotorzone (see Figure e).

The sludge will have characteristics in the order of 20,000 mg TSS/1 and 10,000 mg BOD/1, so it is obvious that even a minor amount of this material caught up in the re-circulation flow will significantly increase the concentration of the waste stream entering the Rotorzone. If, for example, the sludge was caught up in the recycle flow at a ratio of as little as 1:10 or 1:15, the resulting concentration would be sufficient to produce a considerable first-stage overload on an amount of disk area selected based on normal concentrations.

The resulting build-up of poorly-shearing gelatinous biomass and trapped solids would pose a serious potential for strain on the drive unit, and for structural damage to disk bank assemblies and shaft, in spite of them being considerably over designed for loads anticipated in normal operation.

Clearly, these potential problems should be avoided by the removal of sludge once it reaches the level specified as maximum for the ROTORDISK® unit in question.

3.5 - FRONT VIEW SCHEMATIC OF ROTORDISK®

UNIT OPERATING AT-, AND ABOVE-,
RECOMMENDED MAXIMUM SLUDGE STORAGE LEVELS

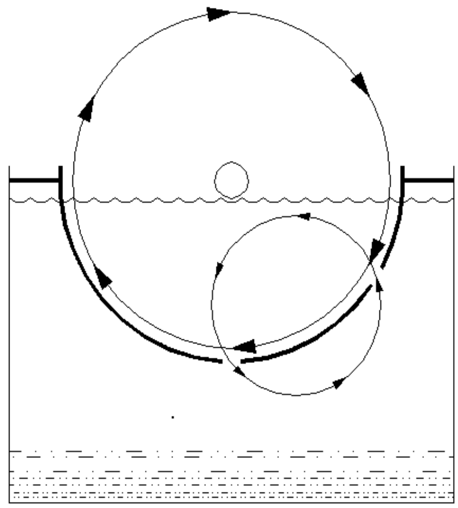


Figure c-unit operating at maximum sludge storage levels. Neither influent flows, nor re-circulating flows, disturb sludge blanket.

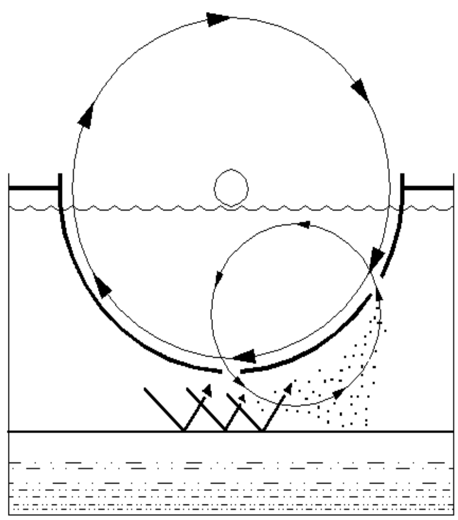


Figure d- unit operating with excess accumulations. Influent flows may disturb sludge blanket and increase BOD and solids loads to Rotorzone to levels above treatment design.

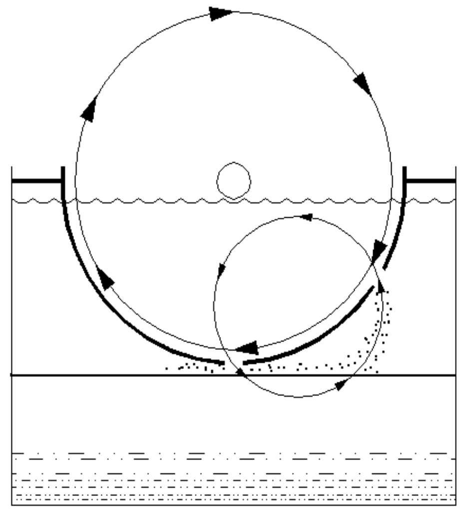


Figure e-Unit operating with excess sludge accumulated to base of Rotorzone. Both influent flows and re-circulation flows will disturb and carry sludge solids. Increase in BOD and solids loads entering Rotorzone will be substantially above design treatment levels, increase accumulated masses on rotating assembly, produce potential for damage to structure and drive unit.

3.6 - PUMPOUT PROCEDURES FOR ROTORDISK® TREATMENT SYSTEMS (summary)

Using suction hose, floating or surface scum should be removed first. Place the suction hose directly to the bottom of the tank and withdraw sludge only, while taking as little as possible of the volume of waste liquid above the sludge blanket (supernatant).

Move the hose at multiple number of points along the bottom of the settlement tanks. Do not wash off biological growth (biomass) on the disks. The exception to this is excess accumulated biomass on the disks due to an overdue sludge pump-out. Excess accumulated biomass is when a disk bank is 100% fully covered with biomass and the colour is grey with a slight odour.

Keep a record of all pump-outs to arrive at an actual normal operating interval for sludge pump-outs. For systems with several flow meters, it is also beneficial to note the total flow generated between pump-outs.

3.7 - START-UP PROCEDURES OF ROTORDISK®

WARNING: A VALVE LOCATED AT THE BOTTOM OF THE DENITRIFICATION TANK AND EQUIPPED WITH A REMOTE ACTUATION MECHANISM WAS PROVIDED WITH YOUR UNIT. THIS VALVE:

- Needs to be OPEN: when the plant is first filled with water, during draining if the plant ever requires such operation and during subsequent refilling operations. FAILURE TO OPEN THIS VALVE DURING FILLING AND DRAINING WILL RESULT IN SERIOUS DAMAGE TO THE PLANT. This is because, during a filling operation, the water rising in the PST would push the denitrification tank upwards while it is empty (this tank wouldn't have had a chance to fill with water until the water level reaches the inlet slot between the PST and the aerobic ROTORDISK®. Th open valves provide a mean of filling the PST and the through (denitrification tank included) at the same time.

- Needs to be CLOSED: during normal operation of the plant. Indeed, the denitrification section contains water already partly treatment thus this water and that contained in the PST shouldn't mix. FAILURE TO CLOSING THIS VALVE DURING NORMAL OPERATION OF THE PLANT WILL RESULT IN A POOR QUALITY EFFLUENT.

The ROTORDISK® sewage treatment plant is based on a fixed film treatment process referred to as the Rotating Biological Contactor (RBC). In this process, micro-organisms or bugs are attached and grown on the surface of a media, the quantity of bugs being directly proportional to the amount of food in the wastewater. When starting up a new system, it will normally take about two weeks to get organic removal from the wastewater and three to four weeks to establish the nitrification process at normal domestic sewage temperatures. The method of and effluent discharge during system start-up should be discussed and thoroughly communicated with the environmental authority. The primary sedimentation tank and RBC of the system should, preferably, be filled with fresh water before admitting wastewater to the system. A flow less than design is not a problem. The biomass will develop themselves on the media. If there is a small flow only a portion of the disk will have biomass. As the flow increases the amount of biomass will increase.

Seeding a ROTORDISK® with activated sludge, although not required, can be accomplished. The activated sludge should be at the same temperature as the influent. Sudden changes in wastewater temperature cause biomass sloughing. In most cases, the use of domestic waste as a seed culture has provided the required biomass for continuous operation. When seeding the ROTORDISK® with activated sludge is decided, the primary sedimentation tank and RBC of the system should first be filled with fresh water (preferably) and the activated sludge added to the RBC. The RBC should be rotating at all times. The wastewater introduced to the tank needs to have only 20% of the disks covered with waste. This can already provide the needed wetting and still provide some time to reach normal operating levels when source flow is introduced. The final clarifier does not need to be filled with anything.

Alternately, seeding can be accomplished using dry bacteria and a source of organic carbon such as raw molasses or sugar. This can be done, for example, in situations where wastewater or activated sludge are not available and the plant needs to be ready to treat wastewater very shortly after it begins receiving it. By simulating the conditions encountered in wastewater (where large amounts of organic carbon and bacteria are present), biomass will establish on the ROTORDISK® and the plant can thus be prepared to work under actual conditions before these are actually encountered. SEPROTECH SYSTEMS INCORPORATED can help find appropriate supplies of both dry bacteria and raw molasses.

The preferred start up is the introduction of source wastewater at design or less than design loading. The disks need to be rotating at all times. When the disks are rotating and wastewater is introduced the biomass will develop and the pollutants will be removed.

The practice of starting up a sewage plant with a charge of septage or activated sludge may be appropriate for suspended growth systems where sludge return is an essential and necessary part of the process. However, start-up with septage is <u>not</u> an appropriate practice for fixed film systems such as the Rotating Biological Contactor process and is <u>not</u> recommended. This is especially true of the ROTORDISK® process and its static, internal storage of sludge.

Studies have shown that the natural start-up time for a ROTORDISK® is 2 1/2 – 3 weeks (normal temperatures and BOD reduction only), and that it has already developed sufficient biomass for 50% removals in only 1 week. These are time frames significantly shorter than respective ones for suspended growth systems. Thus there is little rationale for "pre-starting" a ROTORDISK® unit with septage.

Further, septage contains solids that are already well digested, and therefore not subject to further digestion-compaction in the storage zones. This contrasts to the fresh solids, which will undergo considerable digestion-compaction in the 6 – 9 months after initial settlement. Therefore, a charge of septage would contribute disproportionately to the accumulation of sludge levels, and necessitate a shorter interval to the first pump-out of the unit.

The ROTORDISK® concept of static sludge storage contributes greatly to its overall operation and maintenance simplicity. Following the above guidelines and recommendations will help ensure that the trouble-free simplicity of ROTORDISK® is maintained.

4.0 - STORAGE OF **ROTORDISK®** SEWAGE TREATMENT EQUIPMENT

If the unit is not to be operated for an extended period, then the motor-reducer assembly (drive unit) should be removed from its mound and stored at room temperature in a reasonably dry area (unless the whole unit is being stored in such an area).

Additionally:

1. Reducer: The input shaft should be given several turns once a month to re-lubricate the upper bearings.

NOTE: Some reducers are shipped to site filled with synthetic lubrication. Otherwise, fill the reducer with the lubricant (see reducer section of installation & maintenance instructions).

2. Motor: The motor has a tendency to take on moisture when not in operation. It requires no attention during storage, but before it goes into operation the insulation should be measured using a Meger. It should be at least 1.0 mega-ohm. If below 1.0 mega-ohm, it has taken on excessive condensation, and must be dried out before being operated. (Note: any electrical contractor or repair shop commonly understands these terms and procedures).

3. Support bearings on main ROTORDISK® shaft(s) should be re-lubricated prior to start-up.

4. The system should not be installed and operated in water. In the absence of sewage inputs and normal biological activity, freezing and consequent mechanical damage would be a distinct possibility. Water level in the primary settlement tank to be dropped to below the bottom of the Rotorzone tank level, if freezing of the tank contents is possible.

5.0 - ASSEMBLY PROCEDURE OF ROTORDISK® COMPONENTS SUPPLIED BY SEPROTECH SYSTEMS INCORPORATED

1. Upon receipt of mechanical components:

   a. Check packing list for any missing items on delivery.

   b. Motor/Reducer is shipped loose, for assembly on the reducer flange. The reducer is shipped completely filled with synthetic lubricant.

   c. Bearing components are shipped as a set. Open only when ready for assembly, to avoid moisture contamination.

   d. Chain and sprockets are shipped as a set. Check for the following:

   -Large sprocket bushing (O.D.) fits into the large sprocket bore.
   -Large sprocket bushing bore (I.D.) fits the Rotordisk® shaft drive end.
   -Small sprocket bore (I.D.) fits on the reducer output shaft.
   -Cottered chain fits or matches the teeth on the sprockets.

   e. Coupling (applicable only to split-shaft ROTORDISK® is shipped as a set. Check the coupling hubs if they fit the center stub ends of the ROTORDISK®shafts.

   f. Disk banks are shipped pre-assembled on the shaft by SEPROTECH SYSTEMS INCORPORATED and are shipped on A-frames. Handle with care, as the Fiberglass of the disk banks is brittle.

   g. Hardware (bolts, nuts, washers) for mounting the following items are provided:

   -Bearings
   -Reducer
   -Recycle trough

2. If, for any reason, the diskbanks must be removed from the shaft, the procedure for remounting them is as follows:

If disk banks are 5 ft. in diameter or larger (supplied in semicircular sections)

Mount them on shaft(s) as shown on Dwg.# GL-28D, with 1/2-20NFX1-1/2 Bolts. Connect two half sections with two connecting plates (see sketch of typical mounting details) Remove outer nuts on required tie rods, fit connecting plate on tie rods over the end plates, then fasten them together with nuts and washers.

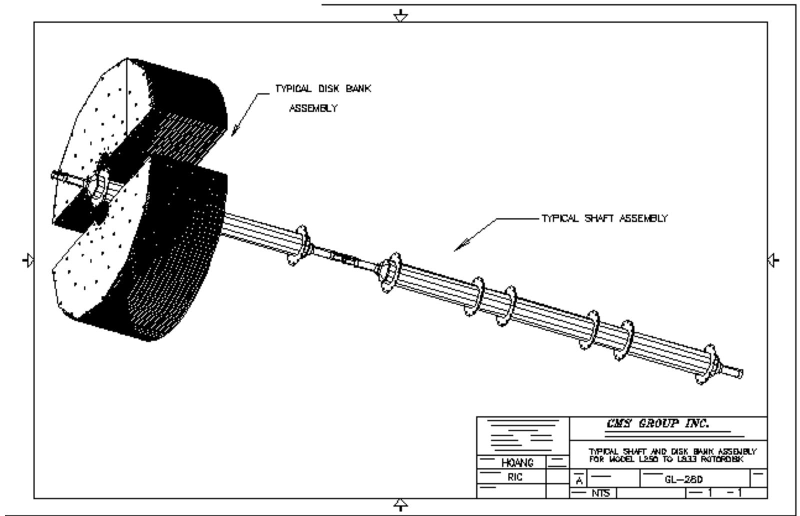


Figure f - typical mounting of disk banks on the shaft(s).

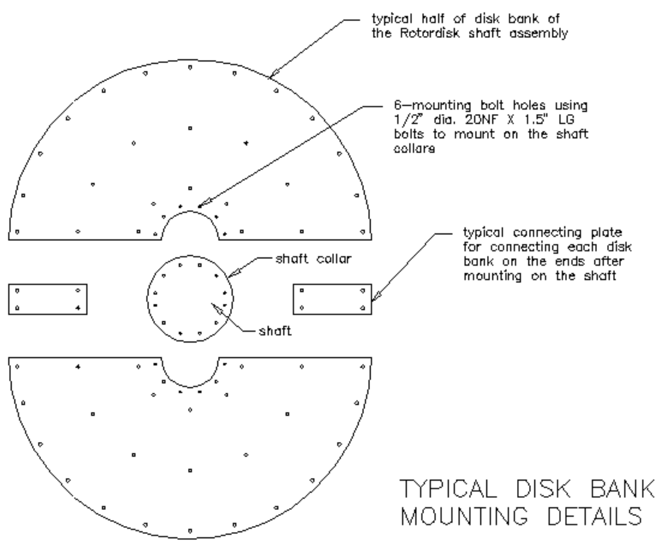


Figure g - exploded view of disk bank mounting parts.

3. Mount Bearings on Shaft(s).

   a) Bearing should be mounted at the centre of stub end. Follow bearing manufacturer's installation instructions.
   b) Use of the bearing fixing rings: one bearing of each pair is "fixed", the other "floating". Install the fixed bearing on the drive end of the shaft and the floating bearing on the non-drive end.

FOR 'L'Rotordisk® models ONLY: On the shaft where the large sprocket will be mounted, fix the bearing into its housing closest to the sprocket. On the other shaft fix the bearing into its housing closest to the coupling (i.e. one bearing should be fixed on every shaft).

NOTE: All bearings mounted on tapered sleeves have to be driven up the taper to the tolerances given in the manual, using a bearing locking tool or equal. See installation, operation and maintenance instructions section of this manual regarding bearings.

4. Mount coupling hubs on their respective shafts (if applicable) so that hub face is flush with the end of its shaft (for direct drive and 'L' models). See installation, operation and maintenance instructions section of this manual regarding couplings.

5. Install shaft(s) in ROTORDISK® tank.

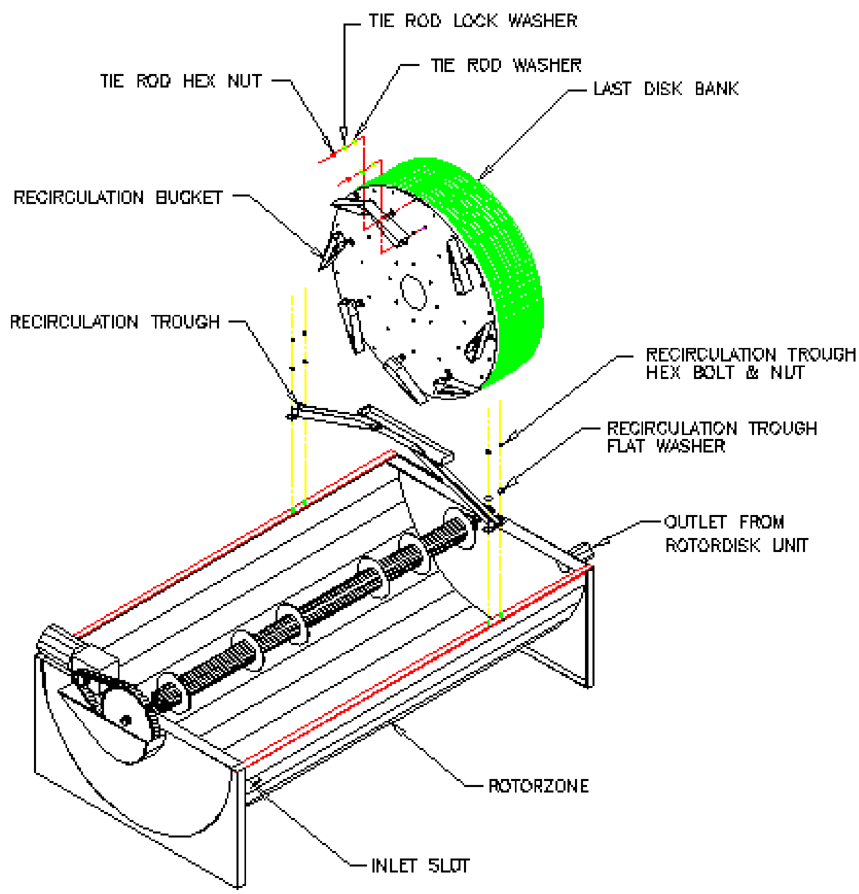
6. Mount small sprocket/coupling hubs on reducer output shaft (whichever is applicable).

7. Install Reducer-Motor Assembly in place. The reducer comes completely filled with synthetic lubricant. Ensure that the breather plug (mounted on top of one of the reducer oil intake ports) is installed on the reducer, after it is mounted on the ROTORDISK®. It is recommended that the motor be mounted into the reducer prior to assembly into the ROTORDISK® tank. Allow for some play in the reducer mounting bolt tightness so the chain tightness can be adjusted later.

8. Connect sprockets with chain. Check the axial alignment of the sprockets while tightening the chain. Tighten the previously loosened reducer mounting bolts after the sprockets are aligned and set in place. See installation, operation and maintenance instructions section of this manual regarding roller chain drives.

9. Connect two coupling hubs, grease, and fit coupling cover (if applicable). Before mounting, check bore on both hubs to match the shaft diameter. See installation, operation and maintenance instructions section of this manual regarding couplings.

10. Mount the stainless steel recycle trough on the ROTORDISK® tank with the bucket opening points to the proper rotation of the shaft.



NOTES:

1. Follow manufacturers instructions in the "Installation & Maintenance Manuals" included by SEPROTECH SYSTEMS INCORPORATED for mounting bearings, couplings (if applicable), reducer, sprockets and chain (if applicable).

2. Make sure all setscrews on sprockets and coupling hubs; bolts on reducer and bearings, are all well tightened before machine goes into operation.

6.0 - ROUTINE MECHANICAL MAINTENANCE OF **ROTORDISK®** SEWAGE TREATMENT PLANTS

6.1 - MOTOR:

If motor is equipped with grease fittings and relief plugs, it should be re-lubricated using a low-pressure gun once a year with Shell Alvenia R2" grease (DO NOT OVER-LUBRICATE). There is no lubrication required for motors without grease fittings and relief plugs

6.2 - REDUCER:

Reduction gear on ROTORDISK® units is filled with synthetic long life lubricant. No inspection or maintenance outside of periodic visual inspection is normally required. If there are no evidence of oil leaks on the seals, the synthetic lubricant must be changed every five (5) years for ROTORDISK® units running 24 hours a day.

Reduction Gear on medium and large ROTORDISK® size units are filled with Shell Tivela 75 oil and does not require oil changes (permanent lubrication). Periodic visual inspection is required. Check oil level and top up to required level with same oil, if necessary.

6.3 - BEARINGS:

Lubricant will deteriorate in time and rate of deterioration is a function of the operating conditions encountered. Lubrication cycle can be determined by analysing the samples taken near the bearing. See bearing manufacturer's maintenance instructions.

6.4 - SPROCKETS AND CHAIN:

(Applicable to non-direct drive ROTORDISK® units)

Chain drive should be inspected every six- (6) months for following points:

- If Chain is covered with grit or chips, it should be cleaned in kerosene and re-lubricated.
- Inspect oil for contamination, such as chips, dirt or grit. Replace oil if necessary (Oil with viscosity of SAE30 at ambient temperature 40^{o} to 100^{o} F is recommended).
- Milky white colour of the oil is indicative of flooding. Replace oil and determine the cause of the flood.
- Check Chain tension and adjust if required.

6.5 - COUPLING:

(Applicable for direct drive ROTORDISK® units and 'L' models)

Coupling should be checked for lubricant level. Lubricant is to be added if required. Re-lubrication with NLGI#2 or LTG Grease once a year is usually adequate.

7.0 - TROUBLE SHOOTING

7.1 - MECHANICAL HARDWARE

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Noisy chain	1. Loose chain 2. Faulty lubrication 3. Misalignment 4. Worn Parts 5. Moving parts rubbing stationary parts	1. Tighten chain 2. Lubricate properly 3. Correct sprocket alignment 4. Replace worn chain 5. Align & tighten chain to clear oil bath
Rapid wear on chain	1. Faulty lubrication 2. Loose or misalign parts	1. Lubricate properly 2. Align & tighten entire drive
Chain climbing sprockets	1. Worn out chain and sprockets 2. Loose chain	1. Replace worn out parts 2. Tighten chain
Stiff chain	1. Misalignment 2. Worn out chain or sprockets 3. Faulty lubrication 4. Rust corrosion	1. Correct alignment 2. Replace worn out parts 3. Lubricate properly 4. Clean and lubricate
Noisy Bearing	Rollers or bearings damaged	Replace bearing cartridge
Bearing grease discoloured or mixed with water	Insufficient grease in the bearings	Purge bearing with grease and increase lubrication interval
Hot bearing	1. Improper lubrication 2. Rollers or bearing race damaged	1. Purge bearing with grease and decrease lubrication interval 2. Replace bearing cartridge
Reducer temperature rises above 200 degrees Fahrenheit.	Oil level too high or too low	Maintain proper oil level
Oil leakage from reducer	1. Oil seals need to be replaced 2. Ventilators/breather plugged causing pressure build-up inside the reducer. 3. Oil level too high	1. Replace oil seals 2. Clean Ventilators 3. Correct oil level
Noisy reducer	1. Bearing failure 2. Misalignment in worm gear inside 3. Coupling between motor and reducer worn out and misalign	1. Check bearings and replace if necessary 2. Align worm gear shafts. 3. Replace coupling between motor and reducer. Align coupling hub vertically
Noisy Motor	Bearing damage	Replace damaged bearings
Motor overheating	1. Reducer overheating 2. Cooling fins on motor are clogged 3. Overload 4. Rotor rubbing on stator 5. Over greasing or lubrication	1. Check reducer 2. Clean fins 3. Check for excess friction or imbalance 4. Replace bearings 5. Avoid packing grease too tightly
Motor won’t start	1. Power trouble 2. Single phasing at station 3. Fuse blown	1. Check source of power supply 2. Do not try to make it go and “fry” motor. Check starter windings 3. Replace fuse
Knocking/rumbling on motor bearings	1. Bearing worn due to lack of lubrication or excessive mechanical overload 2. bearings slack in housing	1. Replace bearing and put new grease of recommended grade. 2. Fir new end shields
Rotordisk® shaft doesn’t turn	1. Power failure 2. Motor failure 3. Reducer failure 4. chain drive failure	1. Check power supply 2. Check and replace motor and bearings. 3. Check teeth worn gears and bearings. Replace necessary parts 4. Replace chain

7.2 - ROTORDISK® PROCESS

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
1. Slime on media appears shaggy with a brown colour	PROPER OPERATION	NO PROBLEM NORMAL CONDITION
2. Black slime growing on disks	Solids and/or BOD overloading	**a.** Pre-aerate RBC influent **b.** For severe organic overloads, increase recycle rate **c.** De-sludge unit **d.** Place another RBC unit in parallel
3. Rotten egg or other obnoxious odors	Solids or BOD overloading	See Problem 2, solutions a, b, c and d, above
4. Development of odors and white biomass over most of the media surface	1. Septic influent wastewater or high hydrogen sulfide or sulfate concentration	**e.** Determine the cause of the problem and correct it at source. For example, aerate equalization tank **f.** Pre-aerate influent wastewater **g.** Determine the cause of the problem, possibly with the addition of chlorine or hydrogen peroxide; potassium permanganate has also been used
	2. Overload first stage	**a.** Check dissolved oxygen levels to confirm overload problem **b.** Increase number of recycle buckets
5. White slime	1. Bacteria that feed on sulfur compounds. Also, industrial discharges containing sulfur compounds may cause an overload	▪ See Problem 2, solutions a and b above
	2. Grease on the disks	**a.** Remove grease at source **b.** Install grease traps
6. Sloughing or loss of slime (biomass)	1. Toxic or inhibitory substances in influent, including abrupt pH changes	**a.** Eliminate source of toxic or inhibitory substances **b.** Reduce peaks of toxic or inhibitory substances by carefully regulating inflow to plant **c.** Dilute influent using plant effluent or any other source of water **d.** See Problem 7.4
	2. Variation in flow or organic loading	**a.** - During low flow or loading periods, pump from secondary clarifier or 4th stage RBC unit effluent to recycle water with food and dissolved oxygen through the RBC unit **b.** - During high flow or loading conditions, attempt to throttle plant inflow during peak periods **c.** - For severe organic under loads, add a cheap source of soluble carbon in the PST such as molasses

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
7. Decrease in process efficiency	1. Reduced wastewater temperature	**a.** Decrease air opening in RBC building **b.** Heat air inside RBC unit cover or building
	2. Unusual variations in flow or organic loading	▪ See Problem 6, cause 2, solutions a and b above
	3. Sustained flows or loads above design levels	▪ Install additional treatment units
	4. High or low pH values	▪ Adjust pH to near neutral
	5. Improper rotation of media	▪ Inspect chain tension and adjust
8. Accumulation of solids and clogging in the RBC system	Solids removal in pre-treatment steps is not adequate	**a.** Improve pre-treatment efficiencies **b.** Provide supplemental aeration to help prevent solids from settling **c.** De-sludge primary tank
9. Floating or rising sludge in the secondary clarifier	Removal of sludge from the clarifier is inadequate	**a.** Increase the duration of pumping sludge from the clarifier **b.** Remove sludge from the clarifier more often
10. Excess shaft weight or biomass thickness	1. Organic loading too high	▪ Decrease organic loading
	2. Stage loading too high	**a.** Increase number of recycle buckets
	3. Inorganic solids accumulation because of inadequate pre-treatment	▪ Check primary treatment and grit removal equipment for proper operation
	4. Accumulation of minerals	▪ Use chemical pre-treatment to eliminate minerals
	5. Digester supernatant adding excessive BOD or sulfides	▪ Modify supernatant pumping frequency
11. Shaft rotation non-uniform or "jerky"	1. Normal variations in balance	▪ Time rotation by quarters. A difference of less than 3 seconds in quarter rotation time is normal
	2. Uneven biomass weight due to power outage	**a.** If severe, shut unit down and wash down disks **b.** Turn off the unit temporarily and rotate manually to uniformly wet biomass growth before restarting **c.** Decrease or stop flow of wastewater to affected units **d.** contact manufacturer for assistance

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
12. Effluent quality apparently below requirements	1. Organic loading too high	**a.** Add additional operating RBCs **b.** Identify cause of additional loading and eliminate at source **c.** Add supplemental air to RBC trough
	2. Sampling or testing procedures inaccurate	**a.** If nitrification is occurring, analyze for carbon BOD only by using nitrification inhibitor **b.** Check for contaminated dilution water, sampler lines, or improper sampling storage
	3. Inadequate secondary clarifier operation	**a.** Clean and de-sludge clarifier **b.** Modify sludge removal procedures to eliminate BOD kickback **c.** Install filters after clarifier **d.** Increase alum dose to enhance flocculation
	4. Anaerobic solids in the RBC tanks producing BOD kickback	▪ Flush or drain tanks
13. Snails or other nuisance organisms in RBC tanks	Nutritional and conducive environment for reproduction of hard-bodied shell snails ($^1/_8$" - $^1/_2$" in size)	**a.** Addition of controlled dosages of chlorine. Physical removal may be required with taking units out of service temporarily **b.** Contact manufacturer

Contact SEPROTECH SYSTEMS INCORPORATED for advice on how to resolve problems related to the process before making changes to the process or equipment.

Adapted from Water Pollution Control Federation "Manual of Practice OM-10", 1988.

8.0 - MAINTENANCE PROGRAM – Do’s and Don’ts

DO'S

1. Do use biodegradable soap if at all possible. The system will however handle a certain amount of normal soap. When laundering clothes, please follow manufacturer's instructions regarding quantity of detergent. Excessive use of detergent can cause odour in the system.

2. Do put large amounts of grease in a container and dump in garbage. The system will handle a certain amount of fat and grease. If a tile bed is used and if fats and grease get into it, they may plug the pores of the soil and seal up the bed. Never put large amounts of grease (i.e. old grease from deep fryer) into the sewer lines.

3. Have your system pumped out a minimum of once a year to remove sludge and scum to maintain top operating treatment in your system and filter bed.

4. For small systems equipped with a service hatch, keep the service hatch above the ground. Do not let run-off water enter system, as this will cause hydraulic overload.

5. If a tile bed is used, do keep traffic such as cars, snowmobiles, etc., away from the system bed areas as they will break pipes and seal the soil over the bed.

6. If a tile bed is used, do leave the raised filter in place without disturbing it. The filter is specifically designed to provide maximum dispersal of the water. Altering it by adding fill, covering it up or changing in any way may destroy its water dispersal characteristics and result in bed failure.

7. If a tile bed is used, do encourage a growth of ground cover over the filter bed as it helps disperse water by evaporation and transpiration.

DON'Ts

1. Do not put non-biodegradable materials downs the drain, put them in the garbage, these include any plastics, rubber, disposable diapers, sanitary napkins, rubber goods, cigarettes, children's toys, cellophane, etc. They will plug the system, and a pump out will be needed.

2. Do not put harsh chemicals down the drain. They will kill the bacteria necessary for efficient treatment. These include acid or caustic cleaners, gasoline, oil, turpentine, photographic chemicals, etc. Disinfectant and chlorine bleaches should be kept to domestic uses.

3. Do not leave taps running or faulty toilets. The excess water may overload the system and, if used, tile field causing breakout and poor treatment.

4. If you do not have access to workers with appropriate training, do not attempt to fix the mechanical parts yourself. Your dealer is trained to repair your plant and work safely with electrical and mechanical components. Call him if you have a problem or concerns.

5. Do not connect any other electrical load to the fuse or breaker feeding the plant as it will cause damage to the controls.

6. Never put large amounts of grease (i.e. old grease from deep fryer) into the sewer lines.

YOUR CO-OPERATION WITH RESPECT TO THE ABOVE POINTS SHOULD ENSURE TROUBLE-FREE OPERATION OF YOUR TREATMENT PLANT AND WILL BE GREATLY APPRECIATED.

9.0 - INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS FOR VARIOUS MECHANICAL PARTS OF THE **ROTORDISK®** AND OTHER EQUIPMENT SUPPLIED

9.1 INSTALLATION & MAINTENANCE DETAILS FOR ROLLER CHAIN DRIVES

CHAIN TENSIONING:
The proper fit of a chain may be obtained by adjusting the sprocket centres. When a chain is correctly tensioned, the total mid-span movement (double amplitude) in the slack span should be 4-6% of the span length for normal drives.

Where there is no adjustment means, adjustment may be made by removing links to compensate for elongation due to wear (Drives with fixed centres). Proper lubrication and proper drive maintenance may minimize chain wear.

LUBRICATION:
Although many slow speed drives operate successfully with little or no lubrication beyond the initial factory lubrication, proper lubrication will greatly extend the useful life of every chain drive.

A good grade of clean petroleum oil without additives, free from flowing at the prevailing temperatures should be used.

Chain drives should be protected from abrasive and corrosive conditions, and the oil supply kept free of contamination. Periodic oil change is desirable. The lubricant viscosity recommended for ambient temperature 40^{o} - 100^{o}F is SAE 30.

OIL BATH:
With bath lubrication, the lower strand of chain runs through a sump of oil in the drive housing. The oil level should reach the pitch line of the chain at its lowest point while operating. Only a short length of chain should run through oil.

INSTALLATION RECOMMENDATIONS:

Shafting, bearings and foundations should be supported rigidly to maintain the initial alignment. Roller chain should be free of grit and dirt. Wash chain in kerosene when required. Re-lubricate!

Misalignment results in uneven loading across the width of the chain and may cause roller link-plate and sprocket tooth wear. Drive alignment involves two things:

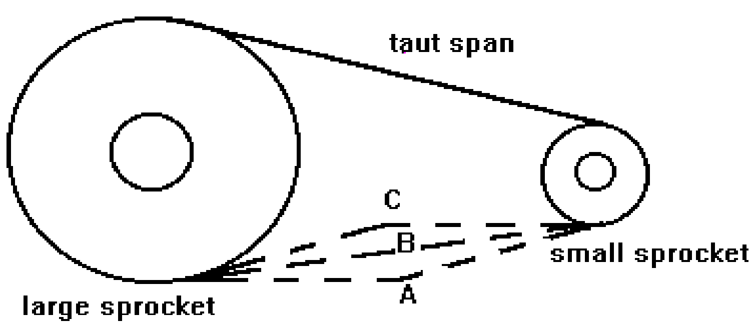
a) Parallel shaft alignment: Shafts should be parallel and level.
b) Axial sprocket alignment: Sprocket axial alignment can be checked with a straight edge, which will extend across the finished sides of the two sprockets.

Normally, it is good practice to align sprockets as close to the shaft bearings as possible.

Installing the Chain: Recheck all preceding adjustments for alignment and make sure all setscrews, bolts and nuts are tight. Fit chain around both sprockets and bring free ends together around one sprocket for connection.

Chain Tension: Check chain tension to be sure that the slack span has 4-6% mid-span movement in horizontal drives.

Recommended Possible Mid-Span Movement AC									
Drive	Tangent Length Between Sprockets								
Center-Line									
	5”	10”	15”	20”	30”	40”	60”	80”	100”
Horizontal to 45	.25”	.5”	.75”	1”	1.5”	2”	3”	4”	5”
Vertical to 45	.12”	.25”	.38”	.5”	.75”	1”	1.5”	2”	2.5”



AC = Total Possible Mid-Span Movement
Depth of Free Sag = .866 AB, approximately

MAINTENANCE RECOMMENDATIONS:

Regular maintenance schedules should be followed for all chain drives. Each drive should be inspected every six months. At each inspection period the following points should be checked:

a) Check Lubrication: If chain is covered with grit or chips, it should be cleaned in kerosene and re-lubricated before reinstalling. With bath lubrication, oil should be maintained at the proper level, as shown in lubrication instructions. Add oil if necessary. At each inspection, oil should be checked for contamination, such as chips, dirt or grit.

b) Check sprocket alignment: If the chain is properly aligned, no wear will show on the inner surfaces of the chain roller link-plates. If wear is apparent, this is evidence that sprockets are misalign and should be realigned as outlined in the installation instructions to prevent further chain and sprocket wear.

c) Check sprocket tooth wear: If sprocket shows evidence of wear high on the sprocket teeth, this is evidence of excessive wear in the chain, the chain should be replaced. If the sprocket teeth are severely worn, the sprocket should be replaced. Do not run new chain on worn sprockets.

d) Check chain tension: At each inspection period, the chain tension should be adjusted. If excessive slack has accumulated which cannot be removed by available shaft centre adjustment (i.e. by moving reducer away from large sprocket using chain tensioning bolts), two or more pitches of chain should be removed and chain reconnected.

9.2 PROCEDURE FOR ASSEMBLING BEARINGS AND PILLOW BLOCKS

Shaft Preparation
Clean shaft and remove any burrs or sharp edges. Check the shaft diameter to given specifications.

Seal Installation
Place seal, which consists of: Double lip 'G' type seal

MOUNTING OF BEARING ON SHAFT

Adapter Sleeve Mounting
Position adapter sleeve on the shaft to correct location with respect to required bearing centerline. A smear of lubricating oil (SAE 10 or 20) applied to the sleeve outside diameter surface results in easier bearing mounting and removal. (For pillow blocks mounted close to a pulley hub or similar obstruction, mount the adapter sleeve with threads inboard for easy removal. Remember to slide lock-nut, lock-washer and bearing onto the shaft before positioning the sleeve.)

NOTE: All bearings mounted on tapered sleeves have to be driven up the taper to the tolerances given in SKF tables, to ensure correct fits. Spherical roller bearings can be measured between the unloaded rollers and the outer ring sphere surface.

Un-mounted Clearance, Spherical Roller Bearings
Measure the un-mounted internal clearance in the bearing by inserting and sliding progressively larger feeler blades the full length of the roller between the most vertical unloaded rollers and the outer ring sphere. Never run the rollers over the feeler blade, as the wrong value will be obtained. Record the measurement of the largest size blade that will slide through. This is the un-mounted internal clearance.

Bearing
Mount the bearing hand tight on the adapter sleeve. Be sure the large end of the bore of the inner ring matches the taper of the adapter. To avoid damage to the bearing it is most important during this and subsequent operation that the shaft is blocked up so the bearing is unloaded. Do not apply lock-washer. Drive up procedure may damage it.

Bearing Drive Up, Spherical Roller Bearings
Lubricate the face and thread of the lock nut and apply to sleeve with chamfered face toward the bearing. Tighten the lock nut. Do not attempt to tighten the lock nut with a hammer and drift (use proper wrenches), the lock nut can be damaged and chips can enter the bearing. Further tighten the lock nut and measure the internal clearance until the internal clearance is less than the un-mounted clearance figure by the amount shown in the attached table (see last page). Finally, remove lock nut, position lock washer with outer tangs facing away from the bearing, and inner tang properly seated in the slot provided in the adapter. Replace lock nut and tighten until firmly seated.

PREPARATION OF PILLOW BLOCK HOUSING

Check to be sure all pillow block parts are free of burrs and are completely clean. Internal surfaces should be removed. Apply a thin coat of grease to the bearing seat in the base. Fit the bearing and seal inserts into the pillow block base, being careful not to damage to O-rings. For assembling larger sizes where hoists must be used, it may be convenient to seat both bearings into their housing bases simultaneously.

<u>FIXING RINGS</u>

On each shaft one bearing is generally "Held" and other bearings are "Free", to permit shaft expansion. For "Held" bearing housings, use two fixing rings. Place one on each side of bearing.

<u>CAPPING THE PILLOW BLOCK</u>

Place the cap on the base so that the dowel pins in the base align with the holes in the cap, being careful not to damage the O-rings. Caps and bases are <u>not</u> manufactured for interchangeable assembly. They must be kept together. Install cap-bolts with lock washers and tighten securely.

<u>GREASE LUBRICATED BLOCKS</u>

Lubrication Notes

<u>Grease Lubrication</u>

If grease is used as a lubricant, it should be smeared between the rolling elements and worked in. The lower half of the housing should be packaged $^1/_2$ to $^3/_4$ full.

PROCEDURE FOR APPLYING LUBRICANT TO BEARINGS AND PILLOW BLOCKS

Pack each bearing as completely full of the specified grease as possible by swiveling the outer ring open and rotating it as necessary to inject the grease. Then, swivel the outer ring closed being careful not to use force in the event a roller end catch the corner of the outer ring sphere.

B) Before assembling the pillow block cap to the base, and after completing bearing and base assembly, fill $^1/_2$ to $^3/_4$ of the pillow block <u>base</u> with the same lubricant that was used to pack the bearing.

LUBRICATION PROCEDURE TO BE USED AT START-UP

A) All pillow block assemblies that have not been prepared for stage are ready for use, assuming the installation procedures have been correctly followed.

B) While shaft is rotating, lubricate each seal through the outside lubricant fittings until grease is seen emerging from the labyrinth areas. Make sure the outside of the lubricant fitting is clean before applying grease.

RE LUBRICATION

Lubricants deteriorate in time, and the rate of deterioration is a function of the lubricant used at the operating conditions encountered. Determining the re-lubrication cycle depends on sampling the grease and analysis of the samples. Provisions must be made to adequately evaluate the contamination by solids. Samples for grease evaluation should be taken from near the bearing, and evaluation of the samples should dictate the re-lubrication cycle.

Remove caps once a year and re-apply new grease.

Each seal assembly should be lubricated once a month, while the bearing is rotating, with the same grease that is used in the bearing.

GREASE CLASSIFICATION

		Oil Viscosity Saybolt Second (approx. SSU)		
Class	Type of Base (1)	@ 100 F	@ 210 F	NLGI (2) Grade
A	Lithium or Equal	200 - 500	48 – 55	0
B	Lithium or Equal	400 - 600	58 – 68	1
C	Lithium or Equal	800 - 1,000	75 – 82	1
D	Lithium only	800 - 1,000	75 – 82	2

	Grease requirement from above			
Operating temperature of bearing (4)	Low (5)	Medium	High	Suggested Re-lube cycle
0 – 70	A or B			6 – 12 months
70 – 120	B or C			6 – 12 months
120 – 160	B or C	C or D (6)	D (7)	2 - 3 weeks
160 – 200	C	C or D (6)	D (7)	1 - 4 weeks

1) Calcium Complex Greases NOT recommended for spherical roller bearings.

2) National Lubricating Grease Institute Consistency Code.

3) Definition of speed categories:
Low: up to 1/4 of catalog speed limit for static oil lubrication.
Medium: 1/4 to 1/2 catalog speed limit for static oil lubrication.
High: 1/2 to full catalog speed limit for static oil lubrication.

4) Consult SKF Engineering if temperature is below 0^{o} or above 200^{o}F.

5) Extremely slow speed will require special consideration if loads are high.

* Under all conditions, application should be checked using the SKF lubricant film parameter found in the Engineer Data Catalog.

6) Use type "C" where load is heavy, 15,000 hours-rating life or less and/or speed are less than RPM.

7) Consult SKF Engineering - Grease lube not normally recommended under this combination of operating conditions.

8) Dry clean applications only. For moderate conditions of dirt and/or moisture, use cycle of 1 to 2 months. For extreme conditions of dirt and/or moisture, use cycle of 1 week. Vertical applications normally require shorter than normal re-lube cycle.

9) Never mix greases with unlike bases.

10) Remove old grease at least once a year.

10 - LIMITED WARRANTY

SEPROTECH SYSTEMS INCORPORATED warrants the parts in each treatment plant to be free from defects in material and workmanship; for a period of 15 months from shipment or 12 months from start-up, whichever occurs first, in the treatment of domestic wastewater. Sole obligation under this warranty is as follows:

SEPROTECH SYSTEMS INCORPORATED shall fulfil this warranty by repairing or exchanging any component part, F.O.B. our factory, that in SEPROTECH SYSTEMS' judgement, shows evidence of defects, provided said component part has been paid for and is returned through an authorized dealer, transportation prepaid. The warranty must also specify the nature of the defect to the manufacturer. New placed parts are under warranty for one year.

The warranty does not cover treatment plants that have been flooded, by external means, or that have been disassembled by unauthorized persons, improperly installed, subjected to external damage or damage due to altered or improper wiring or overload protection.

This warranty applies only to the treatment plant and does not include any other electrical wiring, plumbing, drainage, or disposal system. SEPROTECH SYSTEMS INCORPORATED is not responsible for any delay or damages caused by defective components or material, or for loss incurred because of interruption of service, or for any other special or consequential damages or incidental expenses arising from the manufacture, sale, or use of this plant.

SEPROTECH SYSTEMS INCORPORATED reserves the right to revise, change, or modify the construction and design of the treatment plant for domestic wastewater or any component part or parts thereof without incurring any obligation to make such changes for modifications in previously sold equipment. SEPROTECH SYSTEMS INCORPORATED also reserves the right, in making replacements of component parts under this warranty, to furnish a component part, which, in its judgement is equivalent to the Company part replaced.

Under no circumstance will SEPROTECH SYSTEMS INCORPORATED, be responsible to the warrantee for any other direct or consequential damages. Including but not limited to; lost profits, lost income, labour charges, delays in production, and/or idle production, which damages are caused by a defect in material and/or workmanship in its parts.

This warranty is expressly in lieu of any other expressed or implied warranty, excluding any warranty of merchantability or fitness, and of any other obligation on the part of SEPROTECH SYSTEMS INCORPORATED.

Appendix E.3

Model N30 – Milne Inlet Camp

ROTORDISK®
Aerobic Wastewater
Treatment Plant

Model B30
Shanco Baffinland
Project #60069

ROTORDISK®
Aerobic Wastewater Treatment Plant
Model B30

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

Shanco Baffinland
Project #60069

Seprotech
Water. Pure and Simple

ROTORDISK®

Wastewater Treatment Plant
Model B30

INSTALLATION, OPERATION & MAINTENANCE MANUAL

August 2007

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INSTALLATION, OPERATION AND MAINTENANCE

MANUAL

TABLE OF CONTENTS

IMPORTANT: READ THIS INSTALLATION PROCEDURE PRIOR TO START-UP.

1.0 SITE INSTALLATION OF ROTORDISK® SEWAGE TREATMENT PLANTS:

1.1 (applies to Steel Tankage only)

When there is a complete ROTORDISK® unit supplied, site preparation is as follows:

A level concrete or well-compacted gravel base is to be supplied by Customer/Contractor.

Unit to be lifted only at lifting points by use of hooks and spreader bars.

All anchoring and levelling of ROTORDISK® on site to be done by customer/contractor. Check alignment of shaft and sprockets and clearances of couplings where applicable prior to start-up, failure to do so may void manufacturer's warranty. Refer to this ROTORDISK® manual for details. If required, the contractor must perform levelling.

All hydraulic piping, to and from the unit, is to be supplied and installed by customer/contractor.

All input electric and hydro hook-ups to be done by customer/contractor to local governing regulations and a signed approval sent to SEPROTECH SYSTEMS INCORPORATED. Under no circumstances must electrical connections, junction boxes or equipment pertaining to the electrical function of the unit be installed in the ROTORDISK® tank.

SEPROTECH SYSTEMS INCORPORATED GROUP INC. will supply a man on-site to assist customer/contractor at a specified rate and at customer/contractor discretion.

If unit is not shipped completely assembled assembly instructions and drawings will be supplied.

IMPORTANT: READ THIS INSTALLATION PROCEDURE PRIOR TO START-UP.

1.2 - (applies to Concrete Tankage for ROTORDISK® only)

If the ROTORDISK® unit supplied is to be encased in concrete tankage, the site preparation is as follows:

The unit is lowered into the concrete tankage, the pipe at the end of the unit is placed into the opening of the intermediate wall between the primary and final settlement chambers and lowered onto the anchor bolts (contractors supply).

Unit to be lifted only at lifting points by use of hooks and spreader bars.

All anchor bolts (contractors supply) should be correctly located in concrete in a vertical position. In addition, all bolts should include a levelling nut.

All anchoring and levelling of ROTORDISK® on site to be done by customer/contractor. When the unit is set onto the anchor bolts in the concrete tank, it must be levelled to a slope of no more than 3/4” in 20’ along the length. The unit is then centred in the tank and completely bolted down.

After the unit has been bolted down, check alignment of shaft and sprockets and clearances of couplings where applicable prior to start-up, failure to do so may void manufacturer's warranty. Refer to this ROTORDISK® manual for details. If required, the contractor must perform levelling.

All hydraulic piping, to and from the unit, is to be supplied and installed by customer/contractor.

All input electric and hydro hook-ups to be done by customer/contractor to local governing regulations and a signed approval sent to SEPROTECH SYSTEMS INCORPORATED. Under no circumstances must electrical connections, junction boxes or equipment pertaining to the electrical function of the unit be installed in the ROTORDISK® tank.

SEPROTECH SYSTEMS INCORPORATED will supply a man on-site to assist customer/contractor at a specified rate and at customer/contractor discretion.

If unit is not shipped completely assembled assembly instructions and drawings will be supplied. (As shown)

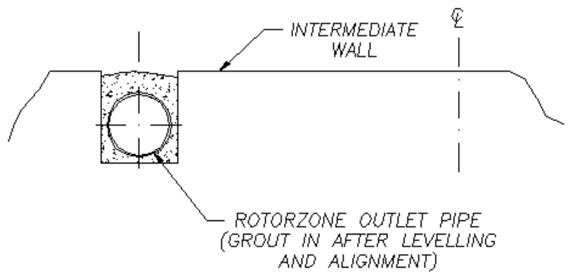


Figure a - **ROTORDISK®** tank outlet through intermediate wall between settlement tank chambers.

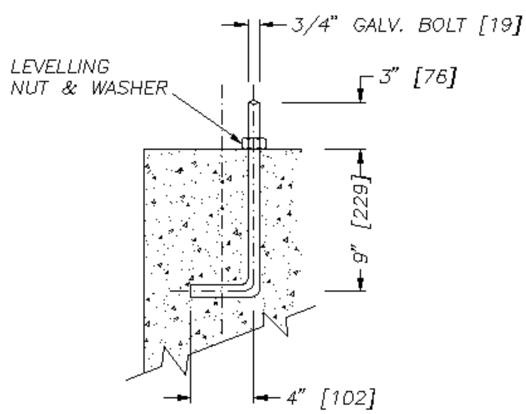
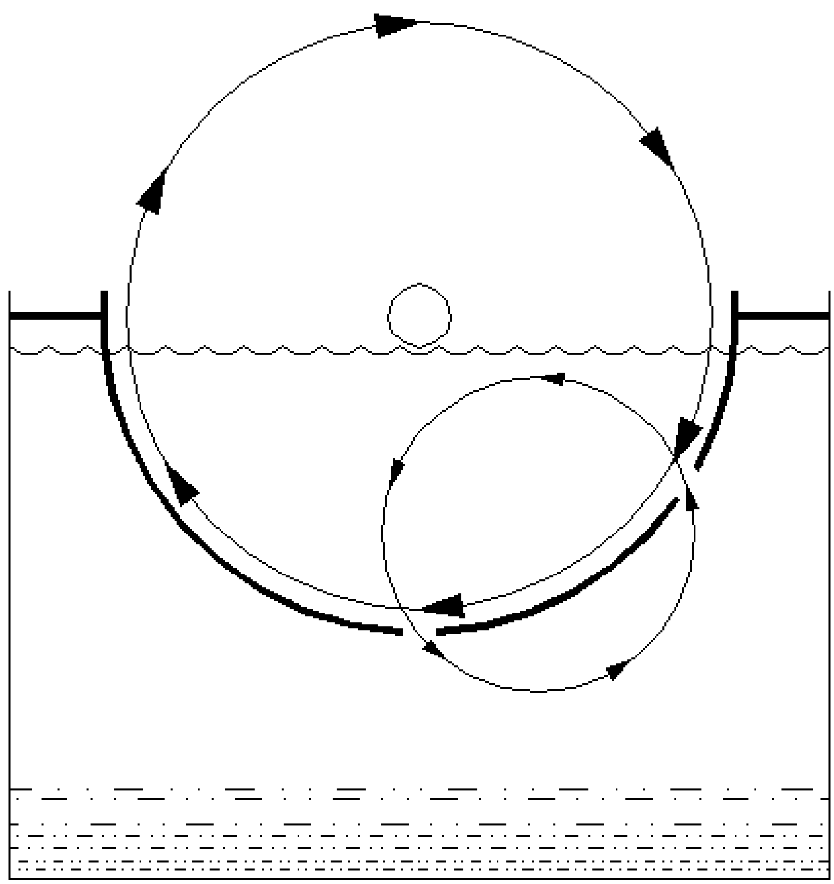


Figure b - anchor bolt detail for **ROTORDISK®** tank.

1.3 - DIRECTION OF SHAFT ROTATION



The direction of shaft rotation should be such that disks mounted on shaft will enter water on the side where inlet to "Rotorzone" is located. The electric motor driving the shaft should be wired accordingly.

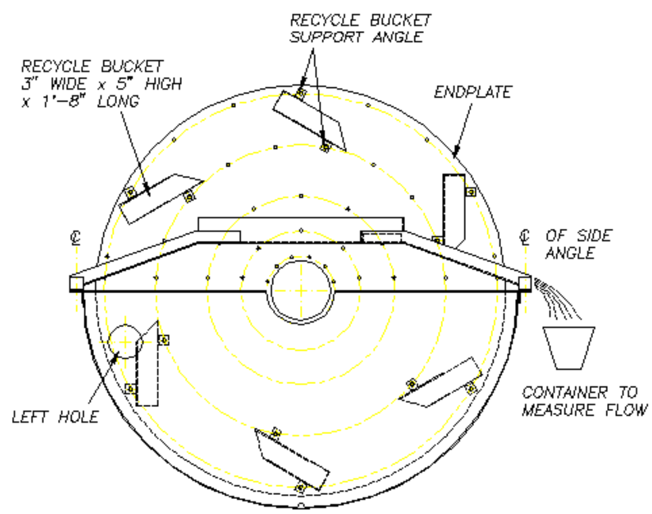
1.4 - DISSOLVED OXYGEN (D.O.) RECYCLE for ROTORDISK®

1.4.1 Recycle buckets are mounted on the last stage of the ROTORDISK®. These buckets rotate at the same speed as the disks. See the attached elevation view of the recycle buckets and trough on the Rotorzone tank.

1.4.2 As the disks rotate, the buckets scoop-up treated wastewater. As this wastewater falls into the recycle trough, it is exposed to the atmosphere, where it absorbs fresh oxygen. The wastewater then cascades on one side of the trough through a narrow steel channel and mixes back with the contents of the Primary Clarifier, thereby introducing fresh dissolved oxygen in the Primary Clarifier. See the section of diskbank assembly showing buckets and recycle trough.

1.4.3 The set-up described above is comprised of the recycle buckets and recycle trough, is what we term as our D.O. re-circulation device. This is especially advantageous to preventing septic conditions from occurring in the Primary Clarifier in small flow or low flow situations.

1.4.4 It is **important** to measure the **<u>actual recycle rate</u>** on the **ROTORDISK®**. This data is compared to our theoretical recycle rate designed. This is advantageous prior to connecting and setting-up for service. Using a container (5 gallon bucket is ideal) and a stopwatch, record the water flowing out of the effluent channel of the recycle trough. Make 3-5 readings, and report this data to SEPROTECH SYSTEMS INCORPORATED for future reference.



SECTION OF DISKBANK ASSEMBLY
SHOWING 6 BUCKETS
AND RECYCLE TROUGH

1.5 - SUMMARY OF OPERATION

(ROTORDISK® systems designed for BOD/SS/Ammonia/Nitrate removal)

A). The sewage plant (as supplied by SEPROTECH SYSTEMS INCORPORATED) is comprised of five (5) main components: the primary settling tank, the RBC tank, the denitrification tank, the secondary settling tank and the multi-media filters.

B). The RBC tank is the aerobic section of the treatment plant divided into four (4) stages.

Raw sewage is pumped and/or gravity flows into the primary settling tank (PST). When the sewage is pumped into the plant, pumping must simulate conditions encountered in gravity fed systems. Indeed, over a 24-hour period, the plant is designed to handle a flow rate corresponding to the Average Daily Flow (ADF) and can accommodate for two Peak Daily Flow (PDF) periods of two (2) hours per day. Each PDF event can be at a maximum of three times ADF.

In the PST, sedimentation separates heavy solids from the bulk of the liquid and the supernatant enters the aerobic section through the inlet slot located at the front section of the RBC tank.

The aerobic section is made up of four stages. The 1st stage is mounted on one common shaft. This 1st stage is comprised of one (1) to three (3) disk banks. The normal colour of the bacteria in the 1st stage is dark brown. This is the stage where most of the BOD removal by biological oxidation occurs. The succeeding 2nd, 3rd, and 4th stages are mounted on the rest of the shaft or another common shaft. Each stage has one (1) to three (3) disk banks. It is in the 2nd stage that further BOD is removed, and nitrifying bacteria (those which convert ammonia (NH_3) in the form of ammonium ions (NH_4^+) into nitrite (NO_2^-) and, ultimately, nitrate (NO_3^-)) start to predominate in the 3rd and 4th stages. The 4th and last aerobic stage has recycle buckets that introduce both fresh dissolved oxygen into the primary settling tank and nitrifying bacteria present in the recycled water.

The rotation of the disks in and out of the water provides a mean of air and heat transfer from the ambient air to the water. The transfer of air to the water is important for aerobic bacteria to remove BOD and ammonia. The transfer of heat to the water is important to maintain the water at an optimum temperature of 15 °C and above such that BOD and ammonia removal rates by the bacteria are maximised (removal rates are a function of the water temperature). Because maintaining a temperature that provides acceptable removal rates is important to the process, RBC's are installed indoors and ambient air is maintained at 15 °C and above.

C). The media in the denitrification section is completely submerged since denitrifying bacteria convert nitrate (NO_3^-) to nitrogen gas (N_2) in an anoxic (i.e., in the absence of dissolved oxygen (DO)) environment.

(Text missing pending completion of patent application process.)

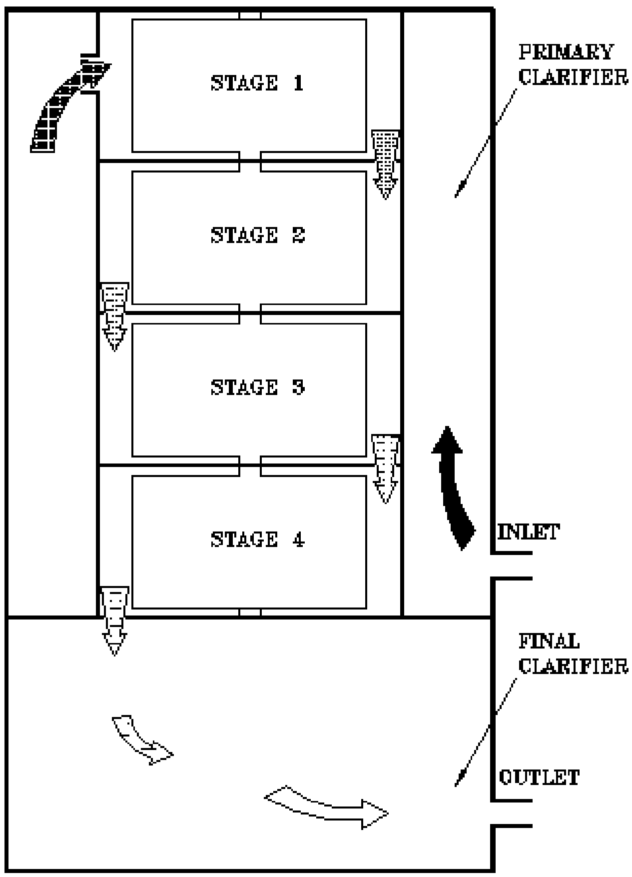
The denitrification section is comprised of two stages separated by a baffle. An equal amount of media is provided in both stages.

D). Partially treated water from the denitrification section then enters the secondary settling tank. Sloughed off biomass from the disks and media bundles and other suspended solids is further settled in this chamber.

E). The partially treated water is then fed to three (3) multi-media filters using one of two (2) submerged pumps. The purpose of these filters is to further reduce the concentration of suspended solids in the final effluent.

2.0 - ROUTINE VISUAL CHECKS ON PHYSICAL AND BIOLOGICAL FUNCTIONING OF ROTORDISK® & DESCRIPTION OF TREATMENT PROCESS

ROTORDISK® sewage treatment plants have three major steps in the purification process. In the primary settling tank, gross solids separate from the flow by either sinking or floating. In the Rotorzone, dissolved pollutants are broken down to simple, non-pollutant compounds by the bacteria ("biomass") which grows on the rotating disks. The final settling tank permits gravity separation of spent biological growth, which continually sloughs off the disks in the Rotorzone preceding it.



2.1 - PRIMARY SETTLING TANK (PST OR PRIMARY "CLARIFIER")

The accumulation of floating scum on the surface of the primary clarifier is normal. It is proportional to the accumulation of settle-able solids at the bottom of the tank. Periodic (9-12 months) removal of sludge at the bottom of the tank is required for proper operation of the Unit.

If no sludge measuring device is available, the accumulation of 9"-12" depth of scum on the surface is a good indication that it is time to remove the accumulated deposits of sludge from the bottom of the tank(s).

2.2 - ROTORZONE

The Rotorzone is subdivided into four sections, with disk banks in each. The wastewater first enters the Rotorzone in the section marked "1" in the sketch (furthest away from the inlet to the plant). The flow then proceeds through sections 2, 3, and 4 before entering the denitrification zone.

The accumulation of biological growth will be greatest in section 1, and gradually decrease through subsequent sections. Generally, the growth will be thick, and often filamentous ("stringy"), in section 1, becoming thinner and more compact through sections 2-4.

The colour of the growth will typically be dark brown to black in Section 1. Some grey growth may also be noticed, depending on the relative load and type of wastewater being treated. Growth in sections 2-4 will typically vary from medium brown to a light brown or tan growth in section 4.

In a well-functioning unit with the appropriate feed of wastewater, there will be an earthy, humus-like ("musty") smell inside the unit. A substantial sour, "sewage" smell may be an indication of sub-optimal conditions in the treatment process.

2.2.1 - 'BATHTUB RING'

The wastewater flows by gravity within a ROTORDISK® Plant thus the water level is relatively constant. Changes in water level of 1" to 2" are not unusual due to surge flows entering the unit. The evidence of this is a 'bathtub ring' 1" - 2" above the normal level. A 'bathtub ring' higher than this suggests that partial or complete flooding of the unit has occurred since the last check. If so, the (gravity or pump) discharge system should be checked for blockages or mechanical malfunction. Another condition which can lead to the level of water rising to greater levels than 1" – 2" is if the plant is fed by pumps that exceed the design limits of the plant (i.e., ADF over a period of 24 hours including a maximum of two (2) PDF events no longer than 2 hours each).

2.3 – ACETIC ACID INJECTION SYSTEM

One of the most important building blocks of life is carbon. The bacteria responsible for denitrification need carbon in an organic form to grow and thus convert nitrate to nitrogen gas. Most soluble organic carbon (often measured in terms of Biochemical Oxygen Demand or BOD) has been consumed in the aerobic section of the wastewater treatment plant and there is thus very little left for the denitrifiers by the time the wastewater reaches the denitrification section of the plant. It is for this reason that acetic acid (vinegar), an easily biodegradable organic carbon source, is injected at the inlet of the denitrification zone.

The system provided consists in a 125 imp. gal. storage tank (ϕ=30", H=49") equipped with a mixer and of a dosing pump of maximum capacity 12.3 l/h mounted on a skid.

The dosing pump can be controlled in either of two ways: by a 4-20 mA signal coming from the flowmeter located on the effluent outlet pipe (the system is programmed to be operated that way by default) or by a dry contact (by others) located outside SEPROTECH SYSTEMS INCORPORATED's main control panel. For example, that dry contact (by others) could be closed when the pumps (by others) feeding the wastewater treatment plant are running and opened when they are not.

The target dose of pure acetic acid (CH_3COOH) in the water is: 175 mg/litre. Assuming that commercial acetic acid is at a concentration of 12% by weight, this means that the target dose of commercial acetic acid at the inlet of the denitrification section would be 1460 mg of commercial acetic acid per liter of water. At ADF (i.e., 49,000 litres per day), this corresponds to a dosing rate of 2.9 litres of commercial acetic acid per hour. If the 4-20 mA signal from the flowmeter is used to control the dosing pump (again, this is the default mode), then the actual dosing rate will be $3 \times 2.9 = 8.7$ litres of commercial acetic acid per hour one third of the time since the flow exiting the plant (via the flowmeter) is pumped from the FST to the multi-media filters at a rate of $3 \times \text{ADF} = \text{PDF}$ (i.e., 147,000 litres per day).

The average daily quantity of commercial acetic acid necessary has been estimated at 70 l/day (15.4 imp. gal per day) based on an ADF of 49,000 litres/day.

2.4 – DENITRIFICATION ZONE

(Text missing pending completion of patent application process.)

In the denitrification zone, the media is completely submerged such that anoxic conditions (i.e., the absence of Dissolved Oxygen (DO) in the water) prevail and thus the denitrification process (i.e., the conversion of nitrate (NO_3^-) to nitrogen gas (N_2)) can take place. The denitrification zone includes two (2) stages that are separated by a baffle.

2.5 – FINAL SETTLING TANK (FST OR FINAL "CLARIFIER")

The effluent near the outlet at the backside of the final clarifier should be relatively clear and colourless and relatively free of suspended matter. Clarity can best be judged by scooping a small volume of the final effluent into a clear glass container. This is particularly true of larger units where the depth and dark colour of the tank walls may make clarity hard to determine. (Note: Although the risk of infection is very small, the wearing of rubber gloves is a rational safety precaution when hand-scooping the effluent for a clarity check. This is particularly true if there are open cuts on the hands.)

Although the final effluent itself should be relatively clear, some floating matter may accumulate on the surface of the final clarifier. This is normal, and will typically be much less than the accumulation of floating scum in the primary clarifier.

2.6 – FILTERS FEED PUMPS LOGIC AND LEVELS IN THE FST

The level in the FST is controlled in the following manner:

- Level Switch Low (LSL or float #1): both filter feed pumps (each of capacity = 3 × ADF) stop when this level is reached;
- Level Switch High (LSH or float #2): lead filter feed pump starts when this level is reached;
- Level Switch High High (LSHH or float #3): lag filter feed pump starts (lead filter feed pump is maintained in operation) and an alarm goes off when this level is reached (i.e., the alarm light is activated);
- Overflow: the FST is equipped with an outlet that can be connected directly to the storm sewer in the exceptional case that the plant is overflowed (piping between this outlet and the storm sewer is out of SEPROTECH SYSTEMS INCORPORATED' scope of supply).

2.7 – POST FILTRATION SYSTEM

The clarified water is pumped from the FST to three multi-media filters operating in parallel. The purpose of these multi-media filters is to reduce further the concentration of suspended solids in the treated wastewater.

The three filters operated in parallel are designed to treat peak low rates (PDF) of 3 times the design average daily flow (ADF) and are fed at this flow rate since each filter feed pump also has a capacity of PDF.

Each of the three filters is filled with anthracite, sand and garnet with gravel underbedding. The water is filtered from top to bottom of each filter with the coarser filtration media placed on top and the finer on the bottom of the filter. Each vessel is made of fibreglass. In normal operation (i.e., when all 3 filters operate in parallel), the filtration velocity is about 10 m/h on each filter.

A backwash of one of the three filters is performed approximately every 4 hours. The filters are backwashed alternately, i.e., filter no. 2 gets backwashed approximately 4 hour (exactly 4 hours + the time it takes to backwash and rinse a filter) after filter no. 1 gets backwashed and filter no. 3 gets backwashed approximately 4 hour after filter no. 2 gets backwashed. These operating parameters are adjustable on the plant's main control panel (see Section 2.9). When a backwash occurs, the water pumped at PDF from the FST is fed to two of the filters and the filtrate from these is used to backwash the third filter from bottom to top (inverse direction than in filtration mode). The two filters used to produce the filtrate operate at velocities of approximately 15 m/h while the third filter gets backwashed at a velocity of approximately 30 m/h.

The filtration system is controlled by the main control panel for the plant. The automatic diaphragm valves installed on the filtration unit are pneumatic and are thus opened and closed using compressed air. A compressor is provided with the plant. The compressed air transits through a filters solenoid valves panel.

2.8 – MONITORING OF DISCHARGE FLOW RATE

The plant is equipped with a magnetic flow meter located on the clean effluent's discharge pipe. This instrument is equipped with a counter that allows tracking of the total volume of clean effluent discharged by the plant. As mentioned in paragraph 2.3, the flow meter is also used to control the injection rate of acetic acid. A thermal chart recorder was also provided in order to produce hardcopies of the flow measurements taken by the flowmeter.

2.9 – OPERATING PARAMETERS ADJUSTABLE ON THE CONTROL PANEL

The following operating parameters were set as default in the Programmable Logic Control (PLC) panel provided with the plant but are adjustable within the ranges shown below. Making changes and adjustments to the default plant's operating parameters requires a good understanding of the wastewater treatment process and should therefore only be performed by qualified and trained staff. Please contact SEPROTECH SYSTEMS INCORPORATED if assistance is needed to optimise the operation of the plant.

	T1 Time between backwashes	T2 Time for a backwash	T3 Time for rinse	T4 Time between sludge pumping	T5 Time for sludge pumping
Factory Setting	4 h	10 min	5 min	1.0 h	0.25 min
Minimum	1 h	5 min	2 min	0.5 h	0.10 min
Maximum	18 h	30 min	30 min	12.0 h	1.00 min

2.10 - FREQUENCY OF INSPECTION

Visual checks every week should be sufficient. However, for better preventative maintenance of the wastewater treatment plant and thus the capital investment, a daily walk through is often the preferred frequency of visit. Many owners prefer the visual and audible (look and listen) walk through. A standard operator checklist should be prepared and used by the person responsible for periodic maintenance of the plant at every visit. SEPROTECH SYSTEMS INCORPORATED can assist in preparing such checklist upon request.

The acetic acid storage tank should be topped off every time the plant is being visited.

The pressure loss on every filter should also be controlled. Two pressure gauges were provided for this purpose, one on the inlet pipe and one on the outlet pipe of each filter. The pressure drop across a filter shouldn't exceed 15 PSI. If it does even after a filter has been backwashed, the frequency and/or duration of backwashes should be increased.

3.0 - STANDARD RECOMMENDATIONS AND PROCEDURES FOR SLUDGE REMOVAL

3.1 - STORAGE CAPACITIES

A design feature of ROTORDISK®, which contributes greatly to overall simplicity of the process, is the sizing of clarifiers to accommodate static internal sludge storage for extended periods. Depending on such factors as raw wastewater solids concentrations, and design organic loading in a given application, maximum sludge storage levels will typically be reached in 6-9 months of operation.

This period is based on calculated rates of initial decomposition of raw and biological solids, and, upon operating experience, indicating the degree of auto-digestion/compacting, which proceeds during the storage period. The 6-9 month period will be shortened to the extent that design hydraulic and waste loads are exceeded. It will be lengthened to the extent that flows and waste load are less than those designed for.

3.2 - DETERMINATION OF ACCUMULATED SLUDGE VOLUMES

The accumulation of maximum storage capacities can be indirectly monitored through visual observation of the thickness of the scum blanket on the surface of the primary clarifier. When the scum blanket has matured to a height of approximately 7"-10", this is a good indication that sludge accumulations at the bottom of both clarifiers are at or near maximum levels, and that sludge withdrawal is indicated.

A more accurate procedure of determining sludge levels is to directly measure actual accumulations, and compare these to the maximum storage capacities listed on the "Details" section of the general arrangement drawing for the ROTORDISK® model in question.

A variety of sludge measuring devices is commercially available. The two most common are the weighted hollow tube type, and, the (electronic) turbidity-change detector type. The former is less costly, relatively easy to use, and more appropriate because of the low frequency with which measurements need to be made in a ROTORDISK® unit.

Whatever means of measuring the sludge may be selected, it must be kept in mind that the sludge is <u>not</u> a firm solids substance. Domestic wastewater sludge is mostly trapped water and other liquids. Only to determine sludge levels by "feeling" for a solid layer with a stick or pole. The settled sludge is far more liquid than the surface scum, which is perhaps 30-40% solids by volume.

Irrespective of the type of device used, sludge levels should be measured at several locations in each settlement tank to ensure a reasonably accurate calculation of accumulated volumes. This is required since sludge accumulation levels are not uniform; being highest at the inlet ends of both clarifiers, and, below the slot at the bottom of the first section of the Rotorzone trough.

Once an average sludge height has been determined, multiply by the surface area of the clarifier in question to determine the existing volume of stored sludge. Compare to maximum design capacity listed on the general arrangement drawing. If the accumulated levels equal or exceed design values, it is time to remove the sludge from the unit.

3.3 - SLUDGE REMOVAL

A pump-out truck of the same type that pumps out septic tanks normally does the sludge removal. For smaller ROTORDISK® units, the entire liquid contents of the treatment plant can be withdrawn. For larger installations, the haulage contractor should be instructed to get the suction hose directly to the bottom of the tanks and withdraw the sludge only, while taking as little of the supernatant as possible. Once the primary sludge is withdrawn from the primary settlement tank, the supernatant of the secondary clarifier can be transferred to the primary settlement tank to expose the secondary sludge. The suction hose should be placed down at a multiple number of points to help ensure complete removal of accumulated sludge deposits. Floating surface scum should also be removed. Haulage contractors should be given a brief description of the unit and its operation if they are not already familiar with it. A particular point to emphasise is that the biological growth on the disks should <u>not</u> be washed off, but should be left in place. The exception to this is if the disks have accumulated excess biomass due to sludge pump out being delayed past the indicated intervals.

Sludge removed from the unit is normally hauled away by the pumping truck and disposed of at municipal facilities, or, by controlled spreading on farmland. On-site disposal in shallow trenches and/or some form of on-site volume reduction (prior to export) may be feasible or desirable depending on the specific opportunities and limitations afforded by the site of a given installation.

3.4 - POTENTIAL CONSEQUENCES OF OPERATING ROTORDISK® UNITS PAST DESIGNATED MAXIMUM SLUDGE STORAGE LEVELS

Sludge accumulations should be removed once they reach indicated maximum storage levels, because failure to do so could result in lowered treatment efficiency, and possibly cause serious damage to the structure of the Rotating Assembly and drive unit. The potential for problems is as described below and depicted in the attached sketches.

Figure (c) shows a unit operating with sludge build-ups at or near maximum storage levels. This will cause no problem since the storage heights are designated so that flows through the primary clarifier will not disturb the sludge layer. Characteristics of wastewater reaching the Rotorzone at this time (and since start-up) will be in the range of 180-200 mg BOD/1 and 50-250 mg SS/1. The supporting structure of the rotating assembly is over designed for the amount of biological build-up which will occur on the disks under this operating condition, and the shear force of the rotation through the trough water will limit the thickness of growth.

However, if sludge is allowed to accumulate past designated storage heights, flow through the primary clarifier will begin to disturb the sludge blanket, and thus carry loads of solids and dissolved organic matter into the Rotorzone which are not anticipated in the design of the unit (Figure d). The pollutant load reaching the biomass on the first stage of disks will overload that biomass (in terms of F:M ratio), and force a change in its activity and growth. The biomass becomes more gelatinous, and does not shear off as well with disk rotation. Additionally, the biomass will readily adsorb and entrap the extra solids with the sum effect being an increase in weight on the rotating assembly that considerably exceeds that which its design is based on.

This tendency reaches its extreme if sludge is allowed to accumulate to the point where it will be disturbed by-, and caught up in -, the re-circulation pattern created by the two slots in the trough on the first section of the Rotorzone (see Figure e).

The sludge will have characteristics in the order of 20,000 mg TSS/1 and 10,000 mg BOD/1, so it is obvious that even a minor amount of this material caught up in the re-circulation flow will significantly increase the concentration of the waste stream entering the Rotorzone. If, for example, the sludge was caught up in the recycle flow at a ratio of as little as 1:10 or 1:15, the resulting concentration would be sufficient to produce a considerable first-stage overload on an amount of disk area selected based on normal concentrations.

The resulting build-up of poorly-shearing gelatinous biomass and trapped solids would pose a serious potential for strain on the drive unit, and for structural damage to disk bank assemblies and shaft, in spite of them being considerably over designed for loads anticipated in normal operation.

Clearly, these potential problems should be avoided by the removal of sludge once it reaches the level specified as maximum for the ROTORDISK® unit in question.

3.5 - FRONT VIEW SCHEMATIC OF ROTORDISK®

UNIT OPERATING AT-, AND ABOVE-,
RECOMMENDED MAXIMUM SLUDGE STORAGE LEVELS

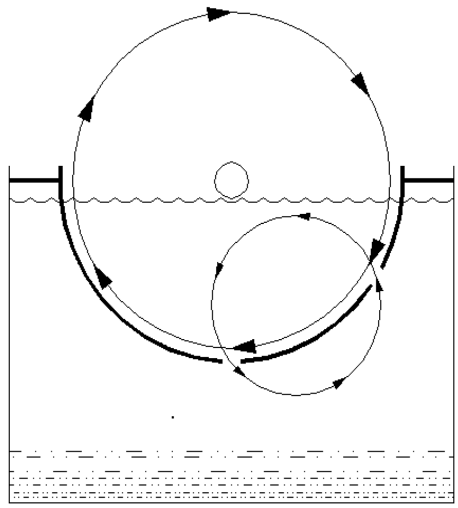


Figure c-unit operating at maximum sludge storage levels. Neither influent flows, nor re-circulating flows, disturb sludge blanket.

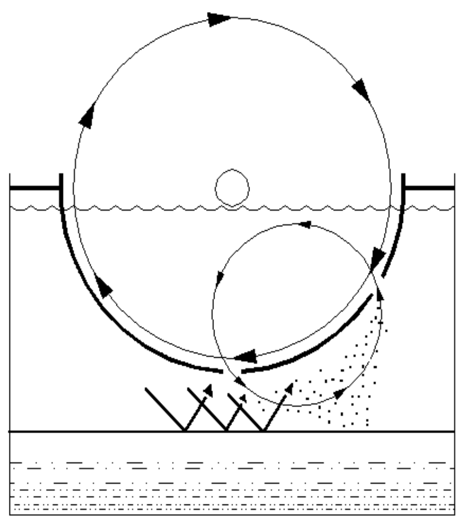


Figure d- unit operating with excess accumulations. Influent flows may disturb sludge blanket and increase BOD and solids loads to Rotorzone to levels above treatment design.

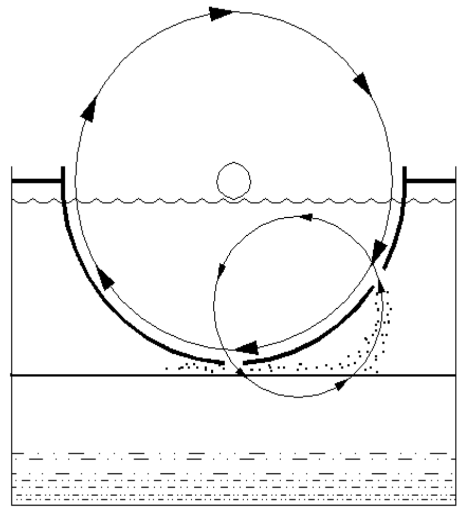


Figure e-Unit operating with excess sludge accumulated to base of Rotorzone. Both influent flows and re-circulation flows will disturb and carry sludge solids. Increase in BOD and solids loads entering Rotorzone will be substantially above design treatment levels, increase accumulated masses on rotating assembly, produce potential for damage to structure and drive unit.

3.6 - PUMPOUT PROCEDURES FOR ROTORDISK® TREATMENT SYSTEMS (summary)

Using suction hose, floating or surface scum should be removed first. Place the suction hose directly to the bottom of the tank and withdraw sludge only, while taking as little as possible of the volume of waste liquid above the sludge blanket (supernatant).

Move the hose at multiple number of points along the bottom of the settlement tanks. Do not wash off biological growth (biomass) on the disks. The exception to this is excess accumulated biomass on the disks due to an overdue sludge pump-out. Excess accumulated biomass is when a disk bank is 100% fully covered with biomass and the colour is grey with a slight odour.

Keep a record of all pump-outs to arrive at an actual normal operating interval for sludge pump-outs. For systems with several flow meters, it is also beneficial to note the total flow generated between pump-outs.

3.7 - START-UP PROCEDURES OF ROTORDISK®

WARNING: A VALVE LOCATED AT THE BOTTOM OF THE DENITRIFICATION TANK AND EQUIPPED WITH A REMOTE ACTUATION MECHANISM WAS PROVIDED WITH YOUR UNIT. THIS VALVE:

- Needs to be OPEN: when the plant is first filled with water, during draining if the plant ever requires such operation and during subsequent refilling operations. FAILURE TO OPEN THIS VALVE DURING FILLING AND DRAINING WILL RESULT IN SERIOUS DAMAGE TO THE PLANT. This is because, during a filling operation, the water rising in the PST would push the denitrification tank upwards while it is empty (this tank wouldn't have had a chance to fill with water until the water level reaches the inlet slot between the PST and the aerobic ROTORDISK®. Th open valves provide a mean of filling the PST and the through (denitrification tank included) at the same time.

- Needs to be CLOSED: during normal operation of the plant. Indeed, the denitrification section contains water already partly treatment thus this water and that contained in the PST shouldn't mix. FAILURE TO CLOSING THIS VALVE DURING NORMAL OPERATION OF THE PLANT WILL RESULT IN A POOR QUALITY EFFLUENT.

The ROTORDISK® sewage treatment plant is based on a fixed film treatment process referred to as the Rotating Biological Contactor (RBC). In this process, micro-organisms or bugs are attached and grown on the surface of a media, the quantity of bugs being directly proportional to the amount of food in the wastewater. When starting up a new system, it will normally take about two weeks to get organic removal from the wastewater and three to four weeks to establish the nitrification process at normal domestic sewage temperatures. The method of and effluent discharge during system start-up should be discussed and thoroughly communicated with the environmental authority. The primary sedimentation tank and RBC of the system should, preferably, be filled with fresh water before admitting wastewater to the system. A flow less than design is not a problem. The biomass will develop themselves on the media. If there is a small flow only a portion of the disk will have biomass. As the flow increases the amount of biomass will increase.

Seeding a ROTORDISK® with activated sludge, although not required, can be accomplished. The activated sludge should be at the same temperature as the influent. Sudden changes in wastewater temperature cause biomass sloughing. In most cases, the use of domestic waste as a seed culture has provided the required biomass for continuous operation. When seeding the ROTORDISK® with activated sludge is decided, the primary sedimentation tank and RBC of the system should first be filled with fresh water (preferably) and the activated sludge added to the RBC. The RBC should be rotating at all times. The wastewater introduced to the tank needs to have only 20% of the disks covered with waste. This can already provide the needed wetting and still provide some time to reach normal operating levels when source flow is introduced. The final clarifier does not need to be filled with anything.

Alternately, seeding can be accomplished using dry bacteria and a source of organic carbon such as raw molasses or sugar. This can be done, for example, in situations where wastewater or activated sludge are not available and the plant needs to be ready to treat wastewater very shortly after it begins receiving it. By simulating the conditions encountered in wastewater (where large amounts of organic carbon and bacteria are present), biomass will establish on the ROTORDISK® and the plant can thus be prepared to work under actual conditions before these are actually encountered. SEPROTECH SYSTEMS INCORPORATED can help find appropriate supplies of both dry bacteria and raw molasses.

The preferred start up is the introduction of source wastewater at design or less than design loading. The disks need to be rotating at all times. When the disks are rotating and wastewater is introduced the biomass will develop and the pollutants will be removed.

The practice of starting up a sewage plant with a charge of septage or activated sludge may be appropriate for suspended growth systems where sludge return is an essential and necessary part of the process. However, start-up with septage is <u>not</u> an appropriate practice for fixed film systems such as the Rotating Biological Contactor process and is <u>not</u> recommended. This is especially true of the ROTORDISK® process and its static, internal storage of sludge.

Studies have shown that the natural start-up time for a ROTORDISK® is 2 1/2 – 3 weeks (normal temperatures and BOD reduction only), and that it has already developed sufficient biomass for 50% removals in only 1 week. These are time frames significantly shorter than respective ones for suspended growth systems. Thus there is little rationale for “pre-starting” a ROTORDISK® unit with septage.

Further, septage contains solids that are already well digested, and therefore not subject to further digestion-compaction in the storage zones. This contrasts to the fresh solids, which will undergo considerable digestion-compaction in the 6 – 9 months after initial settlement. Therefore, a charge of septage would contribute disproportionately to the accumulation of sludge levels, and necessitate a shorter interval to the first pump-out of the unit.

The ROTORDISK® concept of static sludge storage contributes greatly to its overall operation and maintenance simplicity. Following the above guidelines and recommendations will help ensure that the trouble-free simplicity of ROTORDISK® is maintained.

4.0 - STORAGE OF **ROTORDISK®** SEWAGE TREATMENT EQUIPMENT

If the unit is not to be operated for an extended period, then the motor-reducer assembly (drive unit) should be removed from its mound and stored at room temperature in a reasonably dry area (unless the whole unit is being stored in such an area).

Additionally:

1. Reducer: The input shaft should be given several turns once a month to re-lubricate the upper bearings.

NOTE: Some reducers are shipped to site filled with synthetic lubrication. Otherwise, fill the reducer with the lubricant (see reducer section of installation & maintenance instructions).

2. Motor: The motor has a tendency to take on moisture when not in operation. It requires no attention during storage, but before it goes into operation the insulation should be measured using a Meger. It should be at least 1.0 mega-ohm. If below 1.0 mega-ohm, it has taken on excessive condensation, and must be dried out before being operated. (Note: any electrical contractor or repair shop commonly understands these terms and procedures).

3. Support bearings on main ROTORDISK® shaft(s) should be re-lubricated prior to start-up.

4. The system should not be installed and operated in water. In the absence of sewage inputs and normal biological activity, freezing and consequent mechanical damage would be a distinct possibility. Water level in the primary settlement tank to be dropped to below the bottom of the Rotorzone tank level, if freezing of the tank contents is possible.

5.0 - ASSEMBLY PROCEDURE OF ROTORDISK® COMPONENTS SUPPLIED BY SEPROTECH SYSTEMS INCORPORATED

1. Upon receipt of mechanical components:

   a. Check packing list for any missing items on delivery.

   b. Motor/Reducer is shipped loose, for assembly on the reducer flange. The reducer is shipped completely filled with synthetic lubricant.

   c. Bearing components are shipped as a set. Open only when ready for assembly, to avoid moisture contamination.

   d. Chain and sprockets are shipped as a set. Check for the following:

   -Large sprocket bushing (O.D.) fits into the large sprocket bore.
   -Large sprocket bushing bore (I.D.) fits the Rotordisk® shaft drive end.
   -Small sprocket bore (I.D.) fits on the reducer output shaft.
   -Cottered chain fits or matches the teeth on the sprockets.

   e. Coupling (applicable only to split-shaft ROTORDISK® is shipped as a set. Check the coupling hubs if they fit the center stub ends of the ROTORDISK®shafts.

   f. Disk banks are shipped pre-assembled on the shaft by SEPROTECH SYSTEMS INCORPORATED and are shipped on A-frames. Handle with care, as the Fiberglass of the disk banks is brittle.

   g. Hardware (bolts, nuts, washers) for mounting the following items are provided:

   -Bearings
   -Reducer
   -Recycle trough

2. If, for any reason, the diskbanks must be removed from the shaft, the procedure for remounting them is as follows:

If disk banks are 5 ft. in diameter or larger (supplied in semicircular sections)

Mount them on shaft(s) as shown on Dwg.# GL-28D, with 1/2-20NFX1-1/2 Bolts. Connect two half sections with two connecting plates (see sketch of typical mounting details) Remove outer nuts on required tie rods, fit connecting plate on tie rods over the end plates, then fasten them together with nuts and washers.

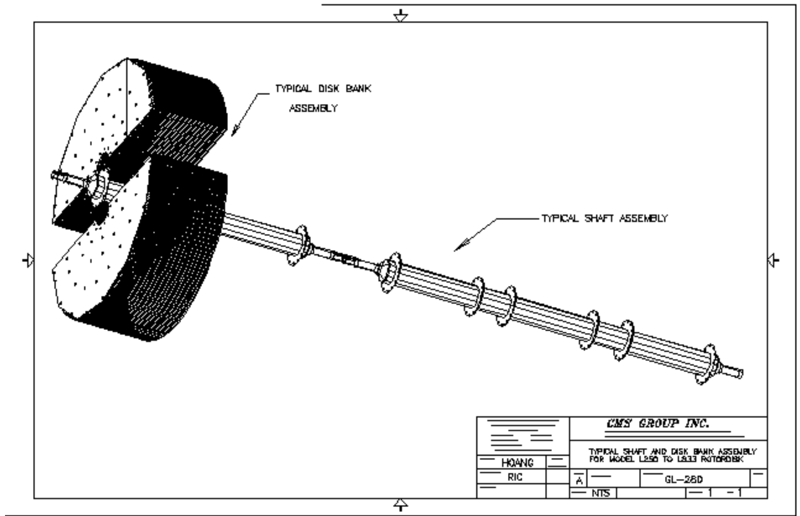


Figure f - typical mounting of disk banks on the shaft(s).

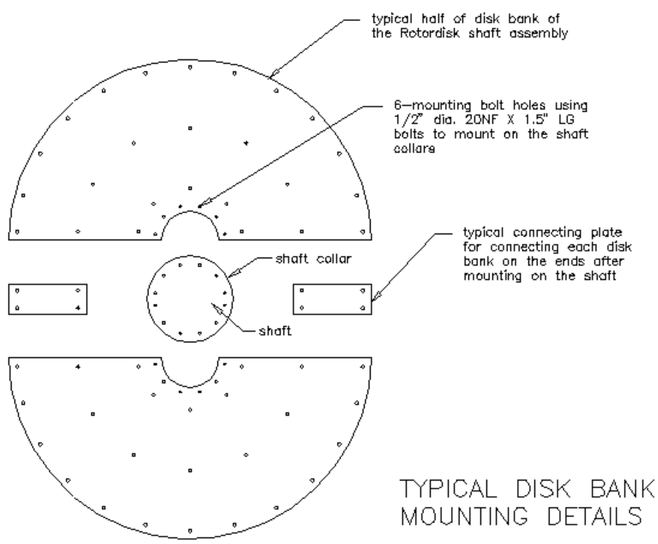


Figure g - exploded view of disk bank mounting parts.

3. Mount Bearings on Shaft(s).

   a) Bearing should be mounted at the centre of stub end. Follow bearing manufacturer's installation instructions.
   b) Use of the bearing fixing rings: one bearing of each pair is "fixed", the other "floating". Install the fixed bearing on the drive end of the shaft and the floating bearing on the non-drive end.

FOR 'L'Rotordisk® models ONLY: On the shaft where the large sprocket will be mounted, fix the bearing into its housing closest to the sprocket. On the other shaft fix the bearing into its housing closest to the coupling (i.e. one bearing should be fixed on every shaft).

NOTE: All bearings mounted on tapered sleeves have to be driven up the taper to the tolerances given in the manual, using a bearing locking tool or equal. See installation, operation and maintenance instructions section of this manual regarding bearings.

4. Mount coupling hubs on their respective shafts (if applicable) so that hub face is flush with the end of its shaft (for direct drive and 'L' models). See installation, operation and maintenance instructions section of this manual regarding couplings.

5. Install shaft(s) in ROTORDISK® tank.

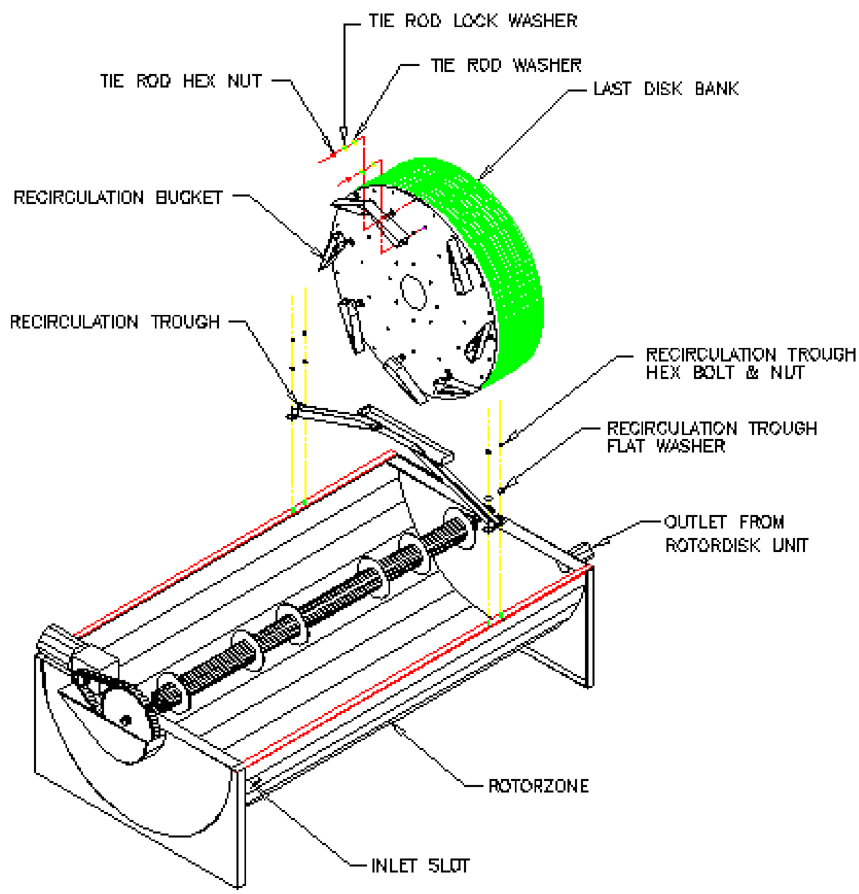
6. Mount small sprocket/coupling hubs on reducer output shaft (whichever is applicable).

7. Install Reducer-Motor Assembly in place. The reducer comes completely filled with synthetic lubricant. Ensure that the breather plug (mounted on top of one of the reducer oil intake ports) is installed on the reducer, after it is mounted on the ROTORDISK®. It is recommended that the motor be mounted into the reducer prior to assembly into the ROTORDISK® tank. Allow for some play in the reducer mounting bolt tightness so the chain tightness can be adjusted later.

8. Connect sprockets with chain. Check the axial alignment of the sprockets while tightening the chain. Tighten the previously loosened reducer mounting bolts after the sprockets are aligned and set in place. See installation, operation and maintenance instructions section of this manual regarding roller chain drives.

9. Connect two coupling hubs, grease, and fit coupling cover (if applicable). Before mounting, check bore on both hubs to match the shaft diameter. See installation, operation and maintenance instructions section of this manual regarding couplings.

10. Mount the stainless steel recycle trough on the ROTORDISK® tank with the bucket opening points to the proper rotation of the shaft.



NOTES:

1. Follow manufacturers instructions in the "Installation & Maintenance Manuals" included by SEPROTECH SYSTEMS INCORPORATED for mounting bearings, couplings (if applicable), reducer, sprockets and chain (if applicable).

2. Make sure all setscrews on sprockets and coupling hubs; bolts on reducer and bearings, are all well tightened before machine goes into operation.

6.0 - ROUTINE MECHANICAL MAINTENANCE OF **ROTORDISK®** SEWAGE TREATMENT PLANTS

6.1 - MOTOR:

If motor is equipped with grease fittings and relief plugs, it should be re-lubricated using a low-pressure gun once a year with Shell Alvenia R2" grease (DO NOT OVER-LUBRICATE). There is no lubrication required for motors without grease fittings and relief plugs

6.2 - REDUCER:

Reduction gear on ROTORDISK® units is filled with synthetic long life lubricant. No inspection or maintenance outside of periodic visual inspection is normally required. If there are no evidence of oil leaks on the seals, the synthetic lubricant must be changed every five (5) years for ROTORDISK® units running 24 hours a day.

Reduction Gear on medium and large ROTORDISK® size units are filled with Shell Tivela 75 oil and does not require oil changes (permanent lubrication). Periodic visual inspection is required. Check oil level and top up to required level with same oil, if necessary.

6.3 - BEARINGS:

Lubricant will deteriorate in time and rate of deterioration is a function of the operating conditions encountered. Lubrication cycle can be determined by analysing the samples taken near the bearing. See bearing manufacturer's maintenance instructions.

6.4 - SPROCKETS AND CHAIN:

(Applicable to non-direct drive ROTORDISK® units)

Chain drive should be inspected every six- (6) months for following points:
- If Chain is covered with grit or chips, it should be cleaned in kerosene and re-lubricated.
- Inspect oil for contamination, such as chips, dirt or grit. Replace oil if necessary (Oil with viscosity of SAE30 at ambient temperature 40^o to 100^o F is recommended).
- Milky white colour of the oil is indicative of flooding. Replace oil and determine the cause of the flood.
-Check Chain tension and adjust if required.

6.5 - COUPLING:

(Applicable for direct drive ROTORDISK® units and 'L' models)

Coupling should be checked for lubricant level. Lubricant is to be added if required. Re-lubrication with NLGI#2 or LTG Grease once a year is usually adequate.

7.0 - TROUBLE SHOOTING

7.1 - MECHANICAL HARDWARE

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Noisy chain	1. Loose chain 2. Faulty lubrication 3. Misalignment 4. Worn Parts 5. Moving parts rubbing stationary parts	1. Tighten chain 2. Lubricate properly 3. Correct sprocket alignment 4. Replace worn chain 5. Align & tighten chain to clear oil bath
Rapid wear on chain	1. Faulty lubrication 2. Loose or misalign parts	1. Lubricate properly 2. Align & tighten entire drive
Chain climbing sprockets	1. Worn out chain and sprockets 2. Loose chain	1. Replace worn out parts 2. Tighten chain
Stiff chain	1. Misalignment 2. Worn out chain or sprockets 3. Faulty lubrication 4. Rust corrosion	1. Correct alignment 2. Replace worn out parts 3. Lubricate properly 4. Clean and lubricate
Noisy Bearing	Rollers or bearings damaged	Replace bearing cartridge
Bearing grease discoloured or mixed with water	Insufficient grease in the bearings	Purge bearing with grease and increase lubrication interval
Hot bearing	1. Improper lubrication 2. Rollers or bearing race damaged	1. Purge bearing with grease and decrease lubrication interval 2. Replace bearing cartridge
Reducer temperature rises above 200 degrees Fahrenheit.	Oil level too high or too low	Maintain proper oil level
Oil leakage from reducer	1. Oil seals need to be replaced 2. Ventilators/breather plugged causing pressure build-up inside the reducer. 3. Oil level too high	1. Replace oil seals 2. Clean Ventilators 3. Correct oil level
Noisy reducer	1. Bearing failure 2. Misalignment in worm gear inside 3. Coupling between motor and reducer worn out and misalign	1. Check bearings and replace if necessary 2. Align worm gear shafts. 3. Replace coupling between motor and reducer. Align coupling hub vertically
Noisy Motor	Bearing damage	Replace damaged bearings
Motor overheating	1. Reducer overheating 2. Cooling fins on motor are clogged 3. Overload 4. Rotor rubbing on stator 5. Over greasing or lubrication	1. Check reducer 2. Clean fins 3. Check for excess friction or imbalance 4. Replace bearings 5. Avoid packing grease too tightly
Motor won’t start	1. Power trouble 2. Single phasing at station 3. Fuse blown	1. Check source of power supply 2. Do not try to make it go and “fry” motor. Check starter windings 3. Replace fuse
Knocking/rumbling on motor bearings	1. Bearing worn due to lack of lubrication or excessive mechanical overload 2. bearings slack in housing	1. Replace bearing and put new grease of recommended grade. 2. Fir new end shields
Rotordisk® shaft doesn’t turn	1. Power failure 2. Motor failure 3. Reducer failure 4. chain drive failure	1. Check power supply 2. Check and replace motor and bearings. 3. Check teeth worn gears and bearings. Replace necessary parts 4. Replace chain

7.2 - ROTORDISK® PROCESS

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
1. Slime on media appears shaggy with a brown colour	PROPER OPERATION	NO PROBLEM NORMAL CONDITION
2. Black slime growing on disks	Solids and/or BOD overloading	**a.** Pre-aerate RBC influent **b.** For severe organic overloads, increase recycle rate **c.** De-sludge unit **d.** Place another RBC unit in parallel
3. Rotten egg or other obnoxious odors	Solids or BOD overloading	See Problem 2, solutions a, b, c and d, above
4. Development of odors and white biomass over most of the media surface	1. Septic influent wastewater or high hydrogen sulfide or sulfate concentration	**e.** Determine the cause of the problem and correct it at source. For example, aerate equalization tank **f.** Pre-aerate influent wastewater **g.** Determine the cause of the problem, possibly with the addition of chlorine or hydrogen peroxide; potassium permanganate has also been used
	2. Overload first stage	**a.** Check dissolved oxygen levels to confirm overload problem **b.** Increase number of recycle buckets
5. White slime	1. Bacteria that feed on sulfur compounds. Also, industrial discharges containing sulfur compounds may cause an overload	▪ See Problem 2, solutions a and b above
	2. Grease on the disks	**a.** Remove grease at source **b.** Install grease traps
6. Sloughing or loss of slime (biomass)	1. Toxic or inhibitory substances in influent, including abrupt pH changes	**a.** Eliminate source of toxic or inhibitory substances **b.** Reduce peaks of toxic or inhibitory substances by carefully regulating inflow to plant **c.** Dilute influent using plant effluent or any other source of water **d.** See Problem 7.4
	2. Variation in flow or organic loading	**a.** - During low flow or loading periods, pump from secondary clarifier or 4th stage RBC unit effluent to recycle water with food and dissolved oxygen through the RBC unit **b.** - During high flow or loading conditions, attempt to throttle plant inflow during peak periods **c.** - For severe organic under loads, add a cheap source of soluble carbon in the PST such as molasses

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
7. Decrease in process efficiency	1. Reduced wastewater temperature	**a.** Decrease air opening in RBC building **b.** Heat air inside RBC unit cover or building
	2. Unusual variations in flow or organic loading	▪ See Problem 6, cause 2, solutions a and b above
	3. Sustained flows or loads above design levels	▪ Install additional treatment units
	4. High or low pH values	▪ Adjust pH to near neutral
	5. Improper rotation of media	▪ Inspect chain tension and adjust
8. Accumulation of solids and clogging in the RBC system	Solids removal in pre-treatment steps is not adequate	**a.** Improve pre-treatment efficiencies **b.** Provide supplemental aeration to help prevent solids from settling **c.** De-sludge primary tank
9. Floating or rising sludge in the secondary clarifier	Removal of sludge from the clarifier is inadequate	**a.** Increase the duration of pumping sludge from the clarifier **b.** Remove sludge from the clarifier more often
10. Excess shaft weight or biomass thickness	1. Organic loading too high	▪ Decrease organic loading
	2. Stage loading too high	**a.** Increase number of recycle buckets
	3. Inorganic solids accumulation because of inadequate pre-treatment	▪ Check primary treatment and grit removal equipment for proper operation
	4. Accumulation of minerals	▪ Use chemical pre-treatment to eliminate minerals
	5. Digester supernatant adding excessive BOD or sulfides	▪ Modify supernatant pumping frequency
11. Shaft rotation non-uniform or “jerky”	1. Normal variations in balance	▪ Time rotation by quarters. A difference of less than 3 seconds in quarter rotation time is normal
	2. Uneven biomass weight due to power outage	**a.** If severe, shut unit down and wash down disks **b.** Turn off the unit temporarily and rotate manually to uniformly wet biomass growth before restarting **c.** Decrease or stop flow of wastewater to affected units **d.** contact manufacturer for assistance

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
12. Effluent quality apparently below requirements	1. Organic loading too high	**a.** Add additional operating RBCs **b.** Identify cause of additional loading and eliminate at source **c.** Add supplemental air to RBC trough
	2. Sampling or testing procedures inaccurate	**a.** If nitrification is occurring, analyze for carbon BOD only by using nitrification inhibitor **b.** Check for contaminated dilution water, sampler lines, or improper sampling storage
	3. Inadequate secondary clarifier operation	**a.** Clean and de-sludge clarifier **b.** Modify sludge removal procedures to eliminate BOD kickback **c.** Install filters after clarifier **d.** Increase alum dose to enhance flocculation
	4. Anaerobic solids in the RBC tanks producing BOD kickback	▪ Flush or drain tanks
13. Snails or other nuisance organisms in RBC tanks	Nutritional and conducive environment for reproduction of hard-bodied shell snails ($^1/_8$" - $^1/_2$" in size)	**a.** Addition of controlled dosages of chlorine. Physical removal may be required with taking units out of service temporarily **b.** Contact manufacturer

Contact SEPROTECH SYSTEMS INCORPORATED for advice on how to resolve problems related to the process before making changes to the process or equipment.

Adapted from Water Pollution Control Federation "Manual of Practice OM-10", 1988.

8.0 - MAINTENANCE PROGRAM – Do’s and Don’ts

DO'S

1. Do use biodegradable soap if at all possible. The system will however handle a certain amount of normal soap. When laundering clothes, please follow manufacturer's instructions regarding quantity of detergent. Excessive use of detergent can cause odour in the system.

2. Do put large amounts of grease in a container and dump in garbage. The system will handle a certain amount of fat and grease. If a tile bed is used and if fats and grease get into it, they may plug the pores of the soil and seal up the bed. Never put large amounts of grease (i.e. old grease from deep fryer) into the sewer lines.

3. Have your system pumped out a minimum of once a year to remove sludge and scum to maintain top operating treatment in your system and filter bed.

4. For small systems equipped with a service hatch, keep the service hatch above the ground. Do not let run-off water enter system, as this will cause hydraulic overload.

5. If a tile bed is used, do keep traffic such as cars, snowmobiles, etc., away from the system bed areas as they will break pipes and seal the soil over the bed.

6. If a tile bed is used, do leave the raised filter in place without disturbing it. The filter is specifically designed to provide maximum dispersal of the water. Altering it by adding fill, covering it up or changing in any way may destroy its water dispersal characteristics and result in bed failure.

7. If a tile bed is used, do encourage a growth of ground cover over the filter bed as it helps disperse water by evaporation and transpiration.

DON'Ts

1. Do not put non-biodegradable materials downs the drain, put them in the garbage, these include any plastics, rubber, disposable diapers, sanitary napkins, rubber goods, cigarettes, children's toys, cellophane, etc. They will plug the system, and a pump out will be needed.

2. Do not put harsh chemicals down the drain. They will kill the bacteria necessary for efficient treatment. These include acid or caustic cleaners, gasoline, oil, turpentine, photographic chemicals, etc. Disinfectant and chlorine bleaches should be kept to domestic uses.

3. Do not leave taps running or faulty toilets. The excess water may overload the system and, if used, tile field causing breakout and poor treatment.

4. If you do not have access to workers with appropriate training, do not attempt to fix the mechanical parts yourself. Your dealer is trained to repair your plant and work safely with electrical and mechanical components. Call him if you have a problem or concerns.

5. Do not connect any other electrical load to the fuse or breaker feeding the plant as it will cause damage to the controls.

6. Never put large amounts of grease (i.e. old grease from deep fryer) into the sewer lines.

YOUR CO-OPERATION WITH RESPECT TO THE ABOVE POINTS SHOULD ENSURE TROUBLE-FREE OPERATION OF YOUR TREATMENT PLANT AND WILL BE GREATLY APPRECIATED.

9.0 - INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS FOR VARIOUS MECHANICAL PARTS OF THE **ROTORDISK®** AND OTHER EQUIPMENT SUPPLIED

9.1 INSTALLATION & MAINTENANCE DETAILS FOR ROLLER CHAIN DRIVES

CHAIN TENSIONING:
The proper fit of a chain may be obtained by adjusting the sprocket centres. When a chain is correctly tensioned, the total mid-span movement (double amplitude) in the slack span should be 4-6% of the span length for normal drives.

Where there is no adjustment means, adjustment may be made by removing links to compensate for elongation due to wear (Drives with fixed centres). Proper lubrication and proper drive maintenance may minimize chain wear.

LUBRICATION:
Although many slow speed drives operate successfully with little or no lubrication beyond the initial factory lubrication, proper lubrication will greatly extend the useful life of every chain drive.

A good grade of clean petroleum oil without additives, free from flowing at the prevailing temperatures should be used.

Chain drives should be protected from abrasive and corrosive conditions, and the oil supply kept free of contamination. Periodic oil change is desirable. The lubricant viscosity recommended for ambient temperature 40^{o} - 100^{o}F is SAE 30.

OIL BATH:
With bath lubrication, the lower strand of chain runs through a sump of oil in the drive housing. The oil level should reach the pitch line of the chain at its lowest point while operating. Only a short length of chain should run through oil.

INSTALLATION RECOMMENDATIONS:

Shafting, bearings and foundations should be supported rigidly to maintain the initial alignment. Roller chain should be free of grit and dirt. Wash chain in kerosene when required. Re-lubricate!

Misalignment results in uneven loading across the width of the chain and may cause roller link-plate and sprocket tooth wear. Drive alignment involves two things:

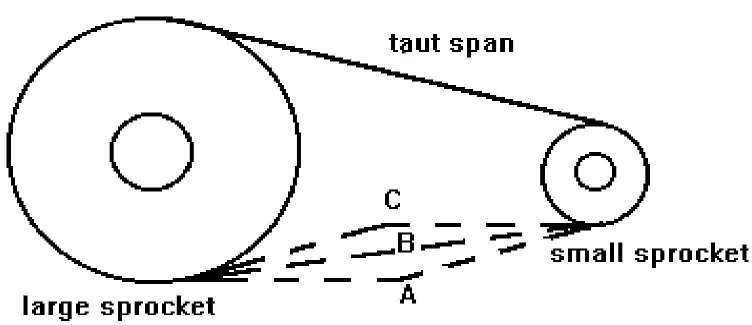
a) Parallel shaft alignment: Shafts should be parallel and level.
b) Axial sprocket alignment: Sprocket axial alignment can be checked with a straight edge, which will extend across the finished sides of the two sprockets.

Normally, it is good practice to align sprockets as close to the shaft bearings as possible.

Installing the Chain: Recheck all preceding adjustments for alignment and make sure all setscrews, bolts and nuts are tight. Fit chain around both sprockets and bring free ends together around one sprocket for connection.

Chain Tension: Check chain tension to be sure that the slack span has 4-6% mid-span movement in horizontal drives.

Recommended Possible Mid-Span Movement AC									
Drive	Tangent Length Between Sprockets								
Center-Line									
	5”	10”	15”	20”	30”	40”	60”	80”	100”
Horizontal to 45	.25”	.5”	.75”	1”	1.5”	2”	3”	4”	5”
Vertical to 45	.12”	.25”	.38”	.5”	.75”	1”	1.5”	2”	2.5”



AC = Total Possible Mid-Span Movement
Depth of Free Sag = .866 AB, approximately

MAINTENANCE RECOMMENDATIONS:

Regular maintenance schedules should be followed for all chain drives. Each drive should be inspected every six months. At each inspection period the following points should be checked:

a) Check Lubrication: If chain is covered with grit or chips, it should be cleaned in kerosene and re-lubricated before reinstalling. With bath lubrication, oil should be maintained at the proper level, as shown in lubrication instructions. Add oil if necessary. At each inspection, oil should be checked for contamination, such as chips, dirt or grit.

b) Check sprocket alignment: If the chain is properly aligned, no wear will show on the inner surfaces of the chain roller link-plates. If wear is apparent, this is evidence that sprockets are misalign and should be realigned as outlined in the installation instructions to prevent further chain and sprocket wear.

c) Check sprocket tooth wear: If sprocket shows evidence of wear high on the sprocket teeth, this is evidence of excessive wear in the chain, the chain should be replaced. If the sprocket teeth are severely worn, the sprocket should be replaced. Do not run new chain on worn sprockets.

d) Check chain tension: At each inspection period, the chain tension should be adjusted. If excessive slack has accumulated which cannot be removed by available shaft centre adjustment (i.e. by moving reducer away from large sprocket using chain tensioning bolts), two or more pitches of chain should be removed and chain reconnected.

9.2 PROCEDURE FOR ASSEMBLING BEARINGS AND PILLOW BLOCKS

Shaft Preparation
Clean shaft and remove any burrs or sharp edges. Check the shaft diameter to given specifications.

Seal Installation
Place seal, which consists of: Double lip 'G' type seal

MOUNTING OF BEARING ON SHAFT

Adapter Sleeve Mounting
Position adapter sleeve on the shaft to correct location with respect to required bearing centerline. A smear of lubricating oil (SAE 10 or 20) applied to the sleeve outside diameter surface results in easier bearing mounting and removal. (For pillow blocks mounted close to a pulley hub or similar obstruction, mount the adapter sleeve with threads inboard for easy removal. Remember to slide lock-nut, lock-washer and bearing onto the shaft before positioning the sleeve.)

NOTE: All bearings mounted on tapered sleeves have to be driven up the taper to the tolerances given in SKF tables, to ensure correct fits. Spherical roller bearings can be measured between the unloaded rollers and the outer ring sphere surface.

Un-mounted Clearance, Spherical Roller Bearings
Measure the un-mounted internal clearance in the bearing by inserting and sliding progressively larger feeler blades the full length of the roller between the most vertical unloaded rollers and the outer ring sphere. Never run the rollers over the feeler blade, as the wrong value will be obtained. Record the measurement of the largest size blade that will slide through. This is the un-mounted internal clearance.

Bearing
Mount the bearing hand tight on the adapter sleeve. Be sure the large end of the bore of the inner ring matches the taper of the adapter. To avoid damage to the bearing it is most important during this and subsequent operation that the shaft is blocked up so the bearing is unloaded. Do not apply lock-washer. Drive up procedure may damage it.

Bearing Drive Up, Spherical Roller Bearings
Lubricate the face and thread of the lock nut and apply to sleeve with chamfered face toward the bearing. Tighten the lock nut. Do not attempt to tighten the lock nut with a hammer and drift (use proper wrenches), the lock nut can be damaged and chips can enter the bearing. Further tighten the lock nut and measure the internal clearance until the internal clearance is less than the un-mounted clearance figure by the amount shown in the attached table (see last page). Finally, remove lock nut, position lock washer with outer tangs facing away from the bearing, and inner tang properly seated in the slot provided in the adapter. Replace lock nut and tighten until firmly seated.

PREPARATION OF PILLOW BLOCK HOUSING

Check to be sure all pillow block parts are free of burrs and are completely clean. Internal surfaces should be removed. Apply a thin coat of grease to the bearing seat in the base. Fit the bearing and seal inserts into the pillow block base, being careful not to damage to O-rings. For assembling larger sizes where hoists must be used, it may be convenient to seat both bearings into their housing bases simultaneously.

FIXING RINGS

On each shaft one bearing is generally "Held" and other bearings are "Free", to permit shaft expansion. For "Held" bearing housings, use two fixing rings. Place one on each side of bearing.

CAPPING THE PILLOW BLOCK

Place the cap on the base so that the dowel pins in the base align with the holes in the cap, being careful not to damage the O-rings. Caps and bases are not manufactured for interchangeable assembly. They must be kept together. Install cap-bolts with lock washers and tighten securely.

GREASE LUBRICATED BLOCKS

Lubrication Notes

Grease Lubrication

If grease is used as a lubricant, it should be smeared between the rolling elements and worked in. The lower half of the housing should be packaged $^1/_2$ to $^3/_4$ full.

PROCEDURE FOR APPLYING LUBRICANT TO BEARINGS AND PILLOW BLOCKS

Pack each bearing as completely full of the specified grease as possible by swiveling the outer ring open and rotating it as necessary to inject the grease. Then, swivel the outer ring closed being careful not to use force in the event a roller end catch the corner of the outer ring sphere.

B) Before assembling the pillow block cap to the base, and after completing bearing and base assembly, fill $^1/_2$ to $^3/_4$ of the pillow block base with the same lubricant that was used to pack the bearing.

LUBRICATION PROCEDURE TO BE USED AT START-UP

A) All pillow block assemblies that have not been prepared for stage are ready for use, assuming the installation procedures have been correctly followed.

B) While shaft is rotating, lubricate each seal through the outside lubricant fittings until grease is seen emerging from the labyrinth areas. Make sure the outside of the lubricant fitting is clean before applying grease.

RE LUBRICATION

Lubricants deteriorate in time, and the rate of deterioration is a function of the lubricant used at the operating conditions encountered. Determining the re-lubrication cycle depends on sampling the grease and analysis of the samples. Provisions must be made to adequately evaluate the contamination by solids. Samples for grease evaluation should be taken from near the bearing, and evaluation of the samples should dictate the re-lubrication cycle.

Remove caps once a year and re-apply new grease.

Each seal assembly should be lubricated once a month, while the bearing is rotating, with the same grease that is used in the bearing.

GREASE CLASSIFICATION

		Oil Viscosity Saybolt Second (approx. SSU)		
Class	Type of Base (1)	@ 100 F	@ 210 F	NLGI (2) Grade
A	Lithium or Equal	200 - 500	48 – 55	0
B	Lithium or Equal	400 - 600	58 – 68	1
C	Lithium or Equal	800 - 1,000	75 – 82	1
D	Lithium only	800 - 1,000	75 – 82	2

	Grease requirement from above			
Operating temperature of bearing (4)	Low (5)	Medium	High	Suggested Re-lube cycle
0 – 70	A or B			6 – 12 months
70 – 120	B or C			6 – 12 months
120 – 160	B or C	C or D (6)	D (7)	2 - 3 weeks
160 – 200	C	C or D (6)	D (7)	1 - 4 weeks

1) Calcium Complex Greases NOT recommended for spherical roller bearings.

2) National Lubricating Grease Institute Consistency Code.

3) Definition of speed categories:
Low: up to 1/4 of catalog speed limit for static oil lubrication.
Medium: 1/4 to 1/2 catalog speed limit for static oil lubrication.
High: 1/2 to full catalog speed limit for static oil lubrication.

4) Consult SKF Engineering if temperature is below 0^o or above 200^oF.

5) Extremely slow speed will require special consideration if loads are high.

   * Under all conditions, application should be checked using the SKF lubricant film parameter found in the Engineer Data Catalog.

6) Use type "C" where load is heavy, 15,000 hours-rating life or less and/or speed are less than RPM.

7) Consult SKF Engineering - Grease lube not normally recommended under this combination of operating conditions.

8) Dry clean applications only. For moderate conditions of dirt and/or moisture, use cycle of 1 to 2 months. For extreme conditions of dirt and/or moisture, use cycle of 1 week. Vertical applications normally require shorter than normal re-lube cycle.

9) Never mix greases with unlike bases.

10) Remove old grease at least once a year.

10 - LIMITED WARRANTY

SEPROTECH SYSTEMS INCORPORATED warrants the parts in each treatment plant to be free from defects in material and workmanship; for a period of 15 months from shipment or 12 months from start-up, whichever occurs first, in the treatment of domestic wastewater. Sole obligation under this warranty is as follows:

SEPROTECH SYSTEMS INCORPORATED shall fulfil this warranty by repairing or exchanging any component part, F.O.B. our factory, that in SEPROTECH SYSTEMS' judgement, shows evidence of defects, provided said component part has been paid for and is returned through an authorized dealer, transportation prepaid. The warranty must also specify the nature of the defect to the manufacturer. New placed parts are under warranty for one year.

The warranty does not cover treatment plants that have been flooded, by external means, or that have been disassembled by unauthorized persons, improperly installed, subjected to external damage or damage due to altered or improper wiring or overload protection.

This warranty applies only to the treatment plant and does not include any other electrical wiring, plumbing, drainage, or disposal system. SEPROTECH SYSTEMS INCORPORATED is not responsible for any delay or damages caused by defective components or material, or for loss incurred because of interruption of service, or for any other special or consequential damages or incidental expenses arising from the manufacture, sale, or use of this plant.

SEPROTECH SYSTEMS INCORPORATED reserves the right to revise, change, or modify the construction and design of the treatment plant for domestic wastewater or any component part or parts thereof without incurring any obligation to make such changes for modifications in previously sold equipment. SEPROTECH SYSTEMS INCORPORATED also reserves the right, in making replacements of component parts under this warranty, to furnish a component part, which, in its judgement is equivalent to the Company part replaced.

Under no circumstance will SEPROTECH SYSTEMS INCORPORATED, be responsible to the warrantee for any other direct or consequential damages. Including but not limited to; lost profits, lost income, labour charges, delays in production, and/or idle production, which damages are caused by a defect in material and/or workmanship in its parts.

This warranty is expressly in lieu of any other expressed or implied warranty, excluding any warranty of merchantability or fitness, and of any other obligation on the part of SEPROTECH SYSTEMS INCORPORATED.

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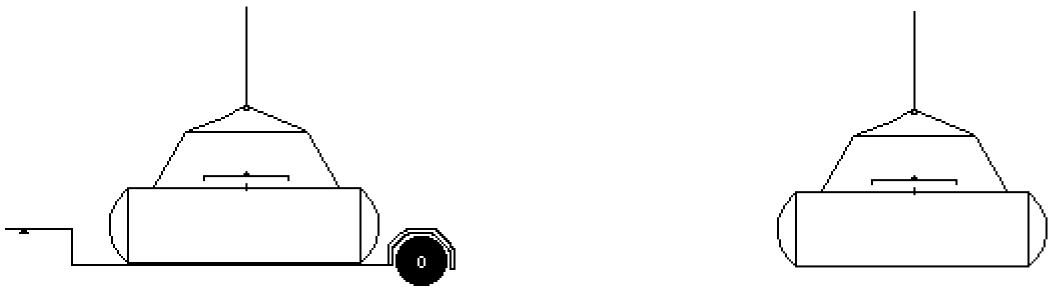
LIFTING

INSTRUCTIONS



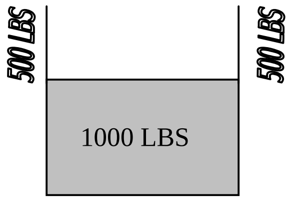
CENTER OF GRAVITY

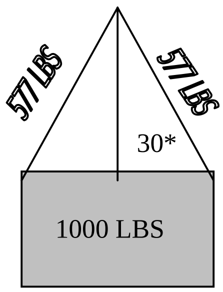
It is always important in rigging practice to rig the load so that it is stable. A stable load is one in which the center of gravity of the load is directly below the main hook and below the lowest point of attachment of the slings. The center of gravity of an object is that point at which the object will balance. The entire weight may be considered as concentrated at this point. A suspended object will always move so that the center of gravity is below the point of support. In order to make a level or stable lift, the crane or hook block must be directly above this point. Thus a load, which is slung above and through the center of gravity, will be stable and will not tend to topple or slide out of the slings.

Predicting the center of mass for an object to be lifted is not a trivial matter. It may require several attempts at rigging to find the appropriate balance point. Many objects are not rectangular such that predicting the center of mass is often difficult. In all crane lifts the center of mass must remain below the hook and below the point of attachment for any rigging. A center of mass above the hook is inherently unstable and will cause the load to flip. Similarly, loads that are not balanced in the horizontal plane may slip form the rigging. The overall stability of the load is a combination of balance with respect to the center of mass, weight distribution, and rigging tightness.

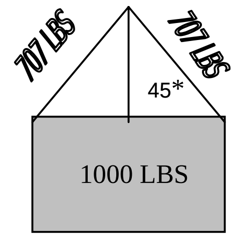
Crane operators should adjust the rigging and test for the actual center of gravity before the load is lifted.

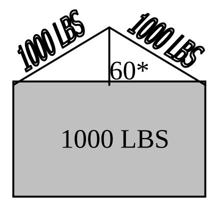
WEIGHT vs. ANGLE





Sling Angle With Vertical	Stresses per Sling Leg Per 1000 LBS Total Load
0	500
5	502
10	508
15	518
20	532
25	552
30	577
35	610
40	653
45	707
50	778
55	872
60	1000
80	2880





The angle at which a sling holds a given load influences the effective weight of the load. Stresses are minimal for loads with slings held perpendicular to the load, as shown in Figure A. For distributing the load vertically among more than a single leg of a sling, a spreader bar may be used. As shown in figures B-D, increasing the angle of the sling to the hook from 30 to 60 degrees increases the effective mass of the load from 1154 lbs. to 2000 lbs., essentially doubling the weight on each leg of the sling at 60 degrees. The chart in the middle offers a handy guide for assessing the effective angle of the sling to the relative weight. Thus, it is always better to limit the angle of the sling. Further, such changes in sling angle must be accounted for in lifts that are close to the sling weight limit and/or for critical lifts (greater than 90% of the crane limit). Crane operators should download a copy of this chart and carry it with them during crane operations.

RIGGING

- Loads should be well secured
- Slings should be adequate to the task
- Slings should be un-kinked and load balanced and secured
- No sudden stops
- No obstructions while lifting or traveling
- No loose items on load or crane before lift
- Bumping into runway stops is prohibited
- Hoist line must be vertical prior to the lift (remove slack in the hoist slowly)
- No crane load should pass overhead of personnel, clear the area before making the lift
- No one is to ride the crane without permission

The most important job of any crane operation is rigging of the load. Poor rigging may result in personnel injury, property damage, or other serious hazards. Rigging is the most time consuming of any crane operation and represents the single most hazardous potential of crane operation. In a multi-sling operation, each leg must be of the same length and must contribute equally to load distribution. Nylon slings are susceptible to damage by sharp corners on the item to be rigged. Caution must be taken to ensure that slings are not damaged by sharp corners or by excessive loading. Rigging requires years of practice to perfect. If in doubt about the security of your rigging, ask for help. Rigging should be checked by lifting the load a few inches off the ground to ensure that no swing develops and that the load is completely secure. Remember it is important to take the time to accomplish this task correctly. Not doing so may result in catastrophic consequences. One of the most important things to check before lifting a load is to look for loose items, such as screws or tools, which may have been used to secure the load. Such items can become projectiles during a lift. This is the reason why crane operators or especially tag line operators should wear hard hats when operating the crane and why it is essential to make sure the path of the crane does not pass over the head of any individual.

Spreader bars must be used when lifting the B30. Slings are to be attached at the lifting lugs located at the Four Inside Corners of the B30.

Overall Weight	34, 200 Lbs
- Weight Trough	3,650
- Weight Shaft	4,634
- Weight Hood	3,900
- Miscellaneous	22,000

Overall Dimensions	311 Inch Long x 143 Inch Wide x 186 Inch High

(Refer to the General Arrangement Drawing for exact dimensions)

The following handling and installation instructions are intended to help customers install the RBC properly and efficiently.

Handling and installation instructions are only recommendations. They do not relieve the purchaser from full responsibility for proper inspection, handling and installation. Improper handling or installation, which results in damage or tank failure, is the sole responsibility of the purchaser. Failure by the customer to comply with the handling or installation instructions will void the tank warranty. Unknown situations or conditions are also the burden of the purchaser.

The presence of SEPROTECH SYSTEMS personnel or an authorized representative at the installation site does not relieve the purchaser of their responsibilities.

DO NOT fully assemble RBC prior to lifting. First install the tank, and then assemble the shaft and other components onto installed tank.

INSPECTION

At the time of delivery, the customer shall be responsible for inspecting the tank for damage during transit. Both the inside and the outside of the tank must be inspected. If damage has occurred it should be noted on the delivery receipt prior to signing acceptance, whether it be a SEPROTECH SYSTEMS truck of common carrier. If a SEPROTECH SYSTEMS truck makes delivery, the factory should be immediately contacted prior to unloading or acceptance. The customer accepts all future responsibility for a damaged tank if the procedures set forth are not followed.

Minor damage can be repaired at the delivery site.

SEPROTECH SYSTEMS tanks are designed to withstand normal handling. Note the following handling precautions:

1. NEVER roll or slide a RBC. Lift the tank using a crane or other approved method.
2. Operators of hoist equipment should follow proper rigging procedures at all times. NEVER allow RBC to swing out of control.
3. Do not drop or allow hard impact from tools, spreader bars, etc.
4. Avoid the use of equipment inside the tank that could scratch or damage the inner corrosion barrier.
5. NEVER use cables or chains around tank.
6. NEVER lift tank by using fittings. Use designated lifting lugs.
7. If RBC is being stored prior to installation, be sure to lay on padded surface and tie down securely.

APPENDIX F

STRATEGY FOR 2009 PWSP TREATMENT AND DISCHARGE

Technical Memorandum

To: Jim Millard
Environmental Superintendent
Baffinland Iron Mines Corporation

Project: W01391.001

From: Dave Ellis, AMEC Geomatrix Limited
Jered Munro, AMEC Geomatrix Limited

Date: March 16, 2009

Subject: Technical Strategy for 2009 PWSP Treatment and Discharge

Baffinland Iron Mines Corporation (BIM) has retained AMEC Geomatrix Limited (AMEC) to prepare the Technical Strategy (TS) for the management, treatment, and disposal of the wastewater and sludge solids stored in the polishing/waste stabilization ponds (PWSPs) at Milne Inlet and the Mary River facilities.

This TS has been developed using information provided by BIM, the Mary River rotating biological contactor (RBC) process design evaluation, and discharge limits that have been adopted for the upcoming 2009 operating season.

Discharge limits for BOD_5, TSS, faecal coliform, oil and grease, pH, and toxicity are set requirements of Water Licence 2BB-MRY0710 that regulates effluent discharges for the project. There is also a requirement for discharge effluent to be acutely non-toxic. This requirement for non-toxicity regulates levels of ammonia. Discharge limits for phosphorus are set based on the results of conservative mass loading modeling that was completed by Knight-Piesold Limited (KPL) and North/South Consultants Inc. (NSC). Discharge criteria for the decant of the PWSPs are summarized in Table 1.

PWSP water quality was last monitored in September 2008. Since that time there has been discharge from the RBC treatment system to the PWSPs with a prolonged period of iced-over conditions. These factors are likely to result in changes to PWSP water quality since the September PWSP sampling event. Due to this uncertainty of the PWSP water quality, the development of a detailed plan and schedule for the decant of the PWSPs is not possible prior to the open water season in June 2009. This TS has been prepared to identify the sequence of events that will be required to allow a timely and successful discharge of the PWSP's without interrupting ongoing site operations. Likely conceptual options for treatment and discharge of PWSP water will also be discussed.

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Table 1: Discharge Criteria for Decant of PWSPs

Parameter	Discharge Criteria	
Location	Mary River WWTF	Milne Inlet WWTF
BOD_5[1]	30 mg/ L	100 mg/L
TSS[1]	35 mg/L	120 mg/ L
Faecal Coliform[1]	1,000 CFU/100mL	10,000 CFU/100mL
Oil and Grease[1]	No visible sheen	No visible sheen
pH[1]	Between 6.0 and 9.5	Between 6.0 and 9.5
Toxicity[1]	Final effluent not acutely toxic	Final effluent not acutely toxic
Ammonia[2]	N/A	N/A
Total Phosphorus[3]	0.5 – 1.0 mg/L	N/A

Notes: 1. Discharge criteria based on water licence effluent limits for maximum average concentration.
2. No specific criteria for ammonia, but effluent must be acutely non-toxic.
3. The range set for total phosphorus discharge target levels to Sheardown Lake were set based on results of the mass loading model. Refer to Section 10 of this report for more information.

WASTEWATER TECHNICAL STRATEGY (TS)

The TS for treating and discharging the accumulated water from the PWSPs requires that the following tasks be undertaken and information collected:

1. Conduct environmental sampling and analysis of the accumulated water and solids in each of the PWSPs as soon as conditions permit (likely June and early July)
2. Confirm PWSP water levels and volumes of water and solids for disposal from each PWSP.
3. Conduct bench-scale treatability testing of PWSP samples.
4. Review and select the specific treatment process for scale-up.
5. Finalize the discharge workplan for each PWSP.
6. Execute the technical workplan to treat and discharge each of the PWSPs.
7. Submit a report for the PWSP treatment and discharge activities for 2009.

The execution of Tasks 1 and 2, above, will provide information required by AMEC to complete treatability testing and to finalize the technical workplan for the 2009 discharge season. The wastewater discharge workplan will be developed and executed in collaboration with BIM staff for the 2009 discharge season. The discharge workplan will be designed so that it can be utilized by BIM during future annual open water discharge seasons.

MILNE INLET

Polishing/Waste Stabilization Pond #1

There is approximately 445 m3 of partially treated effluent in the PWSP at Milne Inlet. The existing water quality in the PWSP dated September 2, 2008 was compliant for all regulated parameters as stated in BIM's water licence (refer to Table 1). However, ammonia was elevated and there will be a requirement for toxicity testing to be completed prior to discharge as identified in the water licence.

If the water does not pass the toxicity testing then further treatment of ammonia will be required to levels that are non-acutely toxic.

Potential Treatment Strategies

The treatment techniques that would be applicable for ammonia removal at Milne should they be required are discussed further.

Option 1: Recycle through the Milne RBC

The RBC at Milne Inlet Camp has not been operational since October. Based on projected camp occupancy levels at Milne Inlet Camp for the 2009 field season, there will be between two and five personnel resident at this location. As a result, decision has been made by BIM not to start up the Milne Inlet Camp RBC for the 2009 season. Recycling through the Milne RBC is therefore not a preferred option at this time.

Option 2: Chemical treatment for ammonia removal

Chemical treatment of the Milne PWSP for ammonia removal is possible by adding a caustic chemical to the pond (e.g., agricultural lime) to raise the pH to between 11.0 and 12.0 to promote the stripping of ammonia from the water. If the pond pH is raised using agricultural lime the additional benefits of increased removal of phosphorus and suspended solids within the pond system will also result. Following the air-stripping of the ammonia, an acidic chemical such as aluminum sulphate (alum) would need to be added to lower the pH to the compliance range before discharge.

Batch treatment of the lagoon using agricultural lime has the following advantages

- Isolated treatment of PWSP with no external effects
- Fast treatment time (approximately 2 weeks)
- Faster discharge rates with independent pump (approximately 2 weeks)

Using batch chemical treatment the Milne PWSP could be treated over the course of 2 weeks and discharged over the following 2 weeks at a discharge rate of 5.5USgpm or 21L/min.

MARY RIVER

Polishing/Waste Stabilization Pond #1

There is approximately 2400 m3 of partially treated effluent in PWSP #1 at Mary River. The existing water quality in the PWSP #1 at Mary River dated September 3, 2008 is not expected to pass the toxicity testing that is required prior to discharge based on current ammonia concentrations as measured in September 2008. Also, based on the September 2008 sampling results, total phosphorus concentrations exceed the currently established target level and would therefore require further treatment.

The two other parameters of concern are faecal coliforms and TSS. Both parameters are marginally within compliance based on September 2008 data.

Potential Treatment Strategies

PWSP #1's high ammonia content is likely to fail the toxicity testing required by the water license. In order to meet regulatory compliance there are two economically feasible options for the site at this time. The water from PWSP #1 could be

- Recycled back through the Mary River RBC
- Chemically treated to aid air stripping

The total phosphorus level is also higher than the current target level range. PWSP#1 may require phosphorus removal. Two feasible strategies for removal of phosphorus are:

- Chemical precipitation and in-pond settling - as described for Milne using agricultural lime and alum. The addition of a flocculating agent to the pond water to serve as a settling aid may be required.
- Filtration – use of a portable multimedia sand filtration skid with a design flowrate of 400 m^3/day will aid in fine particulate phosphorus removal to achieve the target level of 0.5 mg/L. A 400 m^3/day filtration system would allow discharge of PWSP 2 and 3 in approximately 2 weeks. The addition of a flocculating agent to the pond water to serve as a filter aid may be required.

It is possible that a combination of the two techniques listed will be needed in order to achieve the phosphorus levels required. Similarly, the liquid from PWSP #1 may be decanted from the accumulated solids and directed in to PWSP #2 and/or #3 for combined treatment. The Mary River RBC treatment facility is currently achieving compliance via chemical precipitation and settling.

Polishing/Waste Stabilization Pond #2

There is approximately 3196 m3 of partially treated effluent in PWSP #2. The current water quality in PWSP #2 does not meet the criteria stated in the site water license. TSS and total phosphorus are the two parameters that are expected to require additional treatment in this pond.

Potential Treatment Strategies

The most common method of phosphorus removal is chemical precipitation. A coagulant is added to wastewater which forms phosphate and hydroxide solids that can be physically removed from the wastewater. Coagulant selection is determined by the required treatment efficiency and specific wastewater characteristics.

Three feasible strategies for the combined removal of suspended solids and phosphorus are:

- Recycle through existing RBC
- Chemical precipitation and in-pond settling - as described for Milne using agricultural lime and alum. The addition of a flocculating agent to the pond water to serve as a settling aid may be required.
- Filtration – use of a portable multimedia sand filtration skid with a design flowrate of 400 m^3/day will aid in fine particulate phosphorus removal to achieve the target level of 0.5 mg/L. A 400 m^3/day filtration system would allow discharge of PWSP 2 and 3 in approximately 2 weeks. The addition of a flocculating agent to the pond water to serve as a filter aid may be required.

It is possible that a combination of the three of the techniques listed will be required in order to achieve the phosphorus levels required. Similarly, the liquid from PWSP #2 may be decanted from the accumulated solids and directed in to PWSP #3 for combined treatment. The Mary River treatment facility is currently achieving compliance via combined chemical precipitation and filtration.

Polishing/Waste Stabilization Pond #3

The projected volume of partially treated effluent in PWSP #3 is projected to be approximately 806 m3 by the end of June 2009. It is assumed that the water stored in PWSP#3 has approximately the same quality as the current RBC effluent. Laboratory analysis from December 2008 and January 2009 indicated that PWSP#3 is compliant for all parameters stated in the water license. Phosphorus meets the established target level range. Based on AMEC's understanding of current operations, PWSP #3 can be discharged in its current state without additional treatment

SOLIDS TECHNICAL STRATEGY (TS)

The currently approved approach to wastewater solids management is to use the existing PWSP as a sludge drying bed with seasonal treatment and discharge of any accumulated separated wastewater. The PWSPs hold either wastewater or comingled wastewater and solids.

There are currently an estimated 212 m^3 of settled sludge solids in PWSP#1 at Milne, 769 m^3 in Mary River PWSP #1 and 158 m^3 in Mary River PWSP#2. These three solids-containing ponds also hold non-compliant wastewater.

The treatment of non-compliant wastewater may require chemical addition and agitation which will re-suspend any settled solids. This re-suspension of the settled wastewater solids is likely to have negative effects on the treatment of the target wastewater contaminants. In order to prevent future treatment issues, development of an alternate solids management plan has been proposed.

The TS for managing accumulated solids from the PWSPs requires that the following tasks be undertaken and information collected:

1. Conduct environmental sampling and analysis of the accumulated solids in each of the PWSPs.

2. Confirm PWSP solids levels and volumes of water and solids for disposal from each PWSP.

3. Conduct bench-scale treatability testing of PWSP samples.

4. Review and select the specific treatment process for scale-up.

5. Develop a solids treatment workplan for each PWSP.

6. Execute the technical workplan to treat the solids while managing the resultant wastewater at each of the PWSPs.

7. Submit a report for the PWSP solids treatment and discharge activities for 2009.

Treatability testing of the solids will allow AMEC to determine an effective dewatering and storage plan for the 2009 discharge season. If sufficient resources are available, a detailed wastewater solids treatment workplan will be developed and executed in collaboration with BIM staff during the 2009 discharge season. The solids treatment workplan will be designed so that it can be utilized by BIM throughout future operating seasons to avoid additional handling during the open water season.

The solids management strategy employed at the Milne Inlet and Mary River facilities will focus on segregation of the sludge solids and non-compliant wastewater streams to simplify annual handling and treatment.

Conceptual options to be considered for the treatment and management of sludge in the PWSPs at Milne and Mary River include:

- Sludge drying beds
- Contained Passive Filtration (e.g. Geotubes)
- Mechanical Dewatering Technologies (belt press, centrifuge, screw press)

Each of the conceptual dewatering technologies will require the addition of a dewatering aid in order to optimize the treatment process and minimize the volume of solids that will need to be disposed of onsite.

The dewatering aid (polymer) bonds to the free solid particles and increases the solid particle size, allowing sludge-bound water to be released from the sludge. Primary, partially digested sludge solids are generally 1-5% dry solids content in sewage sludge. Dewatered sludge solids are typically 15-40% dry solids depending on the sludge characteristics and the selected dewatering method. The resulting solids volumes are 10-30% of the original sludge volume significantly reducing disposal volumes. The increased solids content also results in a solid waste product that is acceptable for landfilling.

Site specific conditions, resource availability, etc. will determine which of the methods discussed in the detailed workplan will be the most feasible option for solids management.

APPENDIX G

ASSESSMENT OF POTENTIAL EFFECTS OF SEWAGE EFFLUENT DISCHARGE FROM THE MARY RIVER MINE CAMP SITE ON WATER QUALITY.

Technical Memorandum

Date: March 27, 2009

To: Jim Millard
Environmental Superintendent
Baffinland Iron Mines Corporation

From: North/South Consultants Inc.
83 Scurfield Blvd.
Winnipeg, MB, R3Y 1G4

Project: **MARY RIVER PROJECT**

Subject: Assessment of potential effects of sewage effluent discharge from the Mary River Mine Camp Site on water quality.

INTRODUCTION

Knight Piesold Ltd. (KPL) and North/South Consultants (NSC) were retained by Baffinland Iron Mines Corporation (BIM) in 2007 to assess potential effects on the receiving waters from their Waste Water Treatment Facilities at their Mary River Project and confirm that facility designs were appropriate given the projected operating schedule, and projected discharge concentrations and loadings. Based on available receiving environment data and process design considerations, the final effluent from the facilities was expected to be non-acutely toxic. The potential for eutrophication of the fresh water receiving environment (Sheardown Lake) was also evaluated by means of a mass balance modelling approach that used conservative assumptions. The model results indicated that fully mixed concentrations of TSS, ammonia, and nitrate would be within CCME guidelines for the protection of aquatic life, and that total phosphorus increases would remain within triggers specified in the CCME guidance framework for the management of phosphorus. Localized and short-term effects to biota were predicted to occur in the vicinity of the outfall, including localized DO depletion and chronic effects related to TSS, ammonia, and nitrate. The conclusions of the 2007 assessment were that that overall sites and facilities were designed to limit the impact of the treated sewage effluent on the receiving environments

During the 2009 open water season, BIM is planning to discharge accumulated effluent from their Polishing/Waste Stabilization Ponds (PWSPs) during the summer of 2009. The following technical memorandum was prepared to provide an update that reflects current conditions and BIM's 2009 operational plans. Specifically, this work provides an overview of current water quality conditions in Sheardown Lake northwest basin ("Sheardown Lake NW"), a description of the methods applied to assessing potential effects of discharge of pond sewage effluent on water quality in Sheardown Lake NW, and a brief overview of the results of the assessment.

Similar to the 2007 assessment, the approach for the current work included mass-balance modeling of key effluent parameters and an evaluation of potential for acute toxicity at the end-of-pipe.

SOURCES OF INFORMATION

A mass balance modelling approach was used to evaluate the potential effects of treated effluent discharges on water quality in Sheardown Lake. Information required for the mass-balance model includes lake water quality data, lake volume data, and sewage effluent quality data and discharge rates. Lake volume was obtained from the bathymetric survey conducted in August 2007 (NSC 2008a; Figure 1).

Lake water quality has been measured in 2006, 2007, and 2008. Means were obtained for key water quality parameters for Sheardown Lake NW (open-water season) using data collected in 2007 and 2008; data collected in 2006 were limited and the analytical detection limits for key parameters were improved after 2006. Therefore, the mass-balance modeling was conducted using data collected in 2007 and 2008 only.

Water quality sampling included analysis of nutrients and “routine” water quality as well as collection of *in situ* measurements across depth. Sampling was conducted two times during the open-water seasons in 2007 and 2008 (note: additional samples were collected for some parameters during a third sampling period in 2008, however, some of these results were not included due to exceedence of holding times while in transit). Samples for laboratory analysis were collected 1 m from the water surface and 1 m from the sediments. Detailed results of the 2007 sampling program are presented in NSC (2008b).

Sewage effluent quality, volume/discharge rate, and duration and timing of release for ponds and the RBC were provided by AMEC Geomatrix Limited (AMEC). Analyses were conducted using both treated and untreated pond effluent quality (both provided by AMEC). Effluent information is summarized in Table 1. Note that while the target effluent concentration for total phosphorus for effluent from Ponds 1 and 2 is 0.5 mg/L, it is anticipated that concentrations may periodically range up to 1.0 mg/L for these wastewater streams. Therefore, this range of effluent concentrations and associated loadings were evaluated herein.

METHODS

Many water quality parameters are low in Sheardown Lake – as they are in other nearby lakes. In particular, ammonia, total suspended solids (TSS), total phosphorus (TP), nitrate, biological oxygen demand (BOD5), and bacteria have generally occurred near or below the analytical detection limits over the period of study. This occurrence renders it difficult to precisely define the "background" lake water quality conditions. This is particularly problematic for TP as the CCME phosphorus guidance framework specifies assessment of effects based on a relative change from background (CCME 1999; updated to 2008). To assess potential effects of effluents on lake water quality, lake-wide average water quality conditions were derived using data collected in the open-water seasons of 2007 and 2008. This was done by assigning values of one half the detection limit and values equivalent to the detection limit, where values were reported below the analytical detection limit.

The mass-balance modeling approach assumed a "closed" system (i.e., no inflow or outflow), no settling or degradation of effluent parameters (i.e., conservative approach), and cumulative loading associated with effluent releases from July 1, 2009 through May 30, 2010. Specifically, loading associated with the pond discharges and the RBC effluent were calculated and assumed to be concurrently present in the lake (i.e., all discharges would remain and accumulate over the period of evaluation). Pond discharges are expected to occur in August for a period of 2-4 weeks. However, the RBC effluent is expected to be released from July 1 through September 30 at a rate of 9 m^3/day and thereafter at a rate of 3 m^3/day through the end of May 2010 (based on current operational plans). To maintain a conservative approach, the loadings associated with these cumulative releases were calculated and assumed to be instantaneously released to the lake. In actuality, the releases will be more gradual and will occur over a range of environmental conditions (e.g., water temperatures). In addition, losses would be expected through outflows, some dilution would be expected due to inflows, and internal settling and transformations of some parameters would be expected. However, a conservative approach was used in the interest of minimizing risk.

Additionally, to provide 'near-field' estimates of the potential effects of the effluents on water quality in Sheardown Lake NW, mass-balance modeling was applied to near-field areas surrounding the effluent outfall. Specifically, the lake volumes represented by areas of 0.001 km^2, 0.01 km^2, and 0.1 km^2 were estimated from the mean lake depth (12.11 m) and mass-balance calculations were conducted using the effluent loading detailed above. This exercise was intended to provide greater resolution regarding potential changes in water quality near the outfall but does not represent a 'plume model'. The actual dimensions of the plume and the mixing properties of the effluent discharges in the lake are not known.

Potential acute toxicity of the effluents at end-of-pipe was evaluated by comparing effluent quality, provided by AMEC, to the Environment Canada acute toxicity estimation method for ammonia (Canada Gazette 2004) and the estimated effluent pH. As an additional screening tool, effluent quality was also compared to CCME water quality guidelines for the protection of aquatic life. As CCME guidelines are representative of "chronic" conditions, this comparison to effluent quality is highly conservative. However, where parameters are shown to meet CCME guidelines at the end-of-pipe, there is high certainty that the effluent would not lead to in-lake chronic toxicity. For the purposes of evaluating potential toxicity of the effluent at end-of-pipe, flow-weighted means were derived for effluent quality variables, as pond effluent quality is expected to vary between the three sources (Table 1). Potential effluent toxicity was considered for each wastewater stream and for the flow-weighted mean effluent quality.

Mass-balance modeling results were compared to the CCME guidelines for the protection of aquatic life. Site-specific guidelines for ammonia were applied based on the mean pH for Sheardown Lake in conjunction with a range of water temperatures (representing the range of potential temperatures that may occur over the year).

RESULTS

CURRENT LAKE WATER QUALITY

A description of baseline water quality and limnological conditions of Sheardown Lake was provided in the Bulk Sampling Program Environmental Screening Document (Knight Piesold Ref. No. NB102-00181/6-1, Rev.0, November 20, 2006), based on information available to that date. A description of conditions measured in 2007 is presented in NSC (2008b). The following provides an updated overview of existing water quality and limnological data for Sheardown Lake, including data collected in 2008. Figure 2 presents the locations of 2008 sampling sites and Table 2 presents lake-wide means for the open-water seasons of 2007 and 2008 for key water quality parameters.

Thermal stratification has been observed in Sheardown Lake NW in summer at some locations but temperature was relatively uniform across depth in winter and September in 2007 and 2008 (Figures 3 and 4). In general, dissolved oxygen has also been relatively uniform across depth and above the CCME guidelines for the protection of aquatic life (Figures 3 and 4). The exceptions included depletion at depth at site DL0-01-2 in September 2007 and site DL0-01-5 in winter 2007. Overall, the available information indicates that the majority of the water column and lake volume is well-oxygenated throughout the year but may develop pockets of oxygen depletion at depth during some periods.

In general, Sheardown Lake NW is a relatively clear lake (low turbidity and high Secchi Disk depth), is alkaline in the open-water season (pH > 8) and near neutral in the winter (Mean pH of 7.03 in May 2007), soft (hardness typically at or below 60 mg/L), and contains a relatively low concentration of dissolved solids (mean of 71 mg/L in the open-water season and 102 mg/L in winter). Like other lakes in the area, Sheardown Lake NW is nutrient-poor and contains low levels of TP and inorganic forms of nitrogen. TP was generally near or below the analytical detection limit (0.003 mg/L) over the period of study. Lake-wide mean TP concentrations were somewhat higher in the open-water season of 2008 than 2007, although concentrations were generally similar. Similarly, nitrate, nitrite, and ammonia concentrations are low and were generally not detected.

According to the CCME phosphorus guidance framework, Sheardown Lake would be classified as “ultra-oligotrophic” and “uligotrophic” on the basis of TP concentrations measured in 2007 and 2008, respectively (Table 3). On the basis of chlorophyll *a* concentrations measured in the open-water seasons of 2007 and 2008, Sheardown Lake would be categorized as ultra-oligotrophic (Table 4).

POTENTIAL EFFECTS OF EFFLUENTS ON SHEARDOWN LAKE: MASS-BALANCE MODELING

Whole-lake mass balance modeling predictions are presented in Table 5. The estimated fully-mixed concentrations of TSS, ammonia, fecal coliform bacteria, and BOD in Sheardown Lake NW are low and would represent changes that would not be detectable. In each case, the fully-mixed concentrations would be either below or at the analytical detection limit. Change in pH is similarly predicted to be undetectable (Table 5).

The predicted increase in the whole-lake TP concentration due to the combined inputs of treated pond effluents and the RBC effluent is 0.0004 mg/L, assuming the target TP concentration of 0.5 mg/L were achieved for Ponds 1 and 2, which like other parameters would be too small to be detected. As indicated in Section 2.0, actual effluent concentrations for these wastewater streams may range up to 1.0 mg/L periodically. Assuming a concentration of 1.0 mg/L was maintained at all times for Ponds 1 and 2 effluents, the predicted increase in TP in Sheardown Lake in a fully mixed condition would be 0.0007 mg/L. This level of increase would similarly not be detectable. The actual increase would range somewhere between 0.0004 mg/L and 0.0007 mg/L, depending on the TP concentration at the end-of-pipe.

As TP concentrations have been near or below the analytical detection limit and because the trophic boundary between ultra-oligrotrophic and oligotrophic conditions is within the range of measured concentrations, it is difficult to define what the precise existing “background” condition is for Sheardown Lake NW. Given the importance of the potential for eutrophication, background TP concentrations and predictions for fully-mixed TP concentrations with effluent discharges were derived using two statistical methods. Mean background TP concentrations for the lake were calculated in two manners: (1) using a value of one-half the analytical DL; and (2) using a value equal to the DL for measurements reported below the DL. Both of these scenarios are presented in Table 3. These two methods yielded a mean TP of 0.003 mg/L and 0.004 mg/L for the lake; the corresponding trophic status according to the CCME phosphorus guidance framework is ultra-oligotrophic and oligotrophic, respectively (Table 3). The second applicable trigger – an increase of greater than 50% background TP concentrations – would be an increase of either 0.0015 mg/L or 0.002 mg/L. This level of change would likely not be detectable given that the analytical detection limit is 0.003 mg/L. However, mass-balance modeling predictions conducted for both of these background TP scenarios indicate that the increases associated with effluent discharges would not exceed either of the CCME triggers in the fully-mixed state.

Therefore, the whole-lake mass balance modeling results indicate effects would be negligible if the effluents were fully-mixed in the entire volume of the lake. However, mixing processes in lakes, in particular, can be slow and it is not uncommon for gradients in conditions to exist across the entirety of a lake (i.e., fully mixed conditions may not be attained). Regardless of the precise mixing properties, effects would be greatest near the effluent discharge point. To provide some information on potential near-field effects in the vicinity of the effluent discharge point, mass-balance modeling was also conducted using lake volumes associated with areas of 0.001 km^2, 0.01 km^2, and 0.1 km^2. As indicated above, the volumes were calculated for an average lake depth of 12.11 m.

Results of this near-field dilution model are presented in Table 6. These results indicate that effects to pH in the vicinity of the outfall would be negligible and as the end-of-pipe pH is also within the CCME guideline for the protection of aquatic life, the guideline would be met throughout the lake. Concentrations of fecal coliform bacteria would be within the CCME recreational guideline of 2000 CFU/100 mL (CCME 1999; updated to 2008) at the end-of-pipe so no exceedences of the guideline are anticipated. There are no CCME guidelines for TKN or BOD5; however, TKN concentrations would be near background concentrations within approximately 0.1 km^2 due to dilution alone. Some localized effects of BOD5 from effluent discharges may occur in the vicinity of the effluent outfall; however, DO concentrations are generally high in the lake in the open-water season when the two wastewater streams would be discharged concurrently.

TSS concentrations would exceed the CCME guideline of an allowable increase of 5 mg/L above background for an area between 0.001 and 0.01 km^2 from the outfall due to dilution alone. Settling of TSS in the vicinity of the outfall would be expected; therefore the lake area where the guideline would not be met would be smaller.

Concentrations of ammonia are estimated to be < 0.5 mg N/L within 0.001 km^2 of the outfall due to dilution alone. Concentrations are predicted to be near background concentrations within 0.1 km^2 of the outfall. Comparison of these concentrations to CCME guidelines for the protection of aquatic life (Table 7) indicate that at the predicted lake pH and the range of water temperatures that could occur in the lake, ammonia would be below the guideline within an area near 0.001 km^2 of the outfall. Note that the CCME guidelines indicated in Table 7 are specific to a pH of 8.00 and the most stringent guideline is for a water temperature of 20 ^oC. Predicted lake pH values are actually lower than 8.00 within the near-field, and water temperatures have not been recorded in the 20 ^oC range. Therefore, that guideline is conservative. Additionally, ammonia would be subject to nitrification and uptake by algae within the lake, so concentrations may be lower than predicted on the basis of a dilution modeling approach.

TP concentrations would be above the CCME trigger of a 50% increase above background for an area in excess of 0.1 km^2, on the basis of dilution. For the two background TP conditions evaluated (i.e., whether TP is calculated using one half or the full detection limit value for the lake), the areas where this trigger would be exceeded are estimated as 0.13 km^2 and 0.11 km^2, respectively, due to dilution alone if the target TP concentration of 0.5 mg/L for Ponds 1 and 2 is achieved. This area may be somewhat larger due to periodic increases in the end-of-pipe TP concentrations from these wastewater streams. Therefore, increased primary production may occur within this area of the lake in the open-water season. As pond effluents will not be discharged over a prolonged duration, this effect is expected to be short-term and reversible.

END-OF-PIPE EFFLUENT TOXICITY

The pH of the treated pond effluent (as individual or combined wastewater streams) and the RBC effluent would be within the CCME guideline of 6.5-9.0 for the protection of aquatic life. Therefore no effect is anticipated for this parameter

The projected concentrations of ammonia-N in the individual pond wastewater streams range from 0.2 to 2.0 mg N/L with a flow-weighted mean of 1.4 mg N/L. pH for these wastestreams is expected to range between 7.50 and 7.65, with a flow-weighted mean of 7.52. Acute toxicity of the effluents was estimated using the Environment Canada formula presented in the Canada Gazette (2004) and the pH of the effluents (Table 8). The projected ammonia concentrations are notably lower than the calculated acute toxicities of the effluent (Table 8).

CONCLUSIONS

The results of the assessment of potential effects of discharge of treated sewage wastewaters on Sheardown Lake NW water quality can be summarized as follows:

- Based on the results of the modeling there may be some localized changes in water quality, particularly with respect to TSS and total phosphorus, but effects to the lake as a whole are expected to be small and water quality is predicted to remain within CCME guidelines for the protection of aquatic life on a lake-wide basis.
- Effluent is not expected to be acutely toxic to aquatic life.

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Table 1. Projected effluent quality, discharge rate, and total loading for the RBC effluent and effluent from Ponds 1-3. Effluent quality and volumes provided by AMEC.

Parameter	**Unit**	Estimated Treatment Quality					Loading (kg): July 1-May 30				
		Pond #1	Pond #2	Pond #3	Flow-weighted Mean Concentration Ponds #1-3	RBC Effluent	Pond #1	Pond #2	Pond #3	Ponds #1-3	RBC Effluent
Discharge Rate	(m^3/day)	-	-	-	-	9 (July 1-Sept 30)[3] 3 (October 1-May 30)[3]					
Volume	(m^3)	2400	3196	806	6402	1104	2400	3196	806	6402	1104
BOD5	(mg/L)	14	30	4	21	4	33.6	95.9	3.2	132.7	4.4
TSS	(mg/L)	30	30	7	27	7	72.0	95.9	5.6	173.5	7.7
Ammonia	(mg N/L)	2.0	1.2	0.2	1.4	0.2	4.8	3.9	0.18	8.9	0.22
TKN	(mg/L)	15	12.8	1.4	12.2	1.4	36.0	40.9	1.2	78.1	1.5
pH	-	7.5	7.5	7.65	7.52	7.65	0.076	0.101	0.018	0.195	0.025
TP [1]	(mg/L)	0.5-1.0	0.5-1.0	0.3	0.5-0.91	0.3	1.2-2.4	1.6-3.2	0.25	3.0-5.84	0.3
Faecal Coliform	(CFU / 100 ml)	<1000	10	10	381	10	24000[2]	320	81	24400	110

[1] The target end-of-pipe TP concentration for effluents from Ponds 1 and 2 is 0.5 mg/L. However, periodic higher concentrations (up to 1.0 mg/L) may occur. Therefore, ranges of associated loadings are presented here.

[2] A value of 1000 CFU/100 mL was used for loading calculations.

[3] Projected effluent discharge from the Mary River Camp RBC was based on current estimates of future operational conditions. Actual discharge loadings from the RBC may be higher based on potential ramp-up of the work plan and actual water use limits as specified in the water licence. As such, the model may be updated periodically as required

Table 2. Mean routine water quality parameters for the open-water seasons of 2007 and 2008. HTE = holding time exceeded.

Parameter	Units	MRL	2007 Statistics			2008 Statistics				2007-2008 Mean	
			Mean Aug	Mean Sept	Mean 2007	Mean July	Mean August	Mean Sept	Mean 2008	Half the DL	At the DL
Alkalinity as $CaCO_3$	mg/L	5	51	53	52	52	53	56	53	53	53
pH	-		8.26	8.02	8.14	7.87	7.87	7.85	7.86	8.00	8.00
Conductivity	µS/cm	5	104	109	107	107	107	118	111	109	109
TDS (COND - CALC)	mg/L	5	68	71	70	70	70	77	72	71	71
Total Suspended Solids	mg/L	2	<2	<2	<2	1	5	<2	2	2	2
Turbidity	NTU	0.1	0.4	0.4	0.4	HTE	2.4	1.0	1.7	1.0	1.0
Bromide	mg/L	0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Chloride	mg/L	1	1	2	2	2	2	2	2	2	2
Sulphate	mg/L	1	2	3	2	1	1	1	1	2	2
Phenols	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total Organic Carbon	mg/L	0.5	1.9	1.8	1.8	1.7	1.9	2	2	1.8	1.8
Dissolved Organic Carbon	mg/L	0.5	1.9	1.7	1.8	1.6	1.9	2	2	1.8	1.8
Total Kjeldahl Nitrogen	mg/L	0.10	0.14	<0.10	<0.10	0.19	0.17	0.19	0.18	0.12	0.12
Ammonia	mg N/L	0.02	0.02	<0.02	<0.02	0.03	0.01	<0.02	<0.02	<0.02	<0.02
Nitrite	mg N/L	0.005	<0.002	<0.002	<0.002	HTE	<0.005	<0.005	<0.005	<0.005	<0.005
Nitrate	mg N/L	0.10	<0.10	<0.10	<0.10	HTE	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrate/nitrite	mg N/L	0.10	<0.10	<0.10	<0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Phosphorus	mg/L	0.003	<0.003	0.004	<0.003	0.003	0.006	0.004	0.004	0.003	0.004
Chlorophyll *a*	µg/L	0.2	0.3	0.5	0.4	HTE	0.3	<0.2	0.3	0.3	0.3
Pheophytin *a*	µg/L	0.2	1.3	0.6	1.0	HTE	1.8	4.4	3.1	2.0	2.0
BOD	mg/L	1	-	-	-	<1	<1	<1	<1	<1	<1
Total Coliforms	ct/100mL	-	-	-	-	-	1	3	2	2	2
Escherichia Coli	ct/100mL	-	-	-	-	-	0	<1	<1	<1	<1
Heterotrophic Plate Count	ct/1mL	-	-	-	-	-	243	113	178	178	178
Faecal Coliforms	ct/100mL	-	-	-	-	-	0	<1	<1	<1	<1
Faecal Streptococcus	ct/100mL	-	-	-	-	-	1	2	1	1	1

Table 3. Summary of TP concentrations and trophic status for Sheardown Lake NW. Values represent mean concentrations for the lake basin obtained by sampling period, by open-water period for 2007, 2008, and for both combined. Means have been calculated using two methods, for values that were reported below the analytical detection limit (DL): (1) applying a value of one-half the detection limit (DL); and (2) applying a value equal to the DL.

	TP (mg/L)								CCME Trophic Status							
	August 2007	September 2007	Mean 2007 open-water	July 2008	August 2008	September 2008	Mean 2008	Mean 2007 and 2008	August 2007	September 2007	Mean 2007 open-water	July 2008	August 2008	September 2008	Mean July/August 2008	Mean 2007 and 2008
Using Half the DL	<3	4	<3	3	6	4	4	3	Ultra-Oligotrophic	Oligotrophic (boundary)	Ultra-Oligotrophic	Ultra-Oligotrophic	Oligotrophic	Oligotrophic (boundary)	Oligotrophic (boundary)	Ultra-Oligotrophic
Using the DL	3	4	4	3	6	4	4	4	Ultra-Oligotrophic	Oligotrophic (boundary)	Oligotrophic (boundary)	Ultra-Oligotrophic	Oligotrophic	Oligotrophic (boundary)	Oligotrophic (boundary)	Oligotrophic (boundary)

Table 4. Summary of selected trophic status categorization schemes for lakes.

Lake Trophic Status							Reference
Ultra-oligotrophic	Oligotrophic	Oligo-mesotrophic	Mesotrophic	Meso-eutrophic	Eutrophic	Hypereutrophic	
Total Phosphorus (µg/L)							
-	<10	-	10 - 35	-	35-100	> 100	OECD (1982)
<4	4 - 10	-	10 - 20	20 - 35	35 - 100	> 100	CCME (1999; updated to 2008)
-	<5	-	10 – 30	-	-	> 100	Chambers et al. (2001)
<5	-	5 - 10	-	10 - 30	30 - 100	> 100	Wetzel (1983)
-	<10	-	10 - 30	-	-	> 100	Nürnberg (1996)
<3							Sheardown Lake NW: Mean open-water season of 2007
	4						Sheardown Lake NW: Mean open-water season of 2008
3 or 4[1]							Sheardown Lake NW: Mean open-water seasons of 2008/2009
Chlorophyll *a* (µg/L)							
-	<2.5	-	2.5 - 8	-	8 - 25	> 25	OECD (1982)
0.01 - 0.5	0.3 - 3	-	2 - 15	-	10 - 500	-	Wetzel (1983)
-	<3.5	-	3.5 - 9	-	9.1 - 25	> 25	Nürnberg (1996)
0.3							Sheardown Lake NW: Mean open-water season of 2007
0.3							Sheardown Lake NW: Mean open-water season of 2008
0.3							Sheardown Lake NW: Mean open-water seasons of 2008/2009

Table 5. Summary of mass-balance modeling results for Sheardown Lake NW for the fully mixed condition.

	TP[1] (mg/L)	TSS (mg/L)	BOD5 (mg/L)	TKN (mg/L)	Feacal Coliforms (CFU/100 mL)	Ammonia (mg N/L)	pH
Mean Treated Pond Effluent (flow weighted)	0.47-0.91	27	21	12	381	1.4	7.52
RBC Effluent (total July 1 - May 30)[2]	0.3	7	4	1.4	10	0.2	7.65
Using Half the Detection limit for lake water quality							
Existing Concentrations in Sheardown Lake (2007/08 average): using half the DL	0.003	2	<1	0.12	<1	<0.02	8.00
Mass-balance Model With Treated Pond Discharges	0.0034-0.0037	2.02	0.5	0.129	0.8	0.011	8.00
Mass-balance Model with RBC Effluent	0.0030	2.00	0.5	0.120	0.5	0.010	8.00
Mass-balance Model with both Treated Pond and RBC Effluents	0.0034-0.0037	2.02	0.5	0.130	0.8	0.011	8.00
Using the Detection limit for lake water quality							
Existing Concentrations in Sheardown Lake (2007/08 average): using the DL	0.004	2	<1	0.12	<1	<0.02	8.00
Mass-balance Model With Treated Pond Discharges	0.0044-0.0047	2.02	1.0	0.129	1.3	0.021	8.00
Mass-balance Model with RBC Effluent	0.0040	2.00	1.0	0.120	1.0	0.020	8.00
Mass-balance Model with both Treated Pond and RBC Effluents	0.0044-0.0047	2.02	1.0	0.130	1.3	0.021	8.00
Effect of Treated Pond Effluents Alone (no Lake Background)	0.0004-0.0007	0.02	0.0	0.010	0.3	0.001	-

[1] Ranges presented for TP represent mass-balance model predictions using 0.5 mg/L and 1.0 mg/L TP concentrations (and associated loadings) for effluents from Pond 1 and 2. The actual effects are expected to lie between these boundaries, depending on effluent treatment performance.

[2] Projected effluent loadings from the Mary River Camp RBC were based on current estimates of future operational conditions. Actual discharge loadings from the RBC may be higher based on potential ramp-up of the work plan and actual water use limits as specified in the water licence. As such, the model may be updated periodically as required.

Table 6. Summary of near-field mass-balance modeling results for Sheardown Lake : predicted effect of discharge of treated pond effluents and RBC effluent.

	Lake Area (km^2)	TP (mg/L)	TSS (mg/L)	BOD5 (mg/L)	TKN (mg/L)	Feacal Coliforms (CFU/100 mL)	Ammonia (mg N/L)	pH
Using Half the Detection limit for lake water quality								
Existing Concentrations in Sheardown Lake (2007/08 average)	Whole Lake (0.678)	0.003	2	<1	0.12	<1	<0.02	8.00
Predicted Concentrations: Mass-balance	0.001	0.170-0.298	10.30	7.3	4.134	125.3	0.471	7.76
	0.01	0.028-0.047	3.27	1.5	0.732	19.5	0.080	7.95
	0.1	0.0056-0.0080	2.13	0.6	0.185	2.5	0.017	7.99
	Whole Lake (0.678)	0.0034-0.0037	2.02	0.5	0.130	0.8	0.011	8.00
Using the Detection limit for lake water quality								
Existing Concentrations in Sheardown Lake (2007/08 average)	Whole Lake (0.678)	0.004	2	<1	0.12	<1	<0.02	8.00
Predicted Concentrations: Mass-balance	0.001	0.171-0.299	10.30	7.6	4.134	125.6	0.477	7.76
	0.01	0.029-0.048	3.27	2.0	0.732	20.0	0.090	7.95
	0.1	0.0066-0.0087	2.13	1.1	0.185	3.0	0.027	7.99
	Whole Lake (0.678)	0.0044-0.0047	2.02	1.0	0.130	1.3	0.021	8.00

Table 7. Lake mean pH for the open-water and ice-cover seasons and the CCME guidelines for ammonia at a range of water temperatures.

Period	Lake-wide Mean pH	Temperature (^oC)	CCME Guideline for ammonia (mg NH_3-N/L)
Open-water	8.00	0	1.864
	8.00	5	1.232
	8.00	10	0.832
	8.00	15	0.572
	8.00	20	0.399
November-May	6.81	0	18.48

Table 8. Assessment of the acute toxicity potential of effluents.

Parameter	Ammonia (mg N/L)	pH	Temperature (^oC)	EC ammonia acute toxicity (mg N/L)
Existing Concentrations in Sheardown Lake (2007/08 average)	<0.02	8.00	0-20	24.2
Mean Treated Pond Effluent (flow weighted)	1.4	7.52	ambient	65.3
Pond 1 - Treated	2.0	7.50	ambient	67.5
Pond 2 - Treated	1.2	7.50	ambient	67.5
Pond 3 - Treated	0.2	7.65	ambient	49.7
RBC Effluent (total July 1 - May 30)	0.2	7.65	15 to 20	49.7

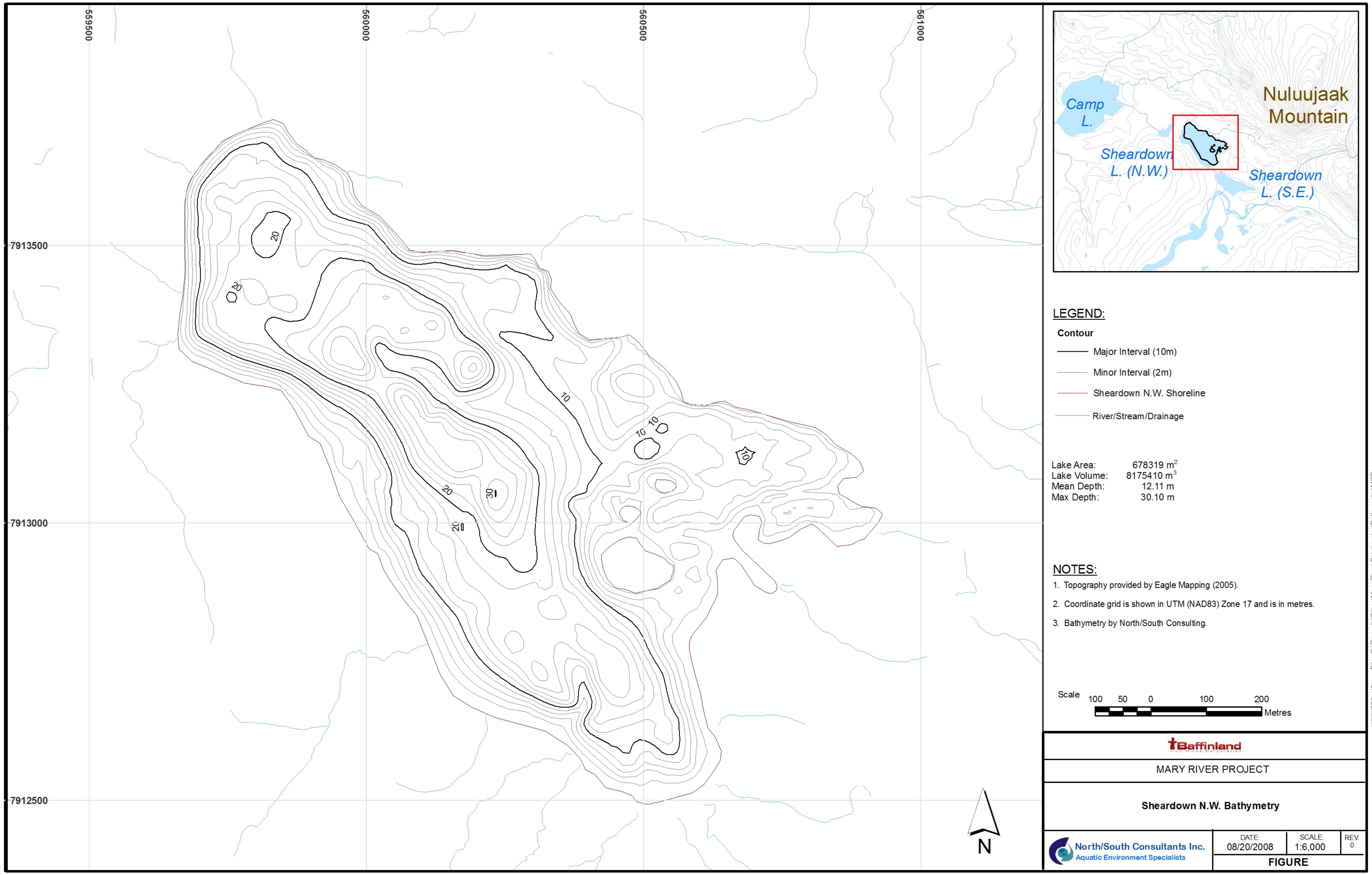

Figure 1. Sheardown Lake NW bathymetry.

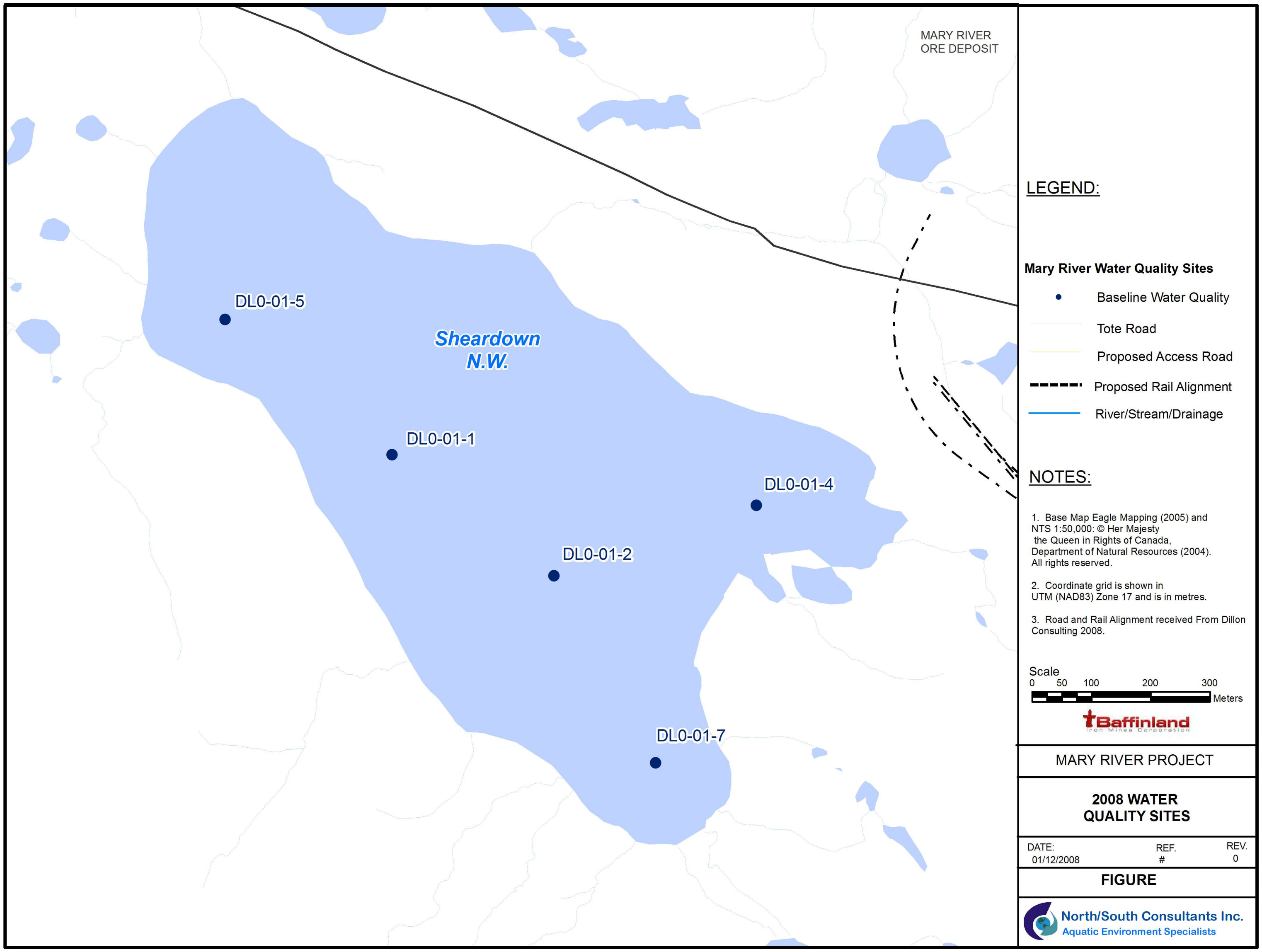

Figure 2. Locations of 2008 water quality sampling sites in Sheardown Lake NW.

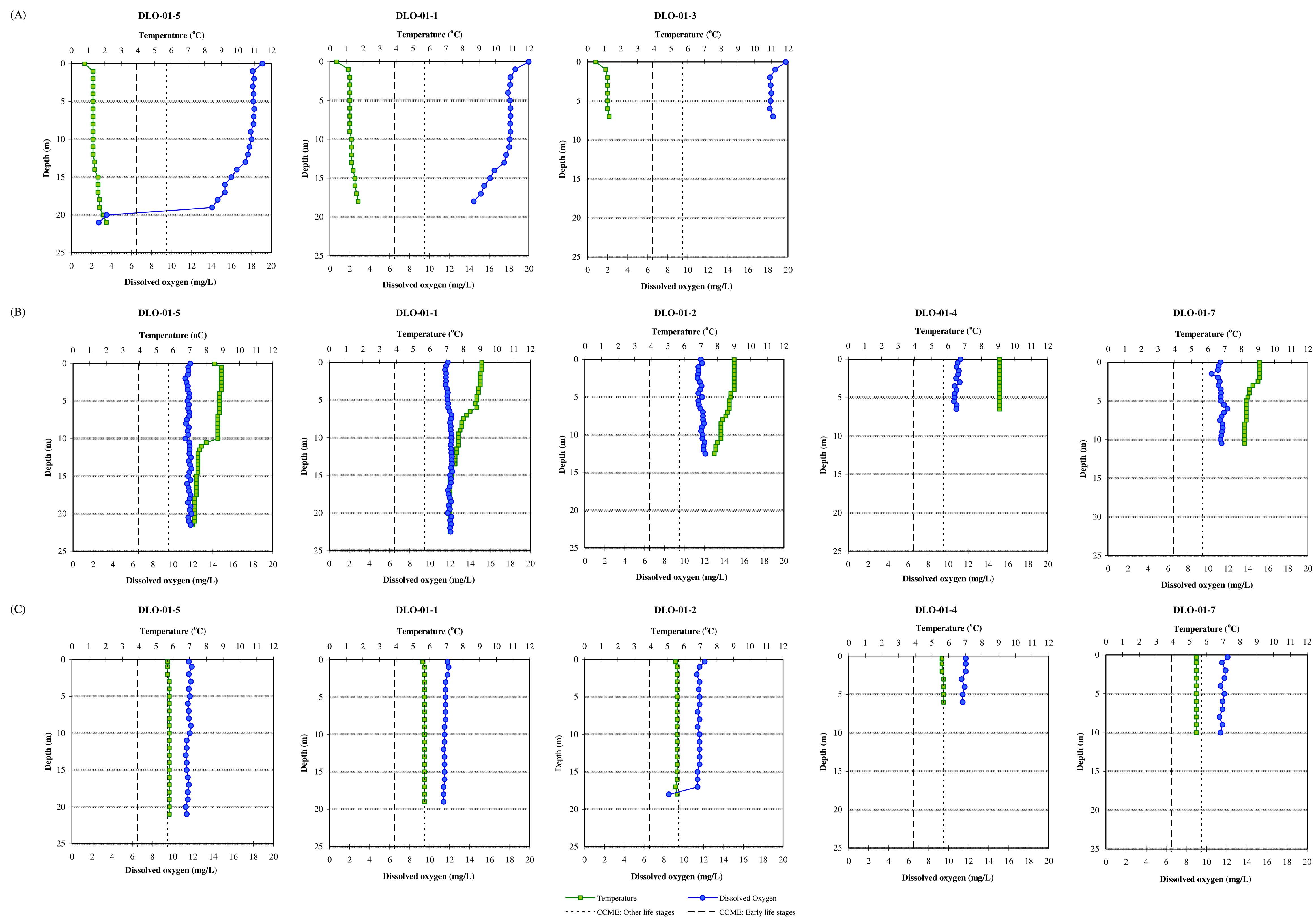

Figure 3. Diussolved oxygen and temperature depth profiles measured in Sheardown Lake NW in: (A) May; (B) Early August; and (C) Early September, 2007.

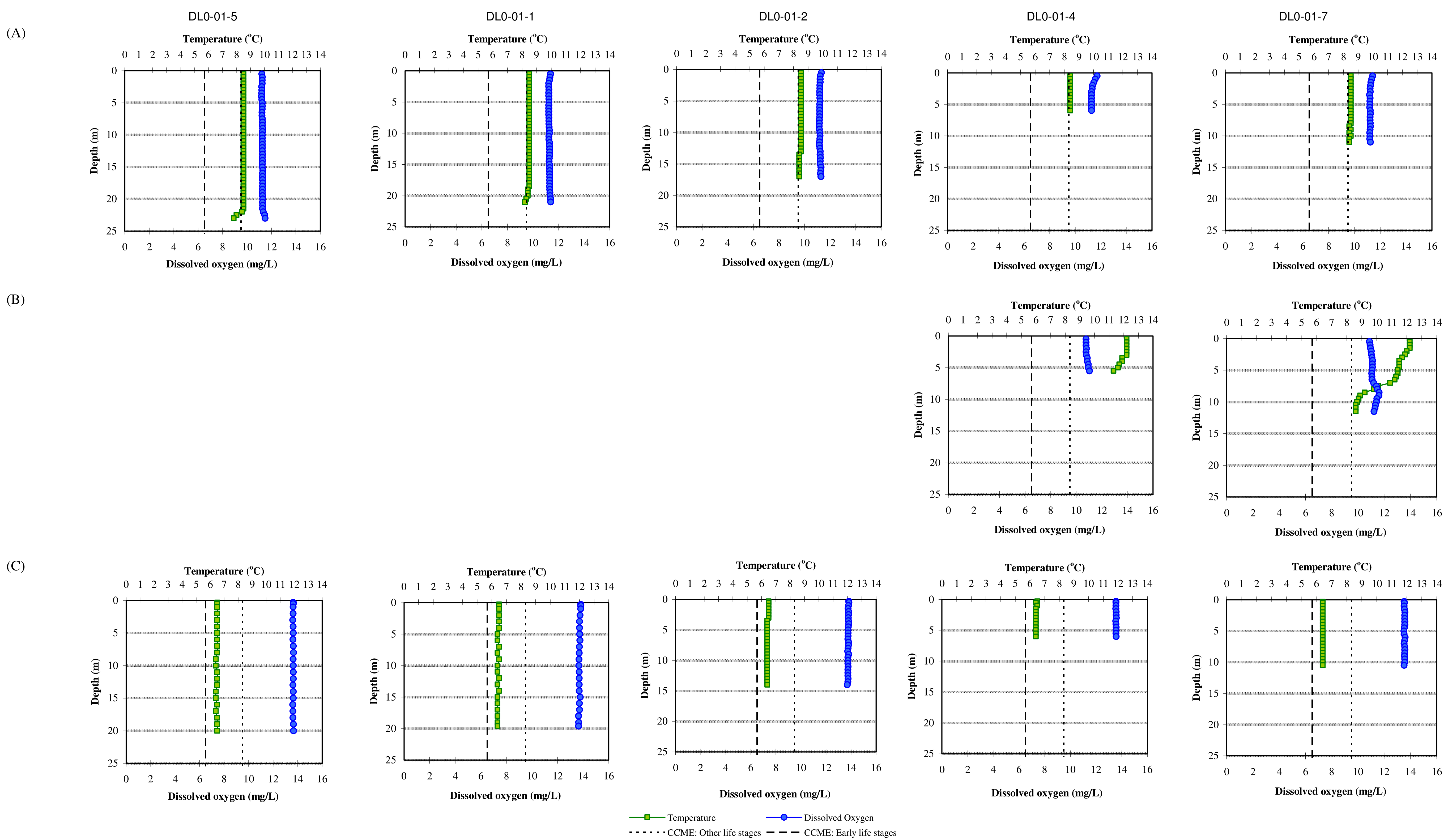

Figure 4. Diussolved oxygen and temperature depth profiles measured in Sheardown Lake NW in: (A) end of July; (B) Early August; and (C) Early September, 2008.

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SITE WATER MANAGEMENT PLAN

Rev. No.	Revision	Date	Approved
0	Issued in Final	October 25, 2007	KDE
1	Updated for 2008 Field Season	March 31, 2008	KDE
2	Updated for 2008 Field Season	March 31, 2009	JM

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REVISIONS TABLE FOR THE
SITE WATER MANAGEMENT PLAN

REVISIONS MADE

Modifications / Additions	Document Reference	
	Section	Page Number
Updated to 2009 project exploration plan.	1.1	1
Updated to 2009 project plan including exploration drilling details.	2.1	5
Description on salt mixing station.	2.1	5
Updated to 2009 geotechnical drilling plan.	2.2	6
Description of armouring.	3.4	9
Description of floculants.	3.7	10
Update to 2009 Steensby Camp description.	5.5	15
Update to 2009 Mid-Rail Camp description	5.7	16
Canges to fuel storage in rail alignment.	5.8	17
Changes to Steensby raill alignment mitigation.	5.9	18
Bulk sample update including geochemisty.	5.11	19
Weathered waste rock pile update.	5.12	20
Crushing operations update.	5.13	21
Update to temporary ore storage at Milne Inlet.	5.14	21
Update on the Milne Tote Road.	5.16	22
Update to use of quarry areas.	5.17	23
Update to roadway, borrow areas, and stockpiles inspections.	6.1	25
Changes to water quality monitoring.	6.2	28

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2009 SITE WATER MANAGEMENT PLAN

SECTION 1.0 - INTRODUCTION

1.1 PROJECT

The Mary River Project (the Project) is an iron ore advanced exploration project in the North Baffin region of Nunavut. The Project is located about 160 km south of Mittimatalik (Pond Inlet) and 270 km southeast of Ikpiarjuk (Arctic Bay) as shown on Figure 1.1.

Baffinland commenced exploration at Mary River in 2004 and has since completed a number of field investigations in the region. Camp accommodations have been established at Mary River, Milne Inlet, Nivek Lake, and Steensby Inlet to support ongoing field investigations including exploration drilling and resource delineation, geotechnical drilling and engineering planning, and environmental and social data collection. A bulk sampling program has been undertaken with a resultant 113,000 tonnes of iron ore shipped to the European market during the summer of 2008.

Field programs and activities are ongoing in support of continued advancement of the Mary River Project. The 2009 field program currently focuses on infill exploration drilling on Deposit Nos. 2 and/or 3 to collect additional information on resources and will be staged from the Mary River site. Depending on available financing, Baffinland may increase field activities accordingly. Equipment, infrastructure, consumables and regulatory permits are currently in place to support a substantially larger exploration drilling program, additional geotechnical drilling to support engineering planning and to undertake further environmental baseline work. This Site Water Management Plan is commensurate with the full scope of activities for which appropriate regulatory permits and authorizations are in place.

The Mary River Project includes the following components which define the aerial extent of the project area as shown on Figure 1.2:

- Mary River Project site (Including Deposit Nos. 1, 2, 3, 3B and 4)
- Milne Inlet Tote Road
- Milne Inlet port site and adjacent marine areas
- Potential future railway heading south from Mary River to Steensby Inlet
- Potential future port site at Steensby Inlet and adjacent marine areas
- Potential future hydro-electric generating station location

1.2 WATER LICENCE REQUIREMENTS

This document was originally updated in 2008 to fulfill the requirements of the Nunavut Water Board (NWB) water license 2BB-MRY0710 to resubmit the Site Water Management Plan (as stated on the license in Part B, Item 5(x)) and to provide an Environmental Monitoring Plan.

A summary of the specific requirements of the water licence as it relates to site water management is as follows:

- The volume of water extracted for the project for the purposes of this licence shall not exceed 515 cubic metres per day (approximately 60 cubic metres for potable water and the remainder for drilling purposes)
- GPS coordinates (in degrees, minutes, seconds) of all locations where water is used will be recorded and reported to the Inspector prior to use
- Daily quantities of water use will be measured and recorded, in cubic metres, for camp, drilling and other purposes
- Surface water samples will be collected throughout the Mary River Exploration Property, including Deposit No. 4, and at sites near Milne Inlet and Steensby Inlet. Subsequent laboratory analytical results are used to identify water quality trends and potential impacts to surface water.
- Quantities of domestic waste, sewage and hazardous waste hauled off-site for disposal will be measured and recorded, in cubic metres. The location and name of the disposal facility(s) and the date that waste was hauled off-site will be recorded.
- All water for domestic purposes shall be obtained from the following sources; Camp Lake (Monitoring Station MRY-1), Phillips Creek (Monitoring Station MRY-2), km 32 Lake (Monitoring Station MRY-3), an unnamed lake at km 32 along the Milne Inlet Tote Road, Deposit No. 4 Camp (location to be identified prior to use), an unnamed lake adjacent to Rail Camp, an unnamed lake near Steensby Inlet Camp, the alternate source for freshwater identified in the Application or at an alternate location approved by the Nunavut Water Board (NWB)
- All water intake hoses shall be equipped with a screen of an appropriate mesh size to ensure fish are not entrained and shall withdraw water at a rate such that fish do not become impinged on the screen
- Camps will not be located, nor material stored, on the frozen surface of a stream or lake, except where for immediate use
- Water Supply Facilities shall be maintained to the satisfaction of the inspector
- Streams will not be used as a water source unless authorized and approved by the NWB
- Water use for drilling will be taken from sources adjacent to drill locations or as otherwise approved by the NWB
- No land based drilling shall be conducted within 30 m of the ordinary high water mark of any water body, unless a request has been submitted and received by the NWB, ten (10) days in advance of drilling. The request must include a thorough description of the proposed activities and the following:

  - An appropriately scaled site map, complete with approximate GPS coordinates of planned drilling locations and the associated water bodies
  - Locations of waste deposition, that are consistent with Part F, Item 4
  - Mitigation measures that are planned to be in place, prior to, during drilling and following if required to protect waters
- Drill waste, including water, chips, muds and salts, in any quantity or concentration, from land-based drilling, will be disposed of in a properly constructed sump or an appropriate natural depression located at least 30 m from the ordinary high water mark of any adjacent water body, where direct flow into a water body is not possible and no additional impacts will be created
- If artesian flow is encountered, drillholes will be immediately sealed and permanently capped. If encountered, artesian flow will be reported to the NWB
- If the bottom of permafrost is broken through by the drill, the depth and location will be recorded and reported to the NWB
- If water is required in sufficient volume as to cause drawdown of the water body, approval by the NWB will be obtained 30 days prior to use. Details to be submitted include: volume required, hydrological overview of water body, details of impacts and proposed mitigation measures.
- Stream banks will not be cut and material shall not be removed from below the ordinary high water mark of any water body unless authorized
- The licensee will not cause erosion to the banks of any body of water and shall provide necessary controls to prevent such erosion
- With respect to access roads, pad construction, and other earthworks, debris and sediment will not be deposited into or on any water body. The materials will be deposited at least 30 m from the ordinary high water mark in such a fashion that they do not enter the water. Chemicals, fuels or wastes associated with this will not be allowed to enter any water body.
- Stream crossings will be located so as to minimize approach grades. Approaches will be stabilized during construction and upon completion in order to control runoff, erosion and subsequent siltation to any water body.
- Machinery will not travel up the streambed of a water body. Fording will be kept to a minimum and limited to one area and a one-time event for each piece of equipment, where possible. Equipment will be well cleaned and free of oil and grease and fluid leaks.
- Pollutants from machinery fording water crossings will not enter the water
- Activities will be conducted so as to minimize impacts on surface drainage, and will undertake corrective measures if surface drainage is impacted
- Sites will be prepared in such a manner as to prevent surface rutting
- Fill material used during construction will be from an approved source and free of contaminants
- Sediment and erosion control measures shall be implemented prior to and maintained during the operation to prevent entry of sediment into water
- Equipment storage holding areas will be located on gravel, sand or other durable land, at least 30 m from the ordinary high water mark of any water body to minimize impacts on surface drainage and water quality

- Equipment and vehicles will not be used unless the ground surface is in a state capable of fully supporting the equipment or vehicles without rutting or gouging. Overland travel of vehicles will cease if rutting occurs.
- An area will be designated for deposition of excavated and stockpiled material that is at least 30 m from the ordinary high water mark of any water body
- In-stream activity will be limited to low water periods, and will not be undertaken during fish migration, unless approved
- Except where approved, winter lake and stream crossings will be constructed entirely of water, ice, or snow, with disturbance minimized by situating ice bridges in areas with minimal approach grading and short crossing routes. Stream crossings will be removed or the ice notched prior to spring break-up.
- GPS coordinates (in degrees, minutes, seconds) will be determined for all locations of temporary and permanent storage areas where wastes associated with camp, drilling and infrastructure operation are deposited. These locations will be reported to the Inspector prior to depositing wastes.
- All waste disposal areas shall be located a minimum of 30 m from the ordinary high water mark of any water body, such that the quality, quantity, or flow of water is not impaired, unless otherwise approved
- All Polishing / Waste Stabilization Pond (PWSP) discharges will be released in a manner that minimizes surface erosion
- PWSP's will be bermed to ensure there is no seepage
- All greywater not directed to the Waste Water Treatment Facility (WWTF) will be contained in a sump located at least 30 m from the ordinary high water mark of any water body, at a site where direct flow into the water body is not possible and additional impacts are not created, unless otherwise approved
- Latrines will be located at least 30 m from the ordinary high water mark of any water body
- The Inspector will be notified of any discharge from waste facilities at least 10 days prior to the discharge

SECTION 2.0 - DRILLING PROGRAMS

2.1 EXPLORATION DRILLING

The exploration drilling program is carried out to identify the quality and quantity of the ore located at Mary River Deposit Nos. 1, 2, 3, 3B and 4, as well as providing information on geomechanical and geochemical aspects necessary for the mine design. In total, up to ten (10) diamond core drills may be used and shared between the exploration and geomechanical/geotechnical drilling programs.

Calcium chloride brine is used as the drilling fluid during the exploration drilling due to the cold temperatures at the site and the presence of permafrost. This prevents the drill rods from freezing in the deep exploration holes. During periods of drilling, the maximum water (brine) use rate is approximately 45 litres per minute (12 US gallons per minute) or 7.5×10^{-4} cubic metres per second per drill rig based on the capacity of the pumps serving the drills. Drilling additives are also used to increase operational efficiencies. Drilling additives include polymers such as DR-133 and W-OB.

A mixing station which produces the calcium chloride brine is a steel tank equipped with hydraulic mixers. Water is added to the tank from a water pumping station. Salt is transported to the mixing station in bags and is added to the tank to be mixed with the water. The entire station will be located more than 33 m from any water body. Special care is taken to ensure housekeeping measures are completed at all times at the salt mixing station. The quantity of salt added is kept to a minimum.

The water pumping stations will draw water from bodies of water of sufficient quantity (i.e. Mary River) so as not to cause drawdown of the water level in the water body. Screens will be placed over the intake hoses to ensure that fish are not entrained. The pumping rate will also kept at a rate to ensure that fish do not become impinged on the screens, and minimize water use.

In 2008, the pumping system and salt mixing station used during previous programs was replaced by an enhanced system that was redesigned to decrease water demand, salt use, minimize the potential for spillage, and improve safety and drilling productivity.

2.2 GEOTECHNICAL DRILLING

The geotechnical program is conducted to identify and qualify the types and depth of soils at the project sites. Information from the geotechnical drilling is used to assist in foundation design for project infrastructure.

The geotechnical drilling program consists of overburden drilling and limited coring of bedrock to confirm bedrock contact. The holes drilled for the geotechnical program are generally shallow; most are less than 30 m deep. In total, up to ten (10) diamond core drills may be used and shared between the exploration and geomechanical/geotechnical drilling programs.

Calcium chloride brine will not been used for the geotechnical drilling. Less water is generally required for geotechnical drilling as opposed to exploration drilling. During periods of drilling, the maximum water use rate is approximately 38 litres per minute (10 US gallons per minute) or 6.3×10^{-4} cubic metres per second based on the capacity of the pumps servicing the drills.

The water pumping stations draw water from bodies of water of sufficient quantity so as not to cause drawdown of the water level in the water body. Screens have been placed over the intake hoses to ensure that fish are not entrained. The pumping rate is kept at a rate to ensure that fish do not become impinged on the screens, and to minimize water use.

SECTION 3.0 - GENERAL MITIGATION MEASURES

The following measures are used to mitigate potential environmental impacts due to issues from discharge of water from the water management areas. If a need is identified, additional measures will be implemented.

3.1 SILT FENCE

3.1.1 Description

Silt fences are a geotextile or fabric barrier that impedes the flow of surface water which potentially may cause suspended sediment to be deposited. Silt fences are typically supported using wooden stakes (usually attached to the fabric by the manufacturer) and may be placed using a variety of methods such as digging a trench and backfilling material to ensure stability. Attempts are made to install silt fence in lines of equal elevation (along contour lines) to prevent channelling or focusing of the runoff.

Standards for installation including trench excavation, insertion of fabric, and backfilling and compacting can be found on the Ontario Provincial Standard Drawing (OPSD) 219.110 - Light Duty Silt Fence Barrier and 219.130 - Heavy Duty Silt Fence Barrier.

3.1.2 Typical Locations of Use

Silt fences are used in areas where surface water could potentially come into contact with disturbed sites causing elevated suspended solids. Typical installation locations are:

- Downstream of drill rigs
- Along roads where surface runoff is expected
- Surrounding stockpiles of material or drill cuttings

3.1.3 Substitutes

Free standing silt fences are considered for use in areas where a typical silt fence is impractical for example on rock or impenetrable surfaces. Diversion/collection channels or berms are used in certain locations.

3.2 DIVERSION/COLLECTION CHANNEL OR BERM

3.2.1 Description

Diversion/collection channels or berms are used to locally direct surface water runoff.

When required, the structures are constructed using suitable materials to divert the surface water without causing erosion or suspension of additional sediment. Excavation of channels may be an option; however, construction of berms using soil or man-made structures such as sand bags/tubes are also evaluated.

3.2.2 Typical Locations of Use

Channels or berms are used in locations where it is required to divert or collect surface water. Diversion structures are installed to prevent runoff from entering a site where the surface soil has been disturbed and would cause suspension of sediment. Additionally collection channels or berms may be constructed to collect runoff emerging from an area of soil disturbance.

One possible use of a diversion/collection channel or berm is to ensure runoff is directed to a constructed mitigation measure such as an in-ground sump.

3.2.3 Substitutes

Silt fences can be used as an alternative to constructing a channel or berm.

3.3 CONTAINMENT BERM

3.3.1 Description

A containment berm can be constructed to establish a sump, basin or pond to contain or collect water. The sump could be used to contain discharge water to allow suspension of sediment prior to discharge or to temporarily contain the water for re-circulation. The berm is constructed using native soils or other suitable man-made products.

Care is taken when constructing berms to ensure the base is on a solid foundation. Soil placed to construct the berms is nominally compacted to provide strength for the structure. Berm heights are minimized (<1 m).

3.3.2 Typical Locations of Use

Containment berms are constructed across small valleys or around natural depressions to augment the capacity of the berms.

3.3.3 Substitutes

In-ground sumps or portable containment sumps or tanks can be used in place of a containment berm.

3.4 ARMOURING

3.4.1 Description

Armouring is used as a barrier between water flow and materials susceptible to erosion. Quarry rock and/or naturally occurring granular borrow material to protect underlying fined grained materials from scour and erosion.

3.4.2 Typical Locations of Use

Armouring may be used in areas of cuts/excavations and in the installation of culverts.

3.4.3 Substitutes

Water diversion, berms, sumps and/or silt fencing may be used where armouring is impracticable due to the lack of aggregate availability or unnecessary based on the level of risk/significance for significant erosion and associated potential for down gradient impacts.

3.5 IN-GROUND SUMP

3.5.1 Description

An in-ground sump can be constructed to establish a sump, basin or pond to contain or collect water, similar to the containment berm. An in-ground sump is constructed by excavating a depression into soil to provide water containment. Excavated material from the sump can be used to construct a containment berm surrounding the sump to augment the capacity of the sump.

3.5.2 Typical Locations of Use

In-ground sumps are used in some areas where excavation of soil is possible.

3.5.3 Substitutes

Containment berms, or portable containment sumps or tanks can be used in place of an in-ground sump.

3.6 PORTABLE CONTAINMENT SUMP

3.6.1 Description

Portable containment sumps are used to establish a sump to contain water from a source such as a drill rig. The portable sump requires only minimal excavation or construction to provide a level base for the sump.

A series of portable containment sumps can be connected together to provide additional containment or settling capacity if required.

Collected sediment or drill cuttings from the portable containment sumps are removed from the sumps as necessary and disposed of in pit locations approved by Baffinland management and located at distances of at least 30 m from water bodies.

3.6.2 Typical Locations of Use

Portable containment sumps are used in areas where containment berms or in-ground sumps are impractical such as steep topography or in areas where overburden is not readily available.

3.6.3 Substitutes

Containment berms or in-ground sumps are used in place of a portable containment sump.

3.7 FLOCCULENTS (CO-POLYMER BLENDED BLOCKS)

3.7.1 Description

Co-polymer blended flocculent blocks are an environmentally friendly means of controlling siltation in ditches and streams, commonly used on construction sites throughout North America. Placing co-polymer blocks in a runoff stream causes sediment particles to settle by flocculation. Once introduced into the runoff stream, polymers transform elevated levels of fine suspended particles, including colloidal clays, phosphorus, and nutrients into masses easily removed from moving water. Therefore, construction site storm water can be clarified prior to discharge into receiving waters. Adequate mixing and settling times for the flow rate, temperature, and sediment load must be achieved for optimum polymer performance. Baffinland has completed some laboratory test work and have preselected several products for testing during 2009.

3.7.2 Typical Locations of Use

This product will be used in non-fish habitat runoff streams, particularly in areas of rugged relief where other methods of sediment/siltation control are not effective (e.g., access road to Deposit No. 1). Flocculent blocks could potentially substitute for other methods of sediment/siltation control where those methods are ineffective due to factors such as stream velocity, equipment access, rugged topography, and frozen ground conditions. The use of flocculent blocks, if effective, could reduce the degree of disturbance caused by other more intrusive sediment control measures.

SECTION 4.0 - HYDROLOGY AND PREDICTED SURFACE WATER RUNOFF RATES

The following sections present the information required by Part B (6) of the Nunavut Water Board (NWB) license 2BB-MRY0710 for the Mary River Project.

4.1 SURFACE WATER RUNOFF EVALUATION

The data presented in this report are based on evaluations based on field data collected during the 2006 and 2007 field seasons. As additional stream gauging data are collected for the Mary River Project area surface water runoff estimations will also improve.

A summary of the unit surface water runoff rates for the Mary River Project area is presented on Table 4.1. The locations of the stream gauging stations are shown on Figures 4.1 and 4.2. The runoff values indicate that from October to May there should be no runoff and that approximately half of the flows occur in July.

4.2 WATER USAGE FOR DRILLING

Based on the flow evaluation discussed in the previous section, special consideration for drill water requirements will be made when creating seasonal drilling schedules. Drilling in locations not adjacent to larger water bodies will be scheduled during periods of high flow to ensure drawdown will not occur. Drillholes located adjacent to larger bodies of water are not water dependent and are completed at times convenient to the drilling schedule.

Drilling programs are undertaken such that any consumption of water from ponds, lakes and rivers will not result in measurable drawdown of the water bodies. A maximum drawdown threshold of 5% has been set for all water bodies, assuming no recharge of the water body. No water is used from streams where there is a potential for drawdown effect without first obtaining regulatory approval as required.

SECTION 5.0 - WATER MANAGEMENT AREAS

The following sections provide a site description, details of surface water quantity and direction and mitigation procedures for the water management areas.

5.1 MARY RIVER CAMP SITE

The location of the site is provided on Figures 1.1 and 1.2.

5.1.1 Description

- A personnel camp and associated support facilities to service approximately 200 people during peak periods
- Domestic water supply from adjacent Camp Lake
- Sewage treatment using pre-engineered facilities discharging to either storage pond or Sheardown Lake
- Gravel airstrip
- Helicopter landing pad
- Bulk and barrel fuel storage and handling areas

5.1.2 Surface Water Direction and Quantity

The catchment areas for the Mary River Camp Site are shown on Figures 5.1 and 5.2. Ultimately the surface water at the site is directed towards Camp, Sheardown and Mary Lakes. The estimated surface water runoff quantities for each catchment area are shown on Table 5.1.

5.1.3 Mitigation Procedures

The Mary River Camp Site is not expected to have significant areas of disturbed soils and as such should not have sediment and erosion issues. The site will be regularly monitored (as discussed in the Monitoring section of this report). If mitigation measures are required to control sediment and erosion they will be selected and installed as previously discussed in the section General Mitigation Measures.

5.2 MARY RIVER DRILLING AREA

The location of the site is provided on Figure 1.2.

5.2.1 Description

- No permanent structures or buildings
- A historic camp from the exploration work undertaken in the 1960's located on the way to the Deposit No. 1 has been partially remediated

- No new camps
- Exploration drilling focused on Deposits No 1, 2, 3 and 3B
- Geotechnical and exploration drilling, and possible surface trenching
- Water pumping stations where water will be pumped from either Mary River or Sheardown Lake to the salt mixing stations
- Salt mixing stations where salt is mixed with the water to create a brine solution. This solution is pumped from the salt mixing stations to drill rigs used for exploration drilling. The brine may be heated in colder temperatures. Drill additives, as discussed earlier, will be added as required.
- Drill water discharge (using mitigation measures previously discussed)
- Fuel is stored at the Mary River Camp Site within the storage facility and transported to the drill sites and to the pumping stations as required
- Geophysical survey using ground penetrating radar (GPR) and resistivity methods at mine infrastructure area

5.2.2 Surface Water Direction and Quantity

The catchment areas for the Mary River Drilling Area are shown on Figure 5.2. Ultimately the surface water at the site is directed towards Camp, Sheardown and Mary Lakes. The estimated surface water runoff quantities for each catchment area are shown on Table 5.1.

During the field work seasons there is additional surface water discharge from the drill rigs. This flow is estimated to be a maximum of 12 gallons per minute per drill during periods of drilling.

5.2.3 Mitigation Procedures

Sediment and erosion control measures are periodically required and are installed as per the previous section: General Mitigation Measures. The site is regularly monitored (as discussed in the Monitoring section of this report).

Fuel required for drilling will be transported in fuel drums or double walled day tanks. Drip pans are used under the tanks to prevent fuel contamination.

5.3 MILNE INLET CAMP SITE

The location of the site is provided on Figures 1.1 and 1.2.

5.3.1 Site Description

- A personnel camp and associated support facilities to service approximately 60 people during peak periods of use

- Domestic water supply from Phillips Creek (Monitoring Location MRY-2) during the summer months and an unnamed lake along the Milne Inlet Tote Road at km 32 during the winter season
- Sewage treatment using pre-engineered facilities discharging to either storage pond or to Milne Inlet via a local drainage ditch
- Gravel airstrip
- Seasonal sea-lift of materials and supplies, as required
- Fuel storage areas for bulk fuel and barrel fuel, as well as waste storage areas. Each consists of a lined containment area.

5.3.2 Surface Water Direction and Quantity

The catchment areas for the Milne Inlet Camp Site are shown on Figure 5.3. The surface water at the site is ultimately directed to Milne Inlet. The estimated surface water runoff quantities for each catchment area are shown on Table 5.2.

5.3.3 Mitigation Procedures

The Milne Inlet Camp Site is not expected to have significant areas of disturbed soils and as such should not have sediment and erosion issues. It can be reasonably expected that there will be some surface soil disturbance in association with seasonal sea-lift activity. The site is regularly monitored (as discussed in the Monitoring section of this report). If mitigation measures are required to control sediment and erosion they will be selected and installed as previously discussed in the General Mitigation Measures section.

5.4 MILNE INLET TOTE ROAD REFUGE STATIONS

The location of the sites is provided on Figure 1.2.

5.4.1 Description

- Small half size trailers located at km 33 and 68 of the Milne Inlet Tote Road
- Fuel storage area for 4 fuel drums per camp; no berms or liners
- Bottled water stored in trailers

5.4.2 Surface Water Direction and Quantity

The surface water at the km 33 refuge station ultimately reports to an unnamed lake and Philips creek, and the water at the km 68 refuge station ultimately reports to an unnamed creek.

5.4.3 Mitigation Procedures

The refuge station sites are not expected to have significant areas of disturbed soils and as such should not have sediment and erosion issues. The site is regularly monitored when in use (as discussed in the Monitoring section of this report). If mitigation measures are required to control sediment and erosion they are selected and installed as previously discussed in the section General Mitigation Measures.

5.5 STEENSBY INLET CAMP SITE

The location of the site is provided on Figures 1.1 and 1.2.

5.5.1 Description

- Seasonal drill camp with water flown or pumped (using collapsible water line) from an unnamed lake located approximately 3 kilometres east of camp and toilet wastes incinerated on site
- Grey water sump used for kitchen and wash tent
- Airstrip - there is no fixed runway at the Steensby Inlet Camp Site. A seasonal on-ice runway is used during the winter near the site.
- Seasonal sea-lift supply of consumables, as required
- Fuel storage area will consist of lined containment berm(s) with a capacity for approximately 7,500 drums
- Geotechnical drilling
- Water for drilling will be obtained from Steensby Inlet and other sources adjacent to the drilling locations
- Drill water discharge (using mitigation measures previously discussed)
- Geophysical survey using ground penetrating radar (GPR) at nearby lakes for water source bathymetry

5.5.2 Surface Water Direction and Quantity

The catchment areas for the Steensby Inlet Camp Site are shown on Figure 5.4. The surface water at the site ultimately reports to Steensby Inlet. The estimated surface water runoff quantities are shown on Table 5.3.

5.5.3 Mitigation Procedures

The Steensby Inlet Camp Site is not expected to have significant areas of disturbed soils and as such should not have sediment and erosion issues. It can be reasonably expected that there will be some surface soil disturbance in association with seasonal sea-lift activity. The site is regularly monitored when in use (as discussed in the Monitoring section of this report). If mitigation measures are required to control sediment and erosion they are selected and installed as previously discussed in the section General Mitigation Measures.

5.6 STEENSBY INLET ON-ICE DRILLING AREA

The location of the site is provided on Figure 1.2.

5.6.1 Description

- No permanent structures or buildings
- No camps
- No fuel storage
- On-ice geotechnical drilling
- Water for drilling is taken from the ocean
- Drill water discharge
- On-ice probing (no water taking or discharge)

5.6.2 Mitigation Procedures

Only geotechnical drilling is completed on the ice, and no drill water is discharged on the ice. For drilling operations on ocean ice in unconsolidated sediments, there was no return water collected and therefore no opportunity for recycling of drill water or capture of drill waste. .All return water escapes from the hole at the casing/ocean bottom interface. If drilling continues into bedrock the drill water is discharged into a portable containment sump and removed from the ice. The water and cuttings contained in the portable containment sump are disposed of in a pit location at least 30 m from water to be determined by Baffinland and Knight Piésold.

No fuel is stored on the ice. Fuel required for drilling will be transported in fuel drums or double walled day tanks. Drip pans are used under the tanks to prevent fuel contamination.

5.7 MID-RAIL CAMP (NIVEK LAKE)

The location of the site is provided on Figures 1.1 and 1.2.

5.7.1 Description

- Seasonal drill camp with water from adjacent unnamed lake and toilet wastes incinerated on site
- Grey water sump used for kitchen and wash tent
- Airstrip - there is no fixed runway at the Rail Camp Site. A seasonal on ice runway will be used during the winter near the site.
- Fuel storage area will consist of two lined containment berms with a capacity for approximately 2000 drums
- Geotechnical drilling

- Water for drilling will be obtained from lakes adjacent to the drilling locations
- Drill water discharge (using mitigation measures previously discussed)
- Geophysical survey using ground penetrating radar (GPR) at nearby lakes for water source bathymetry

5.7.2 Surface Water Direction and Quantity

The surface water at the site ultimately reports to an unnamed lake adjacent to the site.

5.7.3 Mitigation Procedures

The Rail Camp Site is not expected to have significant areas of disturbed soils and as such should not have sediment and erosion issues. The site is to be regularly monitored when in use (as discussed in the Monitoring section of this report). If mitigation measures are required to control sediment and erosion they are selected and installed as previously discussed in the section General Mitigation Measures.

5.8 PROPOSED RAIL ALIGNMENT

The alignment is shown on Figures 1.1 and 1.2.

5.8.1 Description

- Seasonal drill camp as detailed in the Rail Camp section
- No permanent structures or buildings
- Small temporary fuel caches as required
- Geotechnical drilling
- Water for drilling is obtained from sources adjacent to the drilling locations
- Drill water discharge (using mitigation measures previously discussed)
- Geophysical survey using ground penetrating radar (GPR) and resistivity methods

5.8.2 Surface Water Direction and Quantity

The catchment areas for the Proposed Rail Alignment are shown on Figure 5.5. The surface water along the corridor is ultimately directed to Cockburn River, Cockburn Lake, Ravn River and Angajurjualuk Lake. Specific surface water runoff quantities were not calculated for the transportation corridor due to the large catchment area and the minimal quantity of water required for the drilling.

5.8.3 Mitigation Procedures

Sediment and erosion control measures may be required and are installed as per the previous section General Mitigation Measures. The site is regularly monitored as discussed in the Monitoring section of this report.

Fuel required for drilling will be transported in fuel drums or double walled day tanks. Drip pans are used under the tanks to prevent fuel contamination.

5.9 STEENSBY INLET RAIL ALIGNMENT ON-ICE DRILLING

The alignment is shown on Figures 1.1 and 1.2.

5.9.1 Description

- No permanent structures or buildings
- No camps
- No fuel storage
- On-ice geotechnical drilling
- Water for drilling is taken from lakes and sources close to the drill sites
- Drill water discharge
- On-ice probing (no water taking or discharge)
- Geophysical survey using ground penetrating radar (GPR) at proposed bridge locations

5.9.2 Mitigation Procedures

Portable containment sumps will be employed for drilling on ice. A “T” connection will be installed through the drill casing to allow the collection of drill water return during operations. The drill casing will be allowed to freeze into the ground to maximize the effectiveness of the annular seal between the casing and the formation. During drilling operations, the drill water will be pumped into a collection bin located adjacent to the drill. The collection bin is periodically emptied by means of pumping or air-lifting to a sediment disposal location established at each drill site at a distance greater than 30 metres from any water body.

No fuel is stored on the ice. Fuel required for drilling will be transported in fuel drums or double walled day tanks. Drip pans are used under the tanks to prevent fuel contamination.

5.10 PROPOSED HYDRO-ELECTRIC SITE

The location of the site is shown on Figure 1.2

5.10.1 Description

- No permanent structures or buildings
- No camps
- Fuel is stored at either the Milne Inlet or Steensby Inlet Camps within the storage facilities and flown to the drill sites as required

- Geotechnical drilling
- Water for drilling is taken from lakes adjacent to the drill sites
- Drill water discharge (using mitigation measures previously discussed)

5.10.2 Surface Water Direction and Quantity

Specific surface water runoff quantities were not calculated for the proposed hydro-electric site due to the large catchment area and the minimal quantity of water required for the drilling.

5.10.3 Mitigation Procedures

Sediment and erosion control measures may be required and are installed as per the previous section General Mitigation Measures. The site will be regularly monitored as discussed in the Monitoring section of this report.

5.11 BULK SAMPLE OPEN PIT OPERATIONS

Predictions with regard to ARD/ML of residual waste rock and ore produced during the bulk sampling program were made prior to the initiation of the Bulk Sampling Program. Based on the results of that work, the risk of acid-rock drainage (ARD) and metal leaching (ML) was considered to be very unlikely for the Bulk Sampling Program. To help validate these results, an additional environmental geochemical testing program was conducted in 2008 to assess the potential for excavated materials (i.e. waste ore and surplus ore) and exposed excavation faces to leach metals and/or acidity that could degrade the quality of receiving surface waters. Based upon the test results, it is concluded that the excavation surfaces and ore form the bulk sample program have essentially no potential to produce acid rock drainage. The detailed results and discussion of this work are presented in the 2008 Annual Water License Report.

The locations of the bulk sample pit and residual waste rock and ore stockpiles (at Deposit No. 1, the crusher, and Milne Inlet) are shown in Figures 5.2 and 5.3.

5.11.1 Description

- A single mining pit established at the top of Deposit No. 1. Approximately 225,000 tones of weathered surface rock and ore was removed in 2007 and 2008 by drill and blast techniques
- Mining pit has been confirmed to be free draining
- ARD and ML tests have been conducted with results indicating that, due to the physical environment and the geochemistry of the ore, ARD and ML are very unlikely to occur
- No camps
- No fuel storage

5.11.2 Surface Water Direction and Quantity

The catchment areas for the bulk sample open pit operations are shown on Figures 5.1 and 5.2. Ultimately the surface water at the site is directed towards Mary River Camp, Sheardown and Mary Lakes. The estimated surface water runoff quantities for each catchment area are shown on Table 5.1.

5.11.3 Mitigation Procedures

Sediment and erosion control measures are not expected to be required with the completed pit. Mitigating measures are not expected to be required to address potential for ARD or ML. The site will be regularly monitored as discussed in the Monitoring section of this report.,

5.12 WEATHERED ORE / WASTE ROCK STOCKPILE

5.12.1 Description

- A stockpile containing approximately 28,000 tonnes of surficial weathered ore excavated from the surface of Deposit No. 1 remains on the deposit. The roadbed between the stockpile and the pit was also constructed from weathered ore. Approximately 6,000 tonnes of representative (i.e. ore grade) material was left in the bulk sample pit
- ARD and ML tests have been conducted with results indicating that, due to the physical environment and the geochemistry of the ore, ARD and ML are very unlikely to occur

5.12.2 Surface Water Direction and Quantity

The catchment areas for the bulk sample open pit operations are shown on Figure 5.2. Ultimately the surface water in the area is directed towards Camp, Sheardown and Mary Lakes. The estimated surface water runoff quantities for each catchment area are shown on Table 5.1.

5.12.3 Mitigation Procedures

Sediment and erosion control measures are not expected to be required in association with the weathered ore stockpile. Mitigating measures are not expected to be required to address potential for ARD or ML. The site will be regularly monitored as discussed in the Monitoring section of this report.,

5.13 CRUSHING OPERATIONS AT MARY RIVER

Crusher locations are provided on Figure 5.2.

5.13.1 Description

- A temporary crusher station was established north-east of Sheardown Lake at Mary River
- Approximately 190,000 tonnes of ore was hauled from the bulk sample pit to the crusher station and crushed into lump and fine fractions
- Stockpiles containing approximately 25,000 tonnes of non-representative ore (i.e. separate lump and fine high manganese 'waste' ore) remain at the Mary River crusher site.
- ARD and ML tests have been conducted on the fresh ore, with results indicating that, due to the physical environment and the geochemistry of the ore, ARD and ML are very unlikely to occur

5.13.2 Surface Water Direction and Quantity

The catchment areas for the stockpiles and crusher operations in the vicinity of the Mary River Camp are shown on Figure 5.2. Surface water in this area is directed towards Sheardown Lake. The estimated surface water runoff quantities for each catchment area are shown on Table 5.1.

5.13.3 Mitigation Procedures

Sediment and erosion control measures may be required and will be installed as per the previous section General Mitigation Measures. The site will be regularly monitored as discussed in the Monitoring section of this report.

5.14 TEMPORARY ORE STORAGE AT MILNE INLET

5.14.1 Description

- A total of approximately 152,000 tonnes of crushed ore was transported to Milne Inlet from the Mary River Area using the Milne Inlet Tote Road
- An ore stockpile pad containing approximately 24,000 tonnes of non-representative ore (i.e. high manganese 'waste' ore) remains at Milne Inlet. Approximately 6,000 tonnes of representative (i.e. ore grade) material is stockpiled on this pad at Milne Inlet adjacent to the beach loading area
- ARD and ML tests have been conducted on the fresh ore, with results indicating that, due to the physical environment and the geochemistry of the ore, ARD and ML are very unlikely to occur

5.14.2 Surface Water Direction and Quantity

The catchment areas for the stockpiles at Milne Inlet are shown on Figure 5.3. Surface water in this area is directed towards Milne Inlet. The estimated surface water runoff quantities for each catchment area are shown on Table 5.2.

5.14.3 Mitigation Procedures

Sediment and erosion control measures may be required and will be installed as per the previous section General Mitigation Measures. The site will be regularly monitored as discussed in the Monitoring section of this report. The ore pad and stockpile is located in excess of 30 m from the normal high water mark of Milne Inlet and other water bodies.

5.15 BULK FUEL STORAGE AREAS

Described in sections detailing camp and refuge station descriptions.

5.16 MILNE INLET TOTE ROAD

5.16.1 Description

- Historic dirt road constructed in the mid 1960's (Tote Road / bulk sampling road)
- The existing 105 km Tote Road running between Milne Inlet and the Mary River camp was upgraded to support transport of the bulk sample from Deposit No. 1
- Upgrades were made to the tote road by adding fill to the roadbed, cutting and filling on hills, and installing crossing structures (mainly culverts) at watercourse crossings and drainages
- A haul road from the top of Deposit No. 1 to the crusher location was completed by adding fill to the roadbed, cutting and filling on hills, and installing culverts at drainage crossings
- Fill materials needed for the upgrade of the tote road and the mine haul road was obtained from designated large borrow sources and from areas within the road alignment. Approximately 1.1 million m^3 of borrow material was excavated through the course of the bulk sample program. A portion of this material was required for civil works associated with infrastructure improvements at Mary River and Milne Inlet camps.
- Two temporary refuge stations, one at km 33 and one at km 68 consisting each of a half size trailer and 4 drum fuel storage area
- No permanent structures or buildings
- The Milne Inlet Tote Road is shown on Figures 1.1 and 1.2

5.16.2 Surface Water Direction and Quantity

The catchment areas for the Milne Inlet Tote Road are shown on Figure 5.6. Ultimately the surface water north of Katiktok Lake discharges in Milne Inlet via Phillips Creek and surface water south of Katiktok Lake eventually flows into Mary River via Camp, Sheardown and Mary Lakes. Specific surface water runoff quantities were not calculated for the transportation corridor due to the large catchment area and the minimal quantity of water required for road construction and maintenance. Culvert crossings were designed based on estimated water flow and in consideration of the use and temporary nature of the tote road.

5.16.3 Mitigation Procedures

The Milne Inlet Tote Road was upgraded to a year-round all-weather road to support the heavier traffic volume during the bulk sample program. Most of the water crossings along the tote road were installed during the winter of 2008 when water was not present. Construction procedures including the use of water diversion structures, the use of silt fencing, and limiting in-water work minimized the amount and duration of sediment release during installation of water crossings during non-freezing conditions. Visual observations and turbidity measurements before, during and after construction confirmed the short duration and limited extent of sediment release. There were localized areas of sediment release during the spring and summer of 2008 due to contact of run-off with disturbed areas associated with road construction and due to overtopping of the road at spillway locations and isolated areas of embankment failure.

Road operations and maintenance is expected to continue through the proposed future construction of a full-scale mine. The tote road will continue to be inspected on a regular basis to confirm adequate physical stability with erosion and control measures installed when required as per the previous section General Mitigation Measures.

5.17 ASSOCIATED CONSTRUCTION MATERIAL AND QUARRY OPERATIONS

5.17.1 Description

- Granular material borrow pits (sand and gravel up to cobble sized material) were advanced to support road upgrades for the bulk sampling road and camp infrastructure
- Three primary borrow areas were advanced: Borrow Area 1 near Milne Inlet, Borrow Area 2 near km 63 of the Milne Inlet Tote Road, Borrow Area 3 near Mary River camp. In addition to these three primary areas, suitable borrow material was used in areas directly adjacent to the Tote Road, within the right-of-way.
- Borrow materials are expected to be required to support ongoing operations and maintenance of the landforms (roads and camp sites)
- Surficial borrow materials will be obtained by stripping and excavation of the active layer

- Excavation will not occur within 30 m of a watercourse, and seasonal drainage ways will be re-established during pit development
- Rock quarries may be developed for various construction purposes
- Potential rock quarry locations are near Milne Inlet and Mary River
- Rock will be obtained through drilling and blasting
- Quarrying will not occur within 30 m of a watercourse, and drainage will be re-established during quarry development
- Acid rock drainage (ARD) and metal leaching (ML) tests have been conducted on rock samples, with results indicating that, due to the physical environment and the geochemistry of the rock, ARD and ML are very unlikely to occur from quarry materials
- No camps
- No fuel storage
- Locations of the primary borrow sites and rock quarries are shown on Figure 5.6

5.17.2 Surface Water Direction and Quantity

The catchment areas for the borrow and quarry operations are shown on Figure 5.6. Specific surface water runoff quantities were not calculated due to the number of large catchment areas that would be involved.

5.17.3 Mitigation Procedures

In 2008, some borrow areas experienced minor settlement and water release due to thawing of ice-rich soils. In most instances borrow areas were constructed with a control berm to allow for the gradual seepage of released ground meltwater or surface run-off from the borrow area through the permeable control berm. Some regarding will be required and inspections will continue to be undertaken to confirm physical stability and continue to implement sediment and erosion control measures as required and as per the previous section General Mitigation Measures. Berms and other drainage measures will be established as needed to limit erosion and maintain positive drainage to minimize water ponding. Contouring, berming and silt fences will be applied as necessary for sediment and erosion control. The site will be regularly monitored as discussed in the Monitoring section of this report.

SECTION 6.0 - MONITORING

In addition to specific monitoring and reporting requirements under the regulatory approvals such as the water license, QIA land lease, land use permits and fisheries authorization,, routine inspections of various aspects of the operations will be undertaken. Routine water management related inspections will be conducted at drill sites, camp sites and related infrastructure, roadways, and landforms generated in association with the shipment of a bulk sample in 2008 (borrow areas, mining pit, residual ore stockpiles).

Routine inspections and water license monitoring is outlined below.

6.1 ROUTINE INSPECTIONS

6.1.1 Drill Sites

Pre-drilling inspection of the immediate area surrounding the drill site will be completed as part of the safety/environmental inspection prior to the setup of the drill by drilling and other site personnel.

Particular items for review are:

- Drillhole coordinates
- Water source coordinates
- Site photo
- Water source photo
- Distance to nearest water source
- Archaeological approval
- Completed wildlife survey

Routine daily inspections of the immediate area surrounding the drills will be completed as part of the safety/environmental inspection on a daily basis by drilling or other site personnel.

Particular items for review are:

- Fuel leaks
- Drip Pans
- Equipment condition
- Sediment and erosion control measures
- Water intakes
- Water management systems
- Flow meter readings

Post-drilling inspection of the immediate area surrounding the drill site will be completed as part of the safety/environmental inspection after the drill has been removed from site by drilling and other site personnel.

Particular items for review are:

- All materials and debris removed from site
- Quantity of equipment, rods or casing left in the hole
- Site photo
- Water source photo
- Water use assessment
- Environmental concerns
- Wildlife concerns

Pre and Post-Drilling water sampling will be completed for each on-ice drillhole.

The methodology for the water sampling is:

- Select a location a maximum of 30 m from the proposed drillhole location
- Auger a hole through the ice and clear the hole of ice cuttings
- Use a bailer to obtain a water sample from below the bottom of the ice
- Transfer the water sample to the sample bottles
- Repeat the steps to collect a second sample following completion of the drillhole

6.1.2 Camp Sites and Temporary Refuge Stations

Routine camp and temporary refuge station inspections will be completed.

Particular items for review are:

- Fuel leaks
- Sediment and erosion control structures

6.1.3 Roadways

It is intended that the Milne Inlet Tote Road will continue to provide all-season access to the Mary River Site until after proposed construction of the full-scale Mary River Project. Prior to mine construction, the road will be used to facilitate transport of fuel and consumables. The road is expected to require regular maintenance, from snow-ploughing during winter months (when used) to culvert and crossing maintenance in the summer.

The design of the watercourse crossings is such that, during summer, heavy flows may overtop some of the culvert crossings equipped with overflow swales. The road may be

unavailable to haul traffic during a brief period in the summer, and minor repairs to the crossings may be required.
Routine inspections will continue to be undertaken to monitor physical stability and any environmental concerns related to the road and associated water crossings and borrow areas.

6.1.4 Borrow Areas

Fill materials needed for upgrade of the Milne Inlet Tote Road, the mine haul road, and other civil works have been obtained from designated large borrow areas and from within the road alignment.

Re-contouring of the borrow areas has commenced, with further work required to confirm that as-built conditions are suitable for eventual decommissioning. Borrow areas will be contoured and drainage control measures will be established as necessary to reduce the risk of substantial erosion and sediment release that may have an effect on receiving waters. Monitoring will continue to be undertaken to confirm stability of the borrow areas.

6.1.5 Bulk Sample Pit

The bulk sample pit was constructed as a side-hill cut and was confirmed by land survey at its completion in 2008 to be free-draining. The bulk sample pit was designed to be free-draining so as to reduce any risk for poor water quality run-off. The pit will continue to be inspected on an annual basis to ensure the pit slopes will be stable in the long term.

6.1.6 Stockpiles

The bulk sample program generated stockpiles of ore adjacent to the pit at Deposit No.1, at the crusher site at the base of Deposit No.1, and at Milne Inlet where the ore was loaded for shipment in 2008. These stockpiles are expected to be stable in the long term. Monitoring of run-off water quality is discussed in Section 6.2.

6.1.7 Bulk Fuel Storage Areas

Routine inspections will be completed at the bulk fuel storage areas.

Particular items for review are:

- Evidence of hydrocarbon staining or leaks from containment devices
- Full-time supervision of fuel transfer operations
- Full-time supervision of treatment and release of accumulated water from within the containment areas
- Sediment and erosion control structures

6.2 WATER QUALITY MONITORING

The water quality monitoring program consists of several elements as follows:

a) Measurement, recording and reporting of water volumes extracted, as prescribed by the water license
b) Sampling, analysis and reporting of water quality, as prescribed by the water license
c) Weekly monitoring downstream of exploration drilling activities during periods of open water

Table 6.1 summarizes the water quality and quantity monitoring program.

An exploration drill water quality monitoring program has been undertaken since 2005 at selected locations upstream (reference), downstream along the Mary River (potentially affected), and along steep seasonal flow channels that drain the rugged topographic terrain that characterizes the land surface in the vicinity of Deposits 1,2 and 3. The main objective of the monitoring program is to identify and measure Contaminants of Potential Concern (COPCs) in Mary River, both upstream at locations unaffected by drilling activities, and downstream at locations that may be potentially affected by drilling activities. Each year, the water quality monitoring program is dependent and specific to the planned scope of the drill program. The Environmental Superintendent will, in consultation with Operations personnel the annual exploration drill water quality monitoring program and ensure that it is implemented. The results of the monitoring program will be used to guide adaptive management measures, as appropriate.

6.3 WASTE DISPOSAL MONITORING

6.3.1 Monitoring Stations

Signs will be posted in appropriate areas at Monitoring Stations, and will be located and maintained to the satisfaction of the Inspector. Monitoring Stations will be maintained at the following locations:

Monitoring Station Number	Description
MRY-1	Water supply for the Mary River Camp at Camp Lake
MRY-2	Summer water supply for the Milne Inlet Camp at Phillips Creek
MRY-3	Winter water supply for Milne Inlet Camp at the Km 99 lake (See Note 1)
MRY-4	Mary River Camp sewage discharge at the WWTF
MRY-4a	Mary River Camp sewage discharge from the PWSP
MRY-5	Milne Inlet Camp sewage discharge at the WWTF
MRY-5a	Milne Inlet Camp sewage discharge from the PWSP
MRY-6	Water collected within the Bulk Fuel Storage Facility at Mary River prior to release

Monitoring Station Number	Description
MRY-7	Water collected within the Bulk Fuel Storage Facility at Milne Inlet prior to release
MRY-8	Minewater and surface drainage either pumped or released from the Hematite Open Pit
MRY-9	Minewater and surface drainage either pumped or released from the mixed ore (Hematite and Magnetite) Open Pit
MRY-10	Surface discharge from the weathered ore stockpile
MRY-11	Surface discharge from the lump ore and fine ore stockpiles at the processing area
MRY-12	Surface discharge from the lump ore and fine ore stockpiles at the processing area

Notes:

1. The winter water supply for the Milne Inlet Camp is at km 32 not km 99.
2. Monitoring Station MRY-8 is no longer required as there is only one open pit which will be monitored by MRY-9.

The monitoring locations are shown on Figure 6.1.

6.3.2 Bulk Sample Open Pit

All discharge from the bulk sample open pit will be analyzed and discharge at Monitoring Station MRY-9 will not exceed the following limits:

Parameter	Maximum Average Concentration (mg/L)	Maximum Concentration of Any Grab Sample (mg/L)
Total Arsenic	0.5	1.00
Total Copper	0.30	0.60
Total Lead	0.20	0.40
Total Nickel	0.50	1.00
Total Zinc	0.5	1.00
Total Suspended Solids	15.0	50.0
Oil and Grease	No visible sheen	N/A
Waste discharged will have a pH between 6.0 - 9.5		

6.3.3 Waste Water Treatment Facility (WWTF)

All sewage will be discharged to a Waste Water Treatment Facility at Mary River and Milne Inlet unless otherwise approved.

All sewage discharged from the Waste Water Treatment Facility at Monitoring Stations MRY-4 and MRY-4a, at Mary River, will not exceed the following quality standards:

Parameter	Maximum Average Concentration
BOD_5	30 mg/L
Total Suspended Solids	35 mg/L
Fecal Coliform	1000 CFU/100 mL
Oil and Grease	No visible sheen
pH	between 6.0 - 9.5

All sewage discharged from the Waste Water Treatment Facility at Monitoring Stations MRY-5 and MRY-5a, at Milne Inlet, will not exceed the following quality standards:

Parameter	Maximum Average Concentration
BOD_5	100 mg/L
Total Suspended Solids	120 mg/L
Fecal Coliform	10,000 CFU/100 mL
Oil and Grease	No visible sheen
pH	between 6.0 - 9.5

6.3.4 Monitoring Station Discharge

Effluent discharged from Monitoring Stations MRY-4 and MRY-4a, and MRY-5 and MRY-5a will be demonstrated to be acutely non-toxic in accordance with test procedures measuring acute lethality to Rainbow trout, Oncorhynchus mykiss (Environment Canada's Environmental Protection Series Biological test Method EPS/1/RM/13) and Daphnia magna (Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/14). Testing will occur once annually during open water season.

Samples will be collected at Monitoring Stations MRY-4 and MRY-5 every four weeks during discharge and at Monitoring Stations MRY-4a and MRY-5a once prior to discharge and every 4 weeks thereafter. Samples will be analyzed for: Biochemical Oxygen Demand (BOD), total suspended solids (TSS), pH, fecal coliforms, oil and grease (visual).

6.3.5 Bulk Fuel Storage Facilities

Effluent discharged from the Bulk Fuel Storage Facilities at Monitoring Stations MRY-6 and MRY-7 will meet the following effluent quality standards:

Parameter	Maximum Average Concentration (µg/L)
Benzene	370
Toluene	2
Ethyl benzene	90
Lead	1
Oil and Grease	15,000 and no visible sheen

6.4 ADAPTIVE MANAGEMENT STRATEGIES

Housekeeping and operational measures have been instituted at the salt mixing stations and increased use of sumps and silt curtains at the exploration drill sites have been put in place to further reduce the potential risks for salt related impacts. Work procedures will continuously be adapted with the goal to reduce salt use, reduce water use and reduce the potential effects related to water management on the environment.

Baffinland is committed to continual improvement in its work activities in the aim of reducing risks to the environment and improving operational effectiveness. The strategy employed at Baffinland is regular monitoring supported by operational change and adoption of other mitigating measures if warranted.

SECTION 7.0 - QA/QC PLAN

The Surface Water Sampling Program - Quality Assurance & Quality Control Plan (QA/QC Plan Ref. No. NB102-00181/10-7, Rev. 1) is included in Appendix A of this report. The QA/QC Plan has been prepared to fulfil the requirement of Part I, Item 9 of the License No. 2BB-MRY0710 issued by the NWB to Baffinland on July 27, 2007.

The QA/QC best practices that are outlined are designed to provide guidance to field staff and analytical laboratories in order to maintain a high level of confidence in the water quality data generated from the Mary River Project. The plan addresses best practice methods for water samples collected from lakes, streams and rivers, treated wastewater effluent, drinking water and site drainage.

For a more detailed and comprehensive outline, please refer to the appended report.

TABLES

TABLE 4.1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SITE WATER MANAGEMENT PLAN

MONTHLY UNIT RUNOFF SUMMARY

Gauging	Drainage Area	2006				2007				Average (2006 and 2007)			
Station	(km^2)	Jun	Jul	Aug	Sep	Jun	Jul	Aug	Sep	Jun	Jul	Aug	Sep
H1	248.7	0.0209	0.0582	0.0214	0.0139	0.0147	0.0262	0.0153	0.0042	0.0178	0.0422	0.0184	0.0090
H2	217.5	0.0231	0.0883	0.0247	0.0141	0.0203	0.0358	0.0186	0.0052	0.0217	0.0620	0.0216	0.0097
H3	30.4	0.0337	0.1096	0.0227	0.0134	0.0097	0.0280	0.0147	0.0035	0.0217	0.0688	0.0187	0.0084
H4	9.4	0.0524	0.0923	0.0295	0.0165	0.0172	0.0237	0.0150	0.0050	0.0348	0.0580	0.0222	0.0107
H5	5.4	0.0556	0.1067	0.0252	0.0137	0.0207	0.0189	0.0183	0.0048	0.0381	0.0628	0.0218	0.0093
H6	240.0	0.0127	0.0753	0.0217	0.0137	0.0201	0.0426	0.0191	0.0026	0.0164	0.0589	0.0204	0.0082
H7	14.7	0.0086	0.0784	0.0176	0.0095	0.0238	0.0329	0.0170	0.0039	0.0162	0.0556	0.0173	0.0067
H8	208.4	0.0108	0.0584	0.0118	0.0098	0.0183	0.0340	0.0166	0.0039	0.0146	0.0462	0.0142	0.0068
H9	157.6	0.0134	0.0410	0.0129	0.0129	0.0130	0.0092	0.0062	0.0038	0.0132	0.0251	0.0096	0.0084
Average		0.0257	0.0787	0.0208	0.0131	0.0175	0.0279	0.0157	0.0041	0.0216	0.0533	0.0182	0.0086
5th Percentile		0.0095	0.0479	0.0123	0.0096	0.0110	0.0131	0.0096	0.0029	0.0137	0.0319	0.0114	0.0068
Minimum		0.0086	0.0410	0.0118	0.0095	0.0097	0.0092	0.0062	0.0026	**0.0132**	**0.0251**	**0.0096**	**0.0067**

Notes:

1. The flows for October to May were assumed to be zero based on field observations in 2007.
2. Table has been developed from field data collection.
3. All units are $m^3/s/km^2$ unless otherwise stated.

Rev. 1 - Updated for 2008 Field Season Only

TABLE 5.1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SITE WATER MANAGEMENT PLAN

MARY RIVER AREA - ESTIMATED CATCHMENT RUNOFF RATES

Catchment No.		MR-01	MR-02	MR-03	MR-04	MR-05	MR-06	MR-07	MR-08	MR-09	MR-10	MR-11	MR-12	MR-13	MR-14	MR-15	MR-16	MR-17	MR-18	MR-19	MR-20
	Unit Runoff Rate	Runoff Rate																			
	(cu.m/s/sq.km)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)
Catchment Area (sq.km)		874.50	248.70	6,311.00	217.50	7,663.40	122.97	30.40	9.39	10.45	3.58	5.41	14.70	85.43	114.20	18.02	8.61	1.48	21.75	15.66	73.02
January	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
February	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
March	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
April	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
May	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
June	0.0132	11.53	3.28	83.21	2.87	101.04	1.62	0.40	0.12	0.14	0.05	0.07	0.19	1.13	1.51	0.24	0.11	0.02	0.29	0.21	0.96
July	0.0251	21.94	6.24	158.34	5.46	192.27	3.09	0.76	0.24	0.26	0.09	0.14	0.37	2.14	2.87	0.45	0.22	0.04	0.55	0.39	1.83
August	0.0096	8.38	2.38	60.45	2.08	73.40	1.18	0.29	0.09	0.10	0.03	0.05	0.14	0.82	1.09	0.17	0.08	0.01	0.21	0.15	0.70
September	0.0067	5.86	1.67	42.29	1.46	51.35	0.82	0.20	0.06	0.07	0.02	0.04	0.10	0.57	0.77	0.12	0.06	0.01	0.15	0.10	0.49
October	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
November	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
December	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes:
1. The Unit Runoff Rate is obtained from Table 4.1 and is the minimum average monthly unit runoff rate for the catchment areas listed.
2. The maximum drill water consumption rate for the exploration/geomechanical and geotechnical drilling are 7.5×10^{-4} m^3/s and 6.3×10^{-4} m^3/s respectively.

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TABLE 5.2

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SITE WATER MANAGEMENT PLAN

MILNE INLET AREA - ESTIMATED CATCHMENT RUNOFF RATES

Catchment No.		MI-01	MI-02	MI-03	MI-04	MI-05	MI-06
	Unit Runoff Rate	Runoff Rate					
	(cu.m/s/sq.km)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)	(cu.m/s)
Catchment Area (sq.km)		5.27	3.59	4.11	62.32	5.61	7.96
January	0	0.00	0.00	0.00	0.00	0.00	0.00
February	0	0.00	0.00	0.00	0.00	0.00	0.00
March	0	0.00	0.00	0.00	0.00	0.00	0.00
April	0	0.00	0.00	0.00	0.00	0.00	0.00
May	0	0.00	0.00	0.00	0.00	0.00	0.00
June	0.0132	0.07	0.05	0.05	0.82	0.07	0.10
July	0.0251	0.13	0.09	0.10	1.56	0.14	0.20
August	0.0096	0.05	0.03	0.04	0.60	0.05	0.08
September	0.0067	0.04	0.02	0.03	0.42	0.04	0.05
October	0	0.00	0.00	0.00	0.00	0.00	0.00
November	0	0.00	0.00	0.00	0.00	0.00	0.00
December	0	0.00	0.00	0.00	0.00	0.00	0.00

Notes:

1. The Unit Runoff Rate is obtained from Table 4.1 and is the minimum average monthly unit runoff rate for the catchment areas listed.
2. The maximum drill water consumption rate for the exploration/geomechanical and geotechnical drilling are 7.5×10^{-4} m^3/s and 6.3×10^{-4} m^3/s respectively.

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TABLE 5.3

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SITE WATER MANAGEMENT PLAN

STEENSBY INLET AREA - ESTIMATED CATCHMENT RUNOFF RATES

Catchment No.		SI-01	SI-02	SI-03
	Unit Runoff Rate	Runoff Rate		
	(cu.m/s/sq.km)	(cu.m/s)	(cu.m/s)	(cu.m/s)
Catchment Area (sq.km)		13.68	21.77	1.99
January	0	0.00	0.00	0.00
February	0	0.00	0.00	0.00
March	0	0.00	0.00	0.00
April	0	0.00	0.00	0.00
May	0	0.00	0.00	0.00
June	0.0132	0.18	0.29	0.03
July	0.0251	0.34	0.55	0.05
August	0.0096	0.13	0.21	0.02
September	0.0067	0.09	0.15	0.01
October	0	0.00	0.00	0.00
November	0	0.00	0.00	0.00
December	0	0.00	0.00	0.00

Notes:
1. The Unit Runoff Rate is obtained from Table 4.1 and is the minimum average monthly unit runoff rate for the catchment areas listed.
2. The maximum drill water consumption rate for the exploration/geomechanical and geotechnical drilling are 7.5×10^{-4} m^3/s and 6.3×10^{-4} m^3/s respectively.

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Baffinland Iron Mines Corporation

TABLE 6.1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SITE WATER MANAGEMENT PLAN

WATER QUALITY AND QUANTIY MONITORING LOCATIONS

Monitoring Location ID	Description	UTM Coordinates (NAD83) Easting (m)	UTM Coordinates (NAD83) Northing (m)	Parameters	Maximum Amount/ Average Concentration	Maximum Grab Concentration	Sampling Frequency	Monitoring and Reporting Requirement	Reporting Frequency
MRY-1	Water Supply for the Mary River Camp at Camp Lake	557,682	7,914,693	Daily Volume	< 60 m^3/d (combined total for all camp usage)	N/A	Daily	Water License Part B, Item 5 Part I, Items 7, 19 and 20	Daily Volume Requirement for monthly reporting
MRY-2	Summer Water Supply for the Milne Inlet Camp at Phillips Creek	514,503	7,964,579	Daily Volume	< 60 m^3/d (combined total for all camp usage)	N/A	Daily	Water License Part B, Item 5 Part I, Items 7, 19 and 20	Daily Volume Requirement for monthly reporting
MRY-3	Winter Water Supply for the Milne Inlet Camp at km 32 Lake[1]	521,714	7,951,862	Daily Volume	< 60 m^3/d (combined total for all camp usage)	N/A	Daily	Water License Part B, Item 5 Part I, Items 7, 19 and 20	Daily Volume Requirement for monthly reporting
Unnamed	Water Supply for the Rail Camp at Unnamed Lake Adjacent to Camp	595,547	7,876,328	Daily Volume	< 60 m^3/d (combined total for all camp usage)	N/A	Daily	Water License Part B, Item 5 Part I, Items 7, 19 and 20	Daily Volume Requirement for monthly reporting
Unnamed	Water Supply for the Steensby Inlet Camp at 3km Lake, 10 km Lake or Ocean	596,585	7,800,231	Daily Volume	< 60 m^3/d (combined total for all camp usage)	N/A	Daily	Water License Part B, Item 5 Part I, Items 7, 19 and 20	Daily Volume Requirement for monthly reporting
Various	Water Supply for Exploration and Geotechnical Drilling at Various Named and Unnamed Sources Throughout the Project Area	Mary River will be source for exploration drill program in 2009. No planned geotechnical drilling in 2009 at present time.		Daily Volume	< 455 m^3/d (combined total for all drilling usage)	N/A	Daily	Water License Part B, Item 5 Part I, Items 7, 19 and 20	Daily Volume Requirement for monthly reporting
MILNE-INF	Sewage Influent - WWTF at Milne Inlet Camp	Primary Chamber		BOD5 Total suspended solids (TSS) Faecal coliforms pH Total Kjeldahl Nitrogen (TKN) Ammonia-nitrogen Total phosphorus	N/A	N/A	Every 4 weeks during discharge	Baffinland Requirement	For information only; not reported
MILNE-RC1	Receiving waters of Milne Inlet, adjacent drainage ditch	TBD	TBD	BOD_5 Total suspended solids (TSS) Faecal coliforms pH Total Kjeldahl Nitrogen (TKN) Ammonia-nitrogen Total phosphorus	N/A	N/A	Every 4 weeks during discharge	Baffinland Requirement	For information only; not reported
MRY-INF	Sewage Influent - WWTF at Mary River Camp	Primary Chamber		BOD_5 Total suspended solids (TSS) Faecal coliforms pH Total Kjeldahl Nitrogen (TKN) Ammonia-nitrogen Total phosphorus	N/A	N/A	Every 4 weeks during discharge	Baffinland Requirement	For information only; not reported
Shear-RC1	Sheardown Lake in the vicinity of the sewage outfall	TBD	TBD	BOD_5 Total suspended solids (TSS) Faecal coliforms pH Total Kjeldahl Nitrogen (TKN) Ammonia-nitrogen Total phosphorus Dissolved oxygen	N/A	N/A	Every 4 weeks during discharge	Baffinland Requirement	For information only; not reported
MRY-4	Mary River Camp sewage discharge at the WWTF	557,920	7,914,372	BOD_5 TSS pH Faecel Coliforms Oil and Grease Volume	30 mg/L 35 mg/L 6.0 to 9.5 1,000 CFU/100 mL No visible sheen	N/A	Every 4 weeks during discharge; daily for volumes	Water License Part B, Item 5 Part D, Item 10 Part I, Items 3, 19 and 20	Daily Volume Requirement for monthly reporting
				Total Kjeldahl Nitrogen (TKN) Ammonia-nitrogen Total phosphorus		N/A	Every 4 weeks during discharge	Baffinland Requirement	For information only; not reported
				Acute lethality to Rainbow Trout and Daphnia magna (Biological Test Methods EPS/1/RM/13 and EPS/1/RM/14)	Non-toxic	N/A	Once annually during open water	Water License Part B, Item 5 Part D, Item 12 Part I, Items 4, 19 and 20	Monthly report following testing; annual report
MRY-4a	Mary River Camp sewage discharge from the PWSPs	558,706	7,913,930	BOD_5 TSS pH Faecel Coliforms Oil and Grease Volume	30 mg/L 35 mg/L 6.0 to 9.5 1,000 CFU/100 mL No visible sheen	N/A	Once prior to discharge and every 4 weeks thereafter; daily for volumes	Water License Part B, Item 5 Part D, Item 10 Part I, Items 3, 19 and 20	Daily Volume Requirement for monthly reporting
				Total Kjeldahl Nitrogen (TKN) Ammonia-nitrogen Total phosphorus		N/A	Every 4 weeks during discharge	Baffinland Requirement	For information only; not reported
				Acute lethality to Rainbow Trout and Daphnia magna (Biological Test Methods EPS/1/RM/13 & EPS/1/RM/14)	Non-toxic	N/A	Once annually during open water	Water License Part B, Item 5 Part D, Item 12 Part I, Items 4, 19 and 20	Monthly report following testing; annual report

Baffinland Iron Mines Corporation

TABLE 6.1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

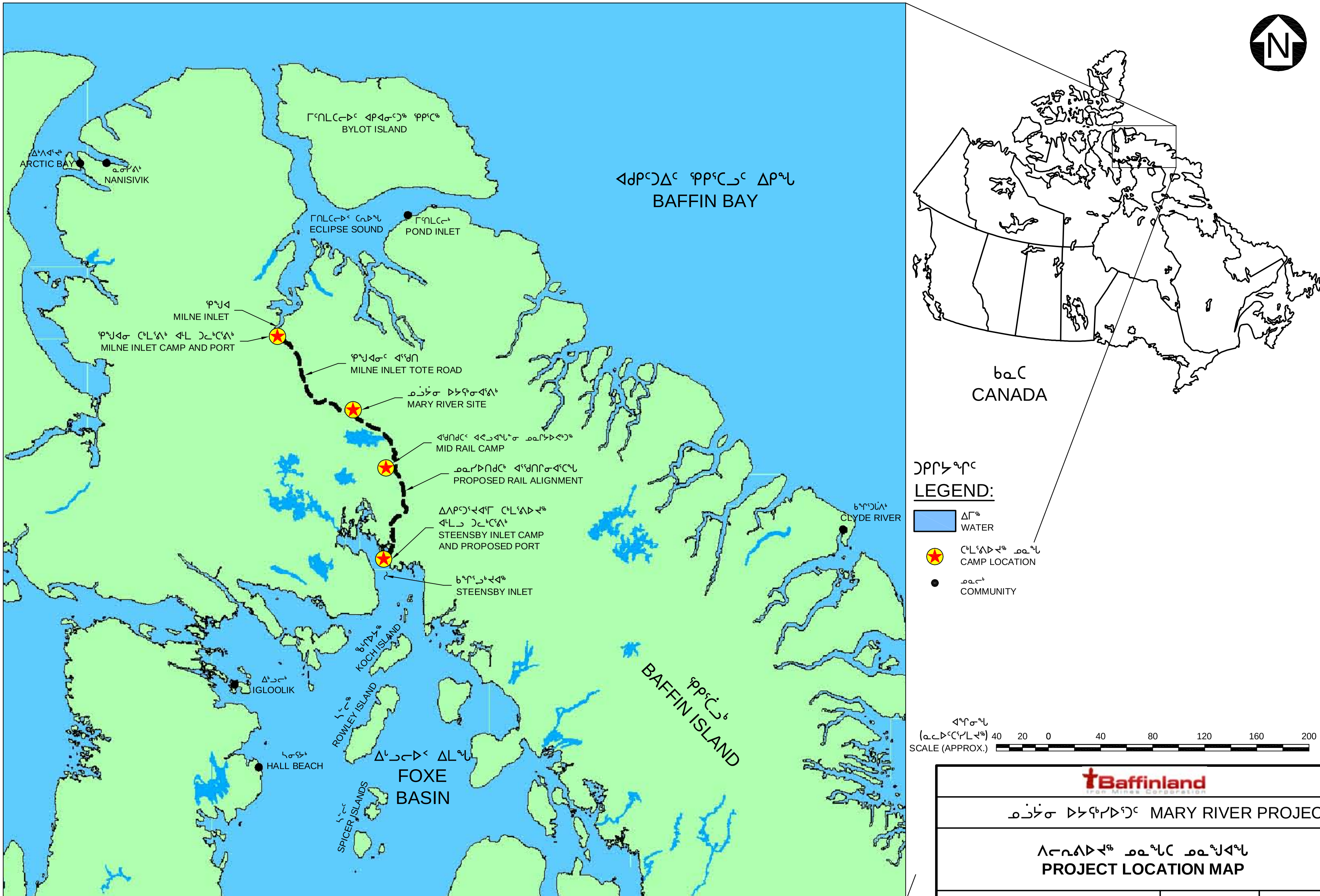
SITE WATER MANAGEMENT PLAN

WATER QUALITY AND QUANTIY MONITORING LOCATIONS

Monitoring Location ID	Description	UTM Coordinates (NAD83)		Parameters	Maximum Amount/ Average Concentration	Maximum Grab Concentration	Sampling Frequency	Monitoring and Reporting Requirement	Reporting Frequency
		Easting (m)	Northing (m)						
MRY-5	Milne Inlet Camp sewage discharge at the WWTF	503,462	7,975,764	BOD_5 TSS pH Faecel Coliforms Oil and Grease Volume	100 mg/L 120 mg/L 6.0 to 9.5 10,000 CFU/100 mL No visible sheen	N/A	Every 4 weeks during discharge; daily for volumes	Water License Part B, Item 5 Part D, Item 11 Part I, Items 3, 19 and 20	Daily Volume Requirement for monthly reporting
				Total Kjeldahl Nitrogen (TKN) Ammonia-nitrogen Total phosphorus		N/A	Every 4 weeks during discharge	Baffinland Requirement	For information only; not reported
				Acute lethality to Rainbow Trout and Daphnia magna (Biological Test Methods EPS/1/RM/13 and EPS/1/RM/14)	Non-toxic	N/A	Once annually during open water	Water License Part B, Item 5 Part D, Item 12 Part I, Items 4, 19 and 20	Monthly report following testing; annual report
MRY-5a	Milne Inlet Camp sewage discharge from the PWSP	503,344	7,976,118	BOD_5 TSS pH Faecel Coliforms Oil and Grease Volume	100 mg/L 120 mg/L 6.0 to 9.5 10,000 CFU/100 mL No visible sheen	N/A	Once prior to discharge and every 4 weeks thereafter; daily for volumes	Water License Part B, Item 5 Part D, Item 11 Part I, Items 3, 19 and 20	Daily Volume Requirement for monthly reporting
				Total Kjeldahl Nitrogen (TKN) Ammonia-nitrogen Total phosphorus		N/A	Every 4 weeks during discharge	Baffinland Requirement	For information only; not reported
				Acute lethality to Rainbow Trout and Daphnia magna (Biological Test Methods EPS/1/RM/13 and EPS/1/RM/14)	Non-toxic	N/A	Once annually during open water	Water License Part B, Item 5 Part D, Item 12 Part I, Items 4, 19 and 20	Monthly report following testing; annual report
MRY-6	Water collected within the Bulk Fuel Storage Facility at Mary River prior to release	558,186	7,914,780	Benzene Toluene Ethylbenzene Lead Oil and Grease	370 μg/L 2 μg/L 90 μg/L 1 μg/L 15,000 μg/L and no visible sheen	N/A	Monthly during removal of water	Water License Part B, Item 5 Part D, Item 17 Part I, Items 5, 19 and 20	Monthly report following testing; annual report
MRY-7	Water collected within the Bulk Fuel Storage Facility at Milne Inlet prior to release	503,309	7,976,097	Benzene Toluene Ethylbenzene Lead Oil and Grease	370 μg/L 2 μg/L 90 μg/L 1 μg/L 15,000 μg/L and no visible sheen	N/A	Monthly during removal of water	Water License Part B, Item 5 Part D, Item 17 Part I, Items 5, 19 and 20	Monthly report following testing; annual report
MRY-8	Minewater and surface drainage either pumped or released from the Hematite Open Pit	NO LONGER REQUIRED(2)							
MRY-9	Minewater and surface drainage either pumped or released from the Magnetite Open Pit(2)	563,239	7,914,596	Total Arsenic Total Copper Total Lead Total Nickel Total Zinc TSS Oil and Grease pH (of waste discharged)	As 0.5 mg/L Cu 0.30 mg/L Pb 0.20 mg/L Ni 0.50 mg/L Zn 0.50 mg/L TSS 15 mg/L O&G No visible sheen pH Between 6.0 and 9.5	As 1.00 mg/L Cu 0.60 mg/L Pb 0.40 mg/L Ni 1.00 mg/L Zn 1.00 mg/L TSS 50.0 mg/L	Monthly during periods of flow	Water License Part B, Item 5 Part D, Item 9 Part I, Items 5, 19 and 20	Monthly report following testing; annual report
MRY-10	Surface discharge from the weathered ore stockpile	563,349	7,915,262	Total Arsenic Total Copper Total Lead Total Nickel Total Zinc TSS Oil and Grease pH (of waste discharged)	As 0.5 mg/L Cu 0.30 mg/L Pb 0.20 mg/L Ni 0.50 mg/L Zn 0.50 mg/L TSS 15 mg/L O&G No visible sheen pH Between 6.0 and 9.5	As 1.00 mg/L Cu 0.60 mg/L Pb 0.40 mg/L Ni 1.00 mg/L Zn 1.00 mg/L TSS 50.0 mg/L	Seepage / surface run off - monthly during periods of flow	Water License Part B, Item 5 Part D, Item 9 Part I, Items 5, 19 and 20	Monthly report following testing; annual report
MRY-11	Surface discharge from the lump ore and fine ore stockpiles at the processing area	560,987	7,913,364	Total Arsenic Total Copper Total Lead Total Nickel Total Zinc TSS Oil and Grease pH (of waste discharged)	As 0.5 mg/L Cu 0.30 mg/L Pb 0.20 mg/L Ni 0.50 mg/L Zn 0.50 mg/L TSS 15 mg/L O&G No visible sheen pH Between 6.0 and 9.5	As 1.00 mg/L Cu 0.60 mg/L Pb 0.40 mg/L Ni 1.00 mg/L Zn 1.00 mg/L TSS 50.0 mg/L	Seepage / surface run off - monthly during periods of flow	Water License Part B, Item 5 Part D, Item 9 Part I, Items 5, 19 and 20	Monthly report following testing; annual report
MRY-12	Surface discharge from the lump ore and fine ore stockpiles at Milne Inlet	12a - 503,356	7,976,452	Total Arsenic Total Copper Total Lead Total Nickel Total Zinc TSS Oil and Grease pH (of waste discharged)	As 0.5 mg/L Cu 0.30 mg/L Pb 0.20 mg/L Ni 0.50 mg/L Zn 0.50 mg/L TSS 15 mg/L O&G No visible sheen pH Between 6.0 and 9.5	As 1.00 mg/L Cu 0.60 mg/L Pb 0.40 mg/L Ni 1.00 mg/L Zn 1.00 mg/L TSS 50.0 mg/L	Seepage / surface run off - monthly during periods of flow	Water License Part B, Item 5 Part D, Item 9 Part I, Items 5, 19 and 20	Monthly report following testing; annual report
		12b - 503,522	7,976,399						
Exploration Drill Monitoring	Monitoring of surface water runoff from areas where thre is exploration drilling (Deposit No. 1, 2, 3)	Various locations upstream, downstream, and near-field.		Major ions, total metals, general parameters, flow.	N/A	N/A	Weekly during drilling.	Annual NIRB Report	Once per year.

Notes:
Shaded monitoring location ID cells denote Water Licence Monitoring Locations
Shaded parameters cells denote required parameters to be reported under the Water Licence.
1. This location is referenced as Km 99 Lake in the Water Licence. This is in error.
2. There is actually only one bulk sample pit now.
More frequent sampling of MRY-4, 4a, 5, 5a, Milne-INFL, and MRY-INFL may be undertaken for the purpose of internal process management and early detection of potential upset conditions.

FIGURES



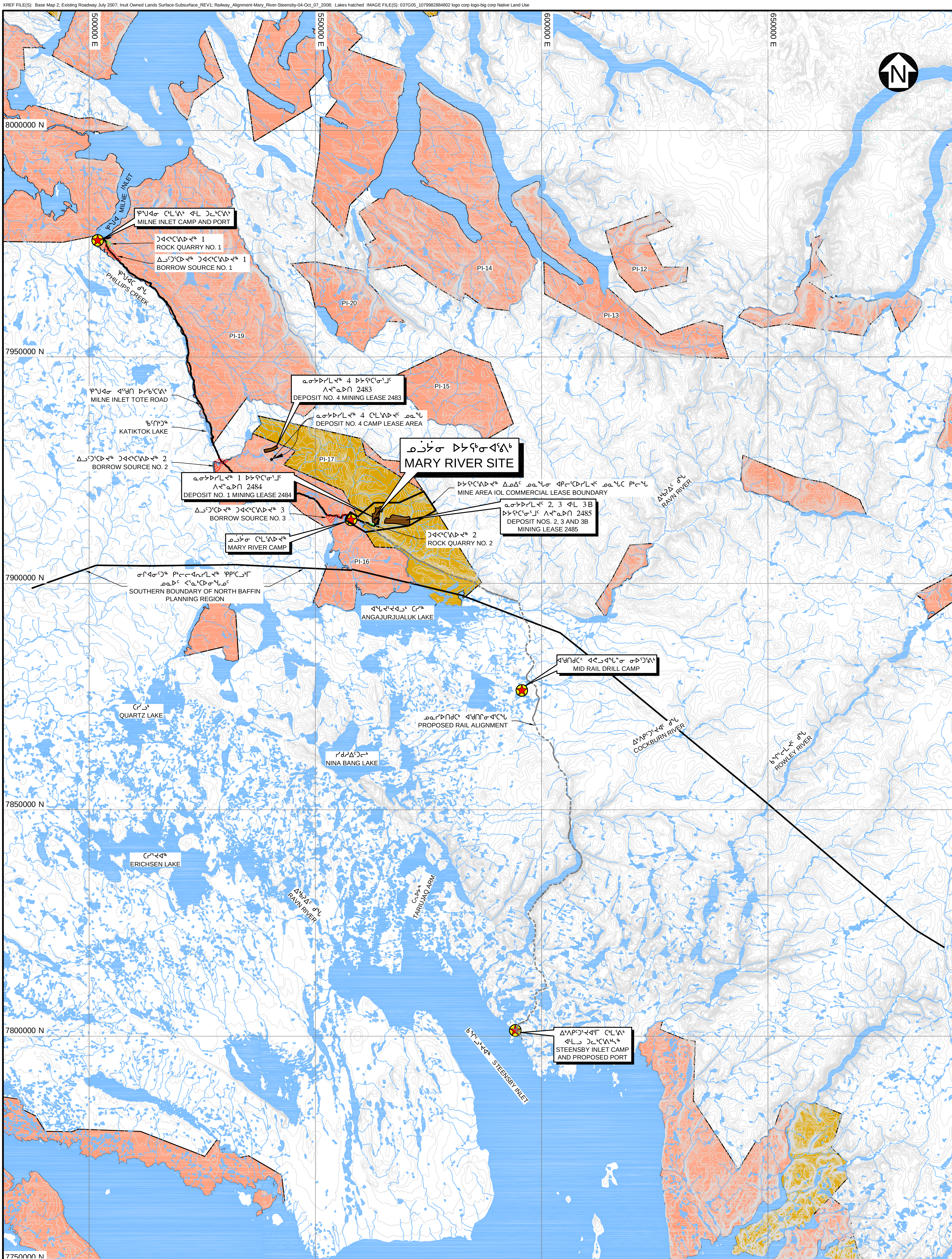
Baffinland Iron Mines Corporation

MARY RIVER PROJECT

PROJECT LOCATION MAP

FIGURE	1.1
REV.	1

XREF FILE(S): Base Map 2; Existing Roadway July 2007; Inuit Owned Lands Surface-Subsurface_REV1; Railway_Alignment-Mary_River-Steensby-04-Oct_07_2008; Lakes hatched IMAGE FILE(S): 037G05_1079982884802 logo corp logo-big corp Native Land Use



LEGEND:

- WATER
- INUIT OWNED LAND - SURFACE ONLY EXCLUDING MINERALS
- INUIT OWNED LAND - SURFACE AND SUBSURFACE INCLUDING MINERALS
- MINERAL LEASE BOUNDARY
- CROWN LAND
- EXISTING BORROW AREA (IOL COMMERCIAL LEASE)
- EXISTING ROCK QUARRY (IOL COMMERCIAL LEASE)
- RIVER/STREAM/DRAINAGE
- MILNE INLET TOTE ROAD
- PROPOSED RAIL ALIGNMENT
- CONTOUR

1.
2. UTM (NAD83) ZONE 17
3.
4. CANARAIL CONSULTANTS INC

NOTE(S):

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA, DEPARTMENT OF NATURAL RESOURCES (2004). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL VARIES.
4. PROPOSED RAIL ALIGNMENT PROVIDED BY CANARAIL CONSULTANTS INC.

SCALE 10 5 0 10 20 30 40 km

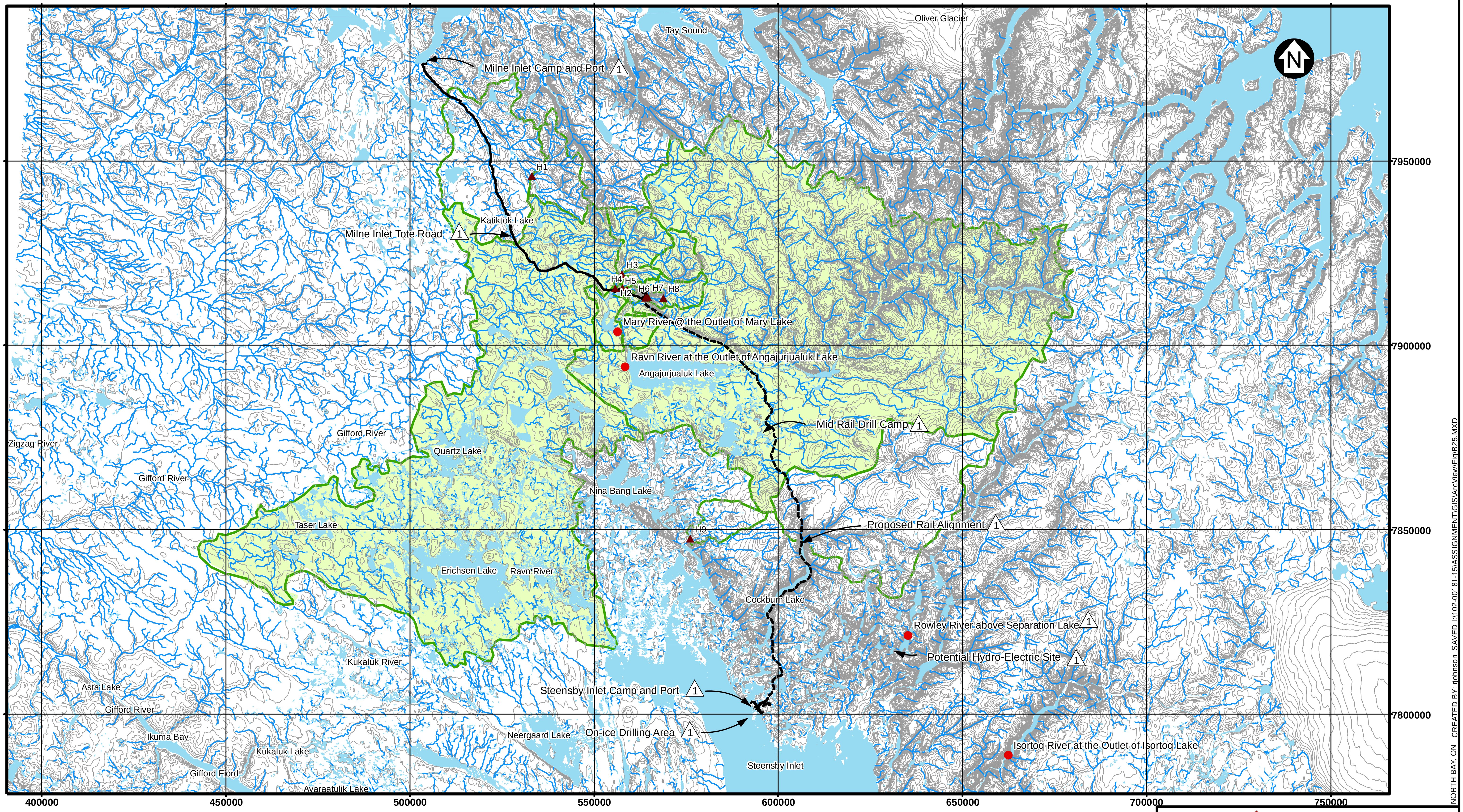
Baffinland Iron Mines Corporation

MARY RIVER PROJECT

LOCATION OF PROJECT ACTIVITIES

REV. 1

FIGURE 1.2



LEGEND:

- Water
- Ravn River Catchment
- River/Stream/Drainage
- Milne Inlet Tote Road 1
- Proposed Rail Alignment 1
- Catchment Boundary
- Streamflow Gauging Station
- WSC Station

NOTES:

1. Base Map: © Her Majesty the Queen in Rights of Canada, Department of Natural Resources (2004). All rights reserved.
2. Coordinate grid is shown in UTM (NAD83) Zone 17 and is in metres.
3. Contours are in metres. Contour interval varies. 1
4. Proposed rail Alignment provided by Canarail Consultants Inc. in late 2007. 1

Scale 10 5 0 10 20 30 40 50 Km

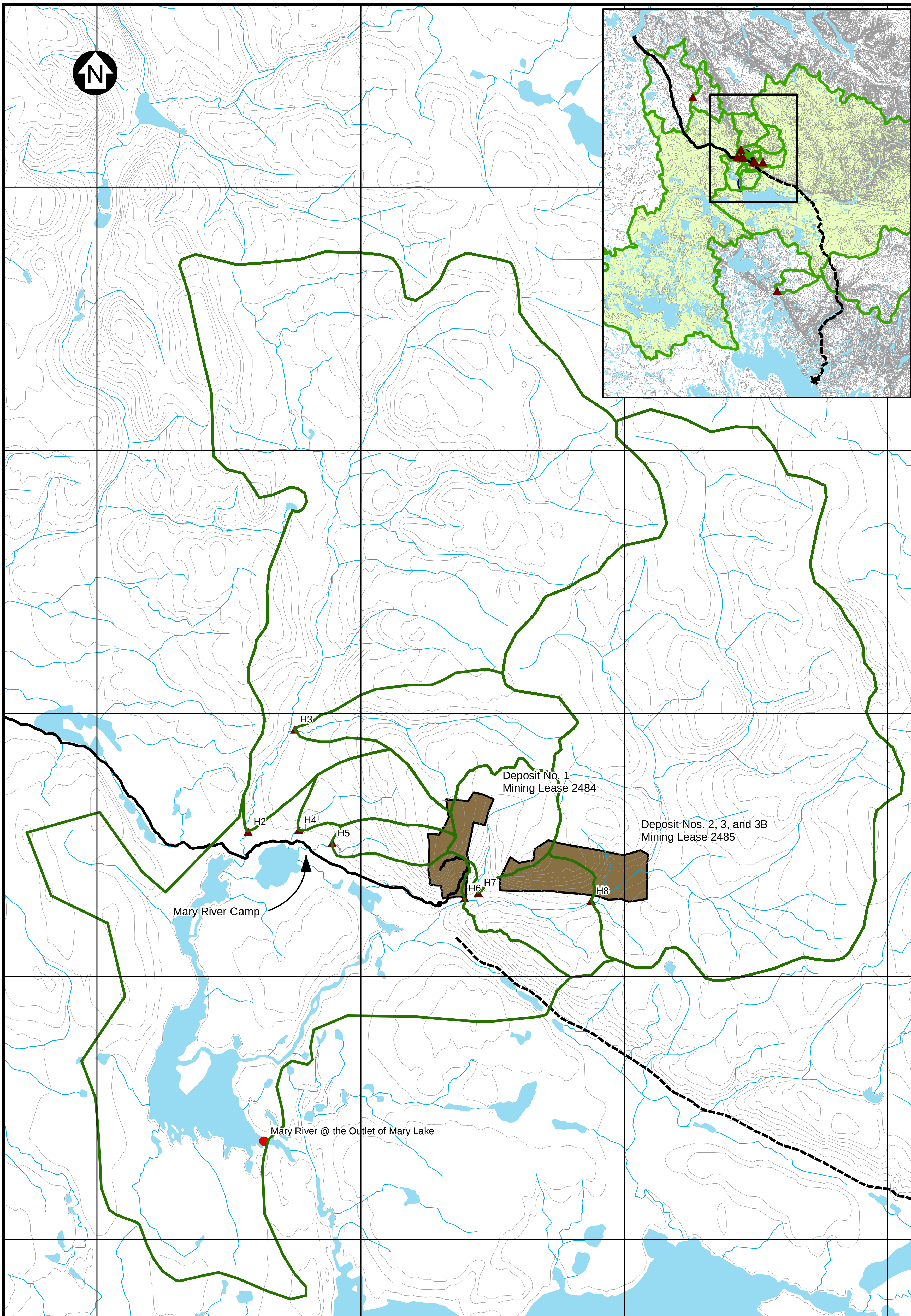
Baffinland Iron Mines Corporation

MARY RIVER PROJECT

STREAMFLOW GAUGING STATIONS MARY RIVER PROJECT SITE AND SURROUNDING AREA

REV. 1

FIGURE 4.1



LEGEND:

- Water 1
- Mineral Lease Boundary
- River/Stream/Drainage
- Milne Inlet Tote Road 1
- Proposed Rail Alignment 1
- Estimated Catchment Boundary 1
- Streamflow Gauging Station
- WSC Station

Scale 2 1 0 2 4 6 8 10 Km 1

NOTES:

1. Base Map: © Her Majesty the Queen in Rights of Canada, Department of Natural Resources, (2004). All rights reserved.
2. Coordinate grid is shown in UTM (NAD83) Zone 17 and is in metres.
3. Contours are in metres. Contour interval varies. 1
4. Proposed Rail Alignment provided by Canarail Consultants Inc. in late 2007. 1

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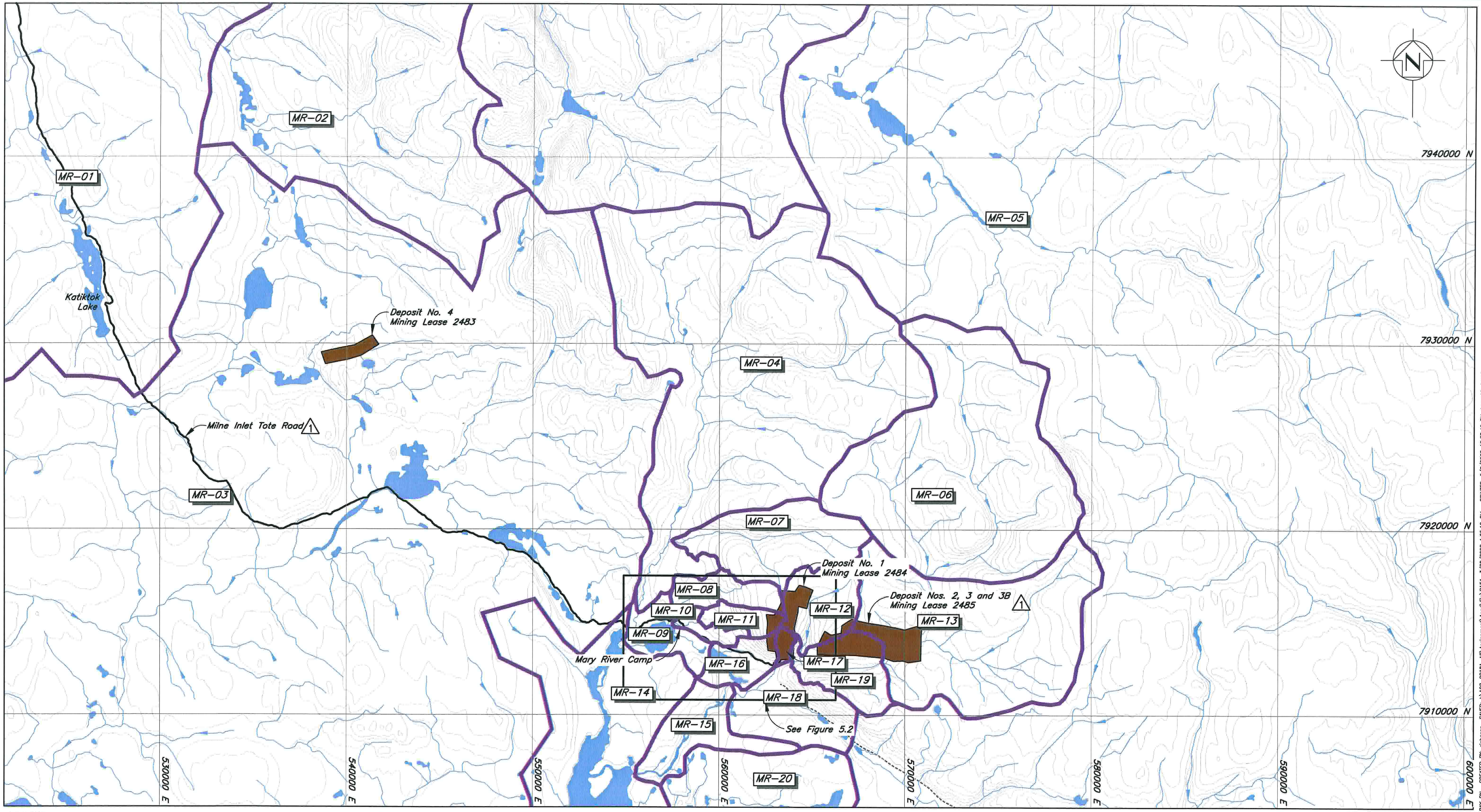
MARY RIVER PROJECT

STREAMFLOW GAUGING STATIONS
MARY RIVER WATERSHED

REV. 1

FIGURE 4.2

NORTH BAY, ON. CREATED BY: rjohnson SAVED I:\102-00181-15\ASSIGNMENT\GIS\ArcView\Figure\B26.MXD



LEGEND:

- Water
- Mineral Lease Boundary
- River/Stream/Drainage
- Direction of surface water runoff
- Milne Inlet Tote Road 1
- Proposed Rail Alignment 1
- Estimated Catchment Boundary
- MR-03 Catchment Area Name

NOTES:

1. Base Map © Her Majesty the Queen in Rights of Canada, Department of Natural Resources (2004). All rights reserved.
2. Coordinate grid is shown in UTM (NAD83) Zone 17 and is in metres.
3. Contours are in metres. Contour interval varies.
4. Catchment areas calculated using Mapinfo.
5. Proposed Rail Alignment provided by Canarail Consultants Inc. in late 2007.

Scale 2 1 0 2 4 6 8 10 Kilometres

CATCHMENT	AREA (km^2)
MR-01	874.5
MR-02	248.7
MR-03	6311
MR-04	217.5
MR-05	7663.4
MR-06	122.97
MR-07	30.40
MR-08	9.385
MR-09	10.45
MR-10	3.58

CATCHMENT	AREA (km^2)
MR-11	5.412
MR-12	14.70
MR-13	85.43
MR-14	114.2
MR-15	18.02
MR-16	8.61
MR-17	1.48
MR-18	21.75
MR-19	15.66
MR-20	73.02

Baffinland

MARY RIVER PROJECT

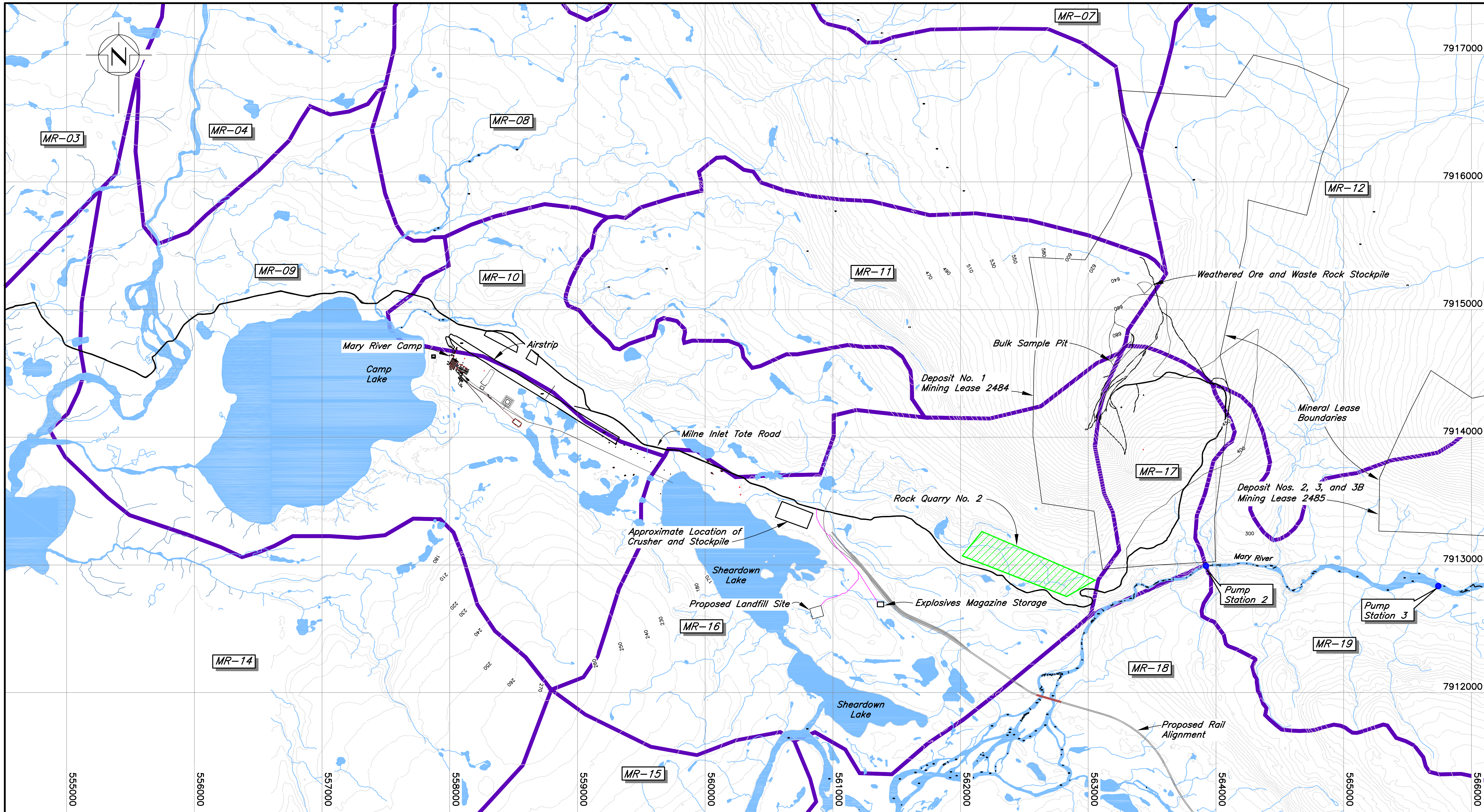
MARY RIVER AREA CATCHMENT AREAS

REV. 1

FIGURE 5.1

XREF FILE(S): Base Map_Overall_RC; CATCHMENTS nad83; Deposit Boundaries IMAGE FILE(S): Baffinland logo-big corp

NORTH BAY ON. CREATED BY: rjohnson SAVED: I:\102-00181-10\Assignment\Acad\Fig\8151, 3/28/2008 1:25:12 PM PRINTED: 5/2/2008 12:37:46 PM, Layout1, bpark



LEGEND:

- Water
- Rock Quarry Location
- River/Stream/Drainage
- Milne Inlet Tote Road
- Drill Road
- Proposed Rail Alignment

NOTES:

1. Topography provided by Eagle Mapping (2005).
2. Coordinate grid is shown in UTM (NAD83) Zone 17 and is in metres.
3. Contours are in metres. Contour interval is 10 metres.
4. Some infrastructure not shown for clarity.

Scale 300 150 0 300 600 900 1200 1500 Metres

Baffinland

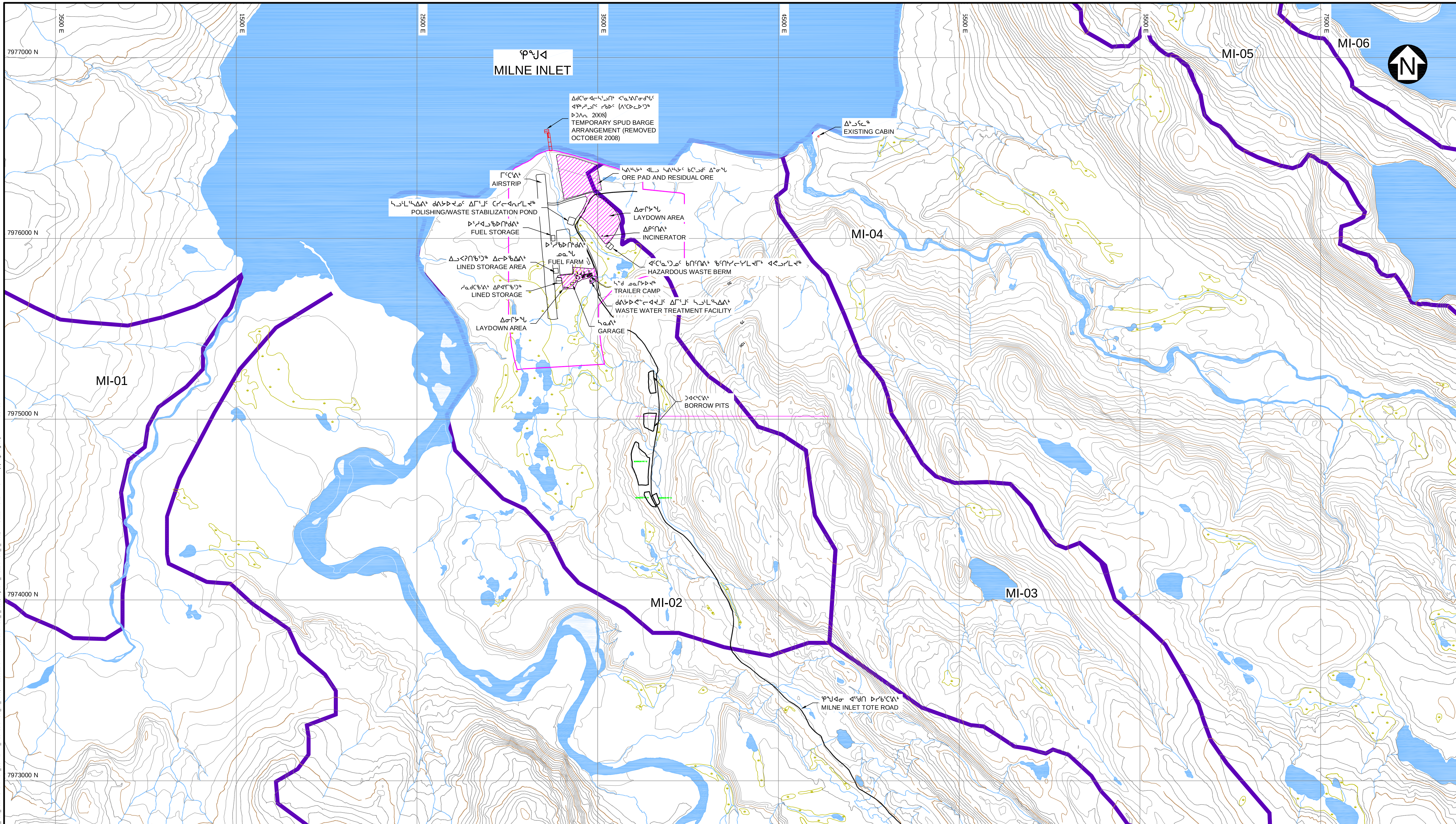
MARY RIVER PROJECT

MARY RIVER DRILLING AREA CATCHEMENT AREAS

REV. 1

FIGURE 5.2

XREF FILE(S): Contours-5m_Interval-01-Sep_18_2008; Milne_Inlet_Tote_Road-As-Built-From_Genivar-KP_Modified-02-Oct_06_2008; Infrastructure-Milne-Detailed-01-Oct_7_2008; Laydown_Areas-01-Oct_7_2008; milne catchments IMAGE FILE(S): logo-big corp MILNE - OCT 08



LEGEND:

- WATER
- WETLAND
- LAYDOWN AREA
- BAFFINLAND'S COMMERCIAL LEASE ON INUIT OWNED LAND
- RIVER/STREAM/DRAINAGE
- DIRECTION OF SURFACE WATER RUNOFF
- MILNE INLET TOTE ROAD
- ROAD
- ESTIMATED CATCHMENT AREA

CATCHMENT	AREA (km²)
MI-01	5.27
MI-02	3.59
MI-03	4.11
MI-04	62.32
MI-05	5.61
MI-06	7.96

1. EAGLE MAPPING (2005)
2. UTM (NAD83) ZONE 17

NOTE(S):

1. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 5 METRES.
4. CATCHMENT AEAS CALCULATED USING MAPINFO.

SCALE 100 50 0 100 200 300 400 500 m

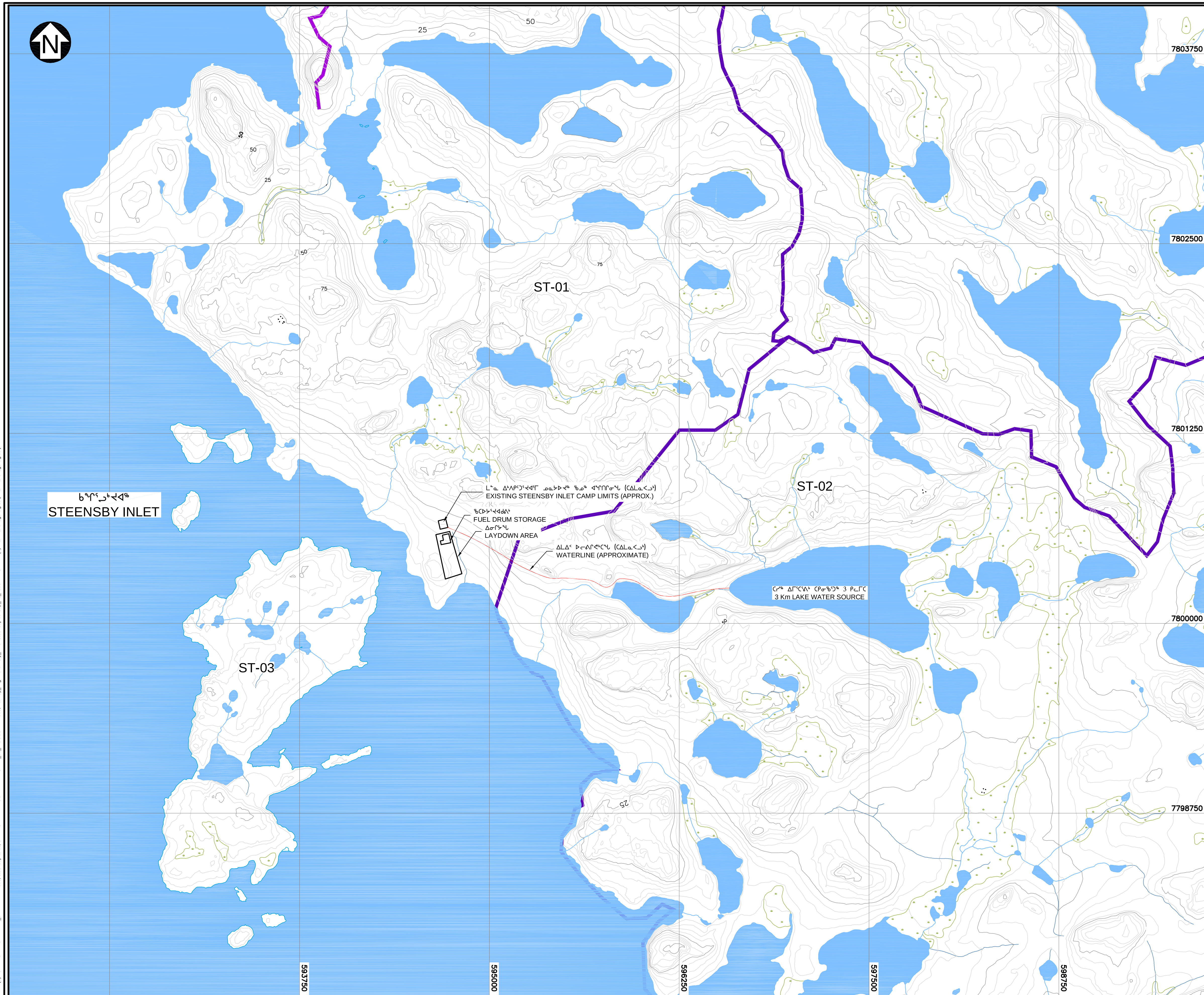
Baffinland Iron Mines Corporation

MARY RIVER PROJECT

MILNE INLET AREA
CATCHMENT AREAS

REV. 1

FIGURE 5.3



LEGEND:

- WATER
- RIVER/STREAM/DRAINAGE
- WETLAND
- ESTIMATED CATCHMENT AREA
- ST-01 CATCHMENT AREA NAME

CATCHMENT	AREA (km²)
ST-01	13.68
ST-02	21.77
ST-03	1.99

NOTE(S):

1. COORDINATE GRID IS UTM (NAD83) ZONE 17 AND IS IN METRES.
2. CONTOUR INTERVAL IS 5 METRES.
3. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
4. CATCHMENT AREAS CALCULATED WITH MAPINFO.

1. UTM (NAD83) Zone 17
2. 5
3. Eagle Mapping (2005)
4. Canarail Consultants Inc
5. Genivar

SCALE 250 12.5 0 250 500 750 1000 1250 m

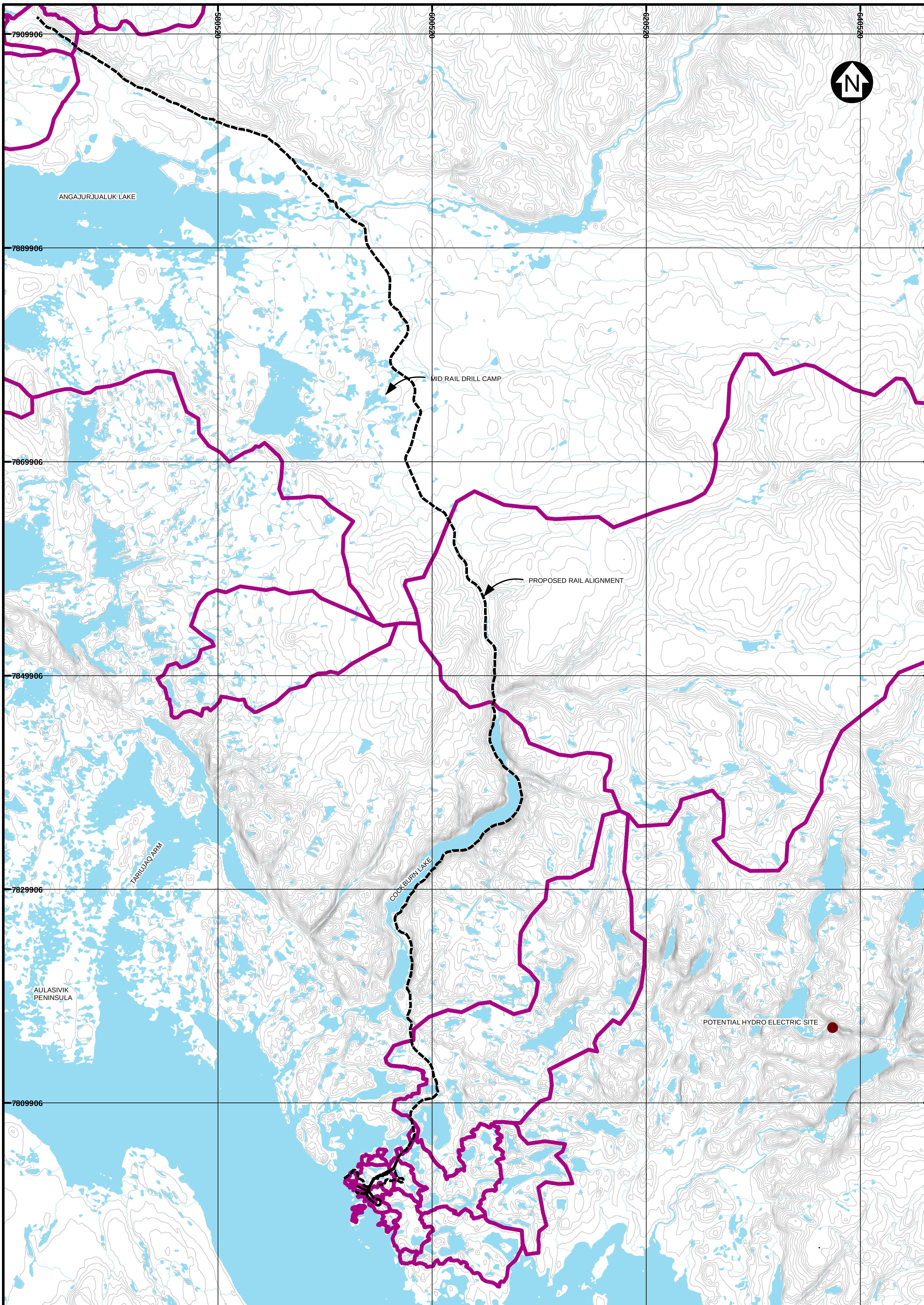
Baffinland Iron Mines Corporation

MARY RIVER PROJECT

STEENSBY INLET AREA
CATCHMENT AREAS

REV. 1

FIGURE: 5.4



LEGEND:

- WATER
- RIVER/STREAM/DRAINAGE
- MILNE INLET TOTE ROAD
- PROPOSED RAIL ALIGNMENT

NOTES:

1. BASE MAP: © HER MAJESTY THE QUEEN IN RIGHTS OF CANADA, DEPARTMENT OF NATURAL RESOURCES (2004). ALL RIGHTS RESERVED.
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METRES.
3. CONTOUR INVTERVAL IS IN METRES. CONTOUR INTERVAL VARIES.
4. PROPOSED RAIL ALIGNMENT PROVIDED BY CANARAIL JANUARY 2008.

SCALE 2 1 0 2 4 6 8 10 km

Baffinland
Iron Mines Corporation

MARY RIVER PROJECT

PROPOSED RAIL ALIGNMENT
CATCHMENT AREAS

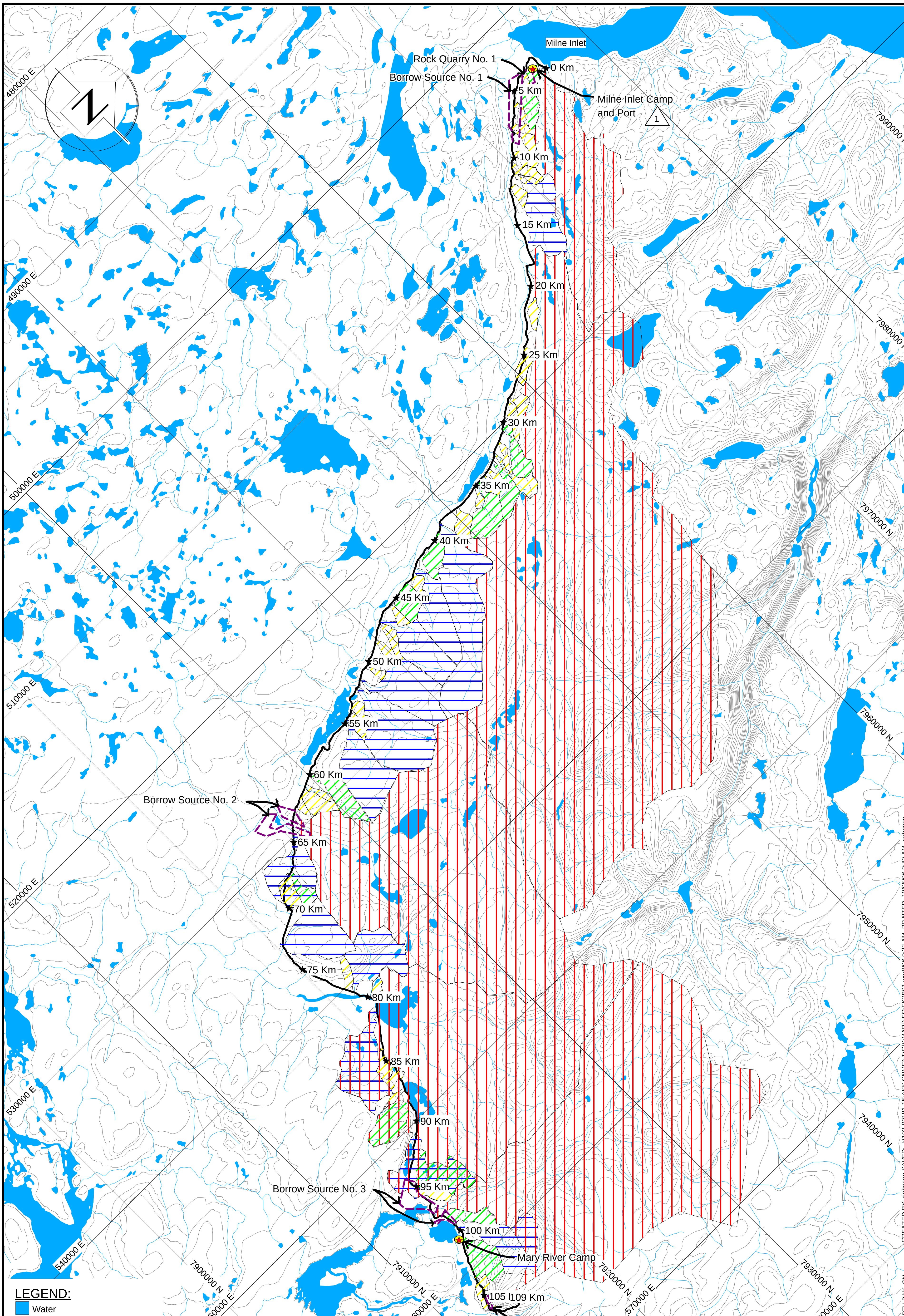
Knight Piésold
CONSULTING

FIGURE 5.5

REV
1

SAVED: I:\102-00181-15\Assignment\GIS\ArcView\figures\B28.mxd ; PRINTED: 01/04/2009 4:11:59 PM ; rjohnson

NORTH BAY, ON



LEGEND:

- Water
- Small Catchment
- Medium Catchment
- Large Catchment
- Extra-Large Catchment
- River/Stream/Drainage
- Milne Inlet Tote Road 1
- Borrow Sources and Rock Quarries

NOTES:

1. Base Map: © Her Majesty the Queen in Rights of Canada, Department of Natural Resources (2004). All rights reserved. (Government of Canada, 2006)
2. Coordinate grid is shown in UTM (NAD83) Zone 17 and is in metres.
3. Contours are in metres. Contour interval varies.
4. Milne Inlet Tote Road surveyed by Knight Piesold (2006). 1
5. Catchments based on July 2006 inspections.

Scale 0 5 10 Km 1

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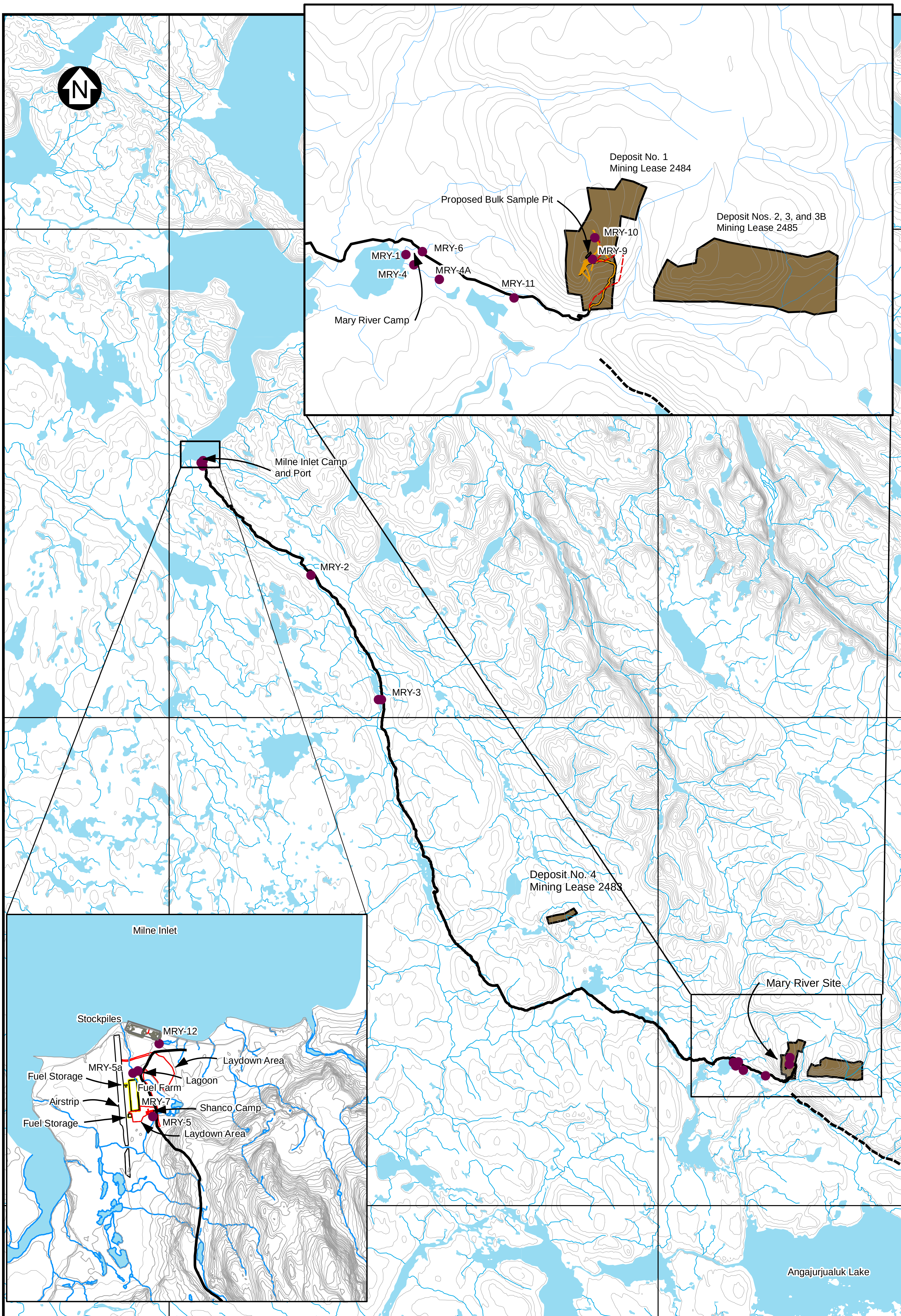
MARY RIVER PROJECT

MILNE INLET TOTE ROAD CATCHMENT AREAS

REV. 1

FIGURE 5.6

NORTH BAY, ON. CREATED BY: rjohnson SAVED: I:\102-00181-15\ASSIGNMENT\GIS\MAPINFO\FIG\B01.wor 8/06 9:32 AM PRINTED: 10/05/06 9:40 AM, rjohnson



NORTH BAY, ON. CREATED BY: rjohnson SAVED I:\102-00181.15\ASSIGNMENT\GIS\ArcView\Figures\B24.MXD

LEGEND:

- Water
- Mineral Lease Boundary
- River/Stream/Drainage
- Milne Inlet Tote Road
- Proposed Rail Alignment
- Existing Trails for Drills
- Proposed Pit/Stockpile Road
- Water Licence Monitoring Location

NOTES:

1. Base Map: © Her Majesty the Queen in Rights of Canada, Department of Natural Resources, (2004). All rights reserved.
2. Coordinate grid is shown in UTM (NAD83) Zone 17 and is in metres.
3. Contours are in metres. Contour interval varies.
4. Proposed Rail Alignment provided by Canarail Consultants Inc.
5. Infrastructure, and water licence, monitoring locations provided by Baffinland.
6. Infrastructure at Milne Inlet and mary River not shown for clarity.

Scale 5 2.5 0 5 10 15 20 Km

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

SURFACE WATER SAMPLING LOCATIONS

Knight Piésold CONSULTING

REV. 1

FIGURE 6.1

APPENDIX A

QUALITY ASSURANCE (QA) AND QUALITY CONTROL (QC) GUIDELINES FOR USE BY CLASS "B" LICENSEES IN COLLECTING REPRESENTATIVE WATER SAMPLES IN THE FIELD AND FOR SUBMISSION OF A QA/QC PLAN (INAC, 1996)

Baffinland
Iron Mines Corporation

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SURFACE WATER SAMPLING PROGRAM
QUALITY ASSURANCE AND QUALITY CONTROL PLAN

Rev. No.	Revision	Date	Approved
0	Issued in Final	October 25, 2007	KDE
1	Issued for 2008 Field Season	March 31, 2008	KDE
2	Issued in Final	March 31, 2008	JM

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BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SURFACE WATER SAMPLING PROGRAM
QUALITY ASSURANCE AND QUALITY CONTROL PLAN

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MARY RIVER PROJECT

SURFACE WATER SAMPLING PROGRAM
QUALITY ASSURANCE AND QUALITY CONTROL PLAN
(REF. NO. NB102-00181/10-7)

SECTION 1.0 - INTRODUCTION

1.1 INTRODUCTION

This Quality Assurance and Quality Control (QA/QC) Plan has been prepared to fulfill the requirement of Part I, Item 9 of License No. 2BB-MRY0710 issued by the Nunavut Water Board to Baffinland Iron Mines Corporation (Baffinland) on July 27, 2007.

Part I, Item 9 of the Water License states:

> *The Licensee shall submit a Quality Assurance/Quality Control Plan, prepared in accordance with the INAC document "Quality Assurance (QA) and Quality Control (QC) Guidelines for use by Class "B" Licensees in Collecting Representative Water Samples in the Field, 1996" to an Analyst for approval within ninety (90) days of the issuance of the license (amendment). The plan shall include analysis of field blanks and certified reference material, and replicate sampling in order to assess accuracy, precision and field contamination.*

In accordance with the stipulations of the Water License, this Surface Water Quality Sampling Program QA/QC Plan has been prepared following the general recommendations presented in *Quality Assurance (QA) and Quality Control (QC) Guidelines for use by Class "B" Licensees in Collecting Representative Water Samples in the Field and for Submission of a QA/QC Plan* (INAC, 1996). A copy of the guidelines is included in Appendix A.

1.2 QA/QC PLAN OBJECTIVES

For the purposes of this report, QA/QC is defined as:

- ***Quality Assurance*** - System of activities used to achieve quality control.
- ***Quality Control*** - Set of best practice methods and procedures used to ensure quality of data in terms of precision, accuracy and reliability.

The QA/QC best practices outlined in this document are designed to provide guidance to field staff and analytical laboratories in order to maintain a high level of confidence in the water quality data generated from the Mary River Project.

SECTION 2.0 - SAMPLE COLLECTION

2.1 GENERAL

The samples will be collected following the general recommendations presented in *Quality Assurance (QA) and Quality Control (QC) Guidelines for use by Class "B" Licensees in Collecting Representative Water Samples in the Field and for Submission of a QA/QC Plan* (INAC, 1996). A copy of the guidelines is included in Appendix A.

2.2 WATER QUALITY MONITORING LOCATIONS

The QA/QC Plan addresses the collection of freshwater surface water quality samples related to monitoring programs being carried out in support of Baffinland's Mary River Project, namely:

1. Collection of environmental surface water samples from area lakes, streams and rivers.
2. Collection of effluent samples from the current and future wastewater treatment facilities located at Mary River and Milne Inlet.
3. Collection of drinking water samples from camp potable water sources.
4. Collection of surface water discharges from future ore stockpiles and waste rock dumps.
5. Collection of surface water discharges from future bulk sample open pits.
6. Collection of water samples from fuel berms.
7. Collection of water samples representative of general site drainage.
8. Measurement of water sample field parameters (e.g. pH, conductivity, temperature etc.).

Exact locations and sampling frequency for designated monitoring stations are presented in the Site Water Management Plan (Knight Piésold, 2008).

2.3 SAMPLING METHODS AND EQUIPMENT

A summary of recommended water sample containers, sample volumes, method detection limits (MDL), sample preservatives and maximum sample hold times is presented in Table 2.1. Laboratory parameters such as pH, BOD, nitrite, nitrate, orthophosphate, fecal colliforms, chlorophyll and phenophytin typically have maximum sample storage times varying from 4 to 48 hours. Due to the remoteness of the site, it may not always be possible to get laboratory analysis done within the sample holding time window. During the preparation of this document the analytical laboratories were consulted with respect to maximum sample holding times. As a result, Table 2.1 presents a preferred and a maximum holding time for time sensitive parameters. Every effort will be made to get samples analysed within the preferred holding time window. If this is not possible, then the maximum holding time will apply.

Every effort will be made to prevent accidental freezing of bacteriological water samples (due to on-site climatic conditions) which could affect analytical results for these parameters.

For a complete list of the required sample analyses at each monitoring station, please refer to the Site Water Management Plan (Knight Piésold, 2008).

2.3.1 General Sampling Procedures

Generally, sampling procedures will consist of the following:

1. Sampler will wear a fresh pair of disposable nitrile gloves for each sampling event.
2. Sample bottles and preservative will be stored under clean conditions on site. Sample bottles will have the appropriate volume of preservative added in the field (or alternatively, sample bottles will be supplied by the analytical laboratory with preservatives already added).
3. A fresh sample bottle(s) will be used at each monitoring station. Sample bottles will *not* be re-used.
4. Sampling will be carried out by either: i) rinsing the sample bottle with source water three times before immersing the sample bottle to fill it (after which preservative is added, as required), or ii) if the sample bottles are provided pre-charged with preservatives then it is generally convenient to transfer water samples from the source to the sample bottle using a 1-2L plastic jug. Plastic jugs will be rinsed in the source water three times before filling the sample bottle. A dedicated jug will be used for different sample types (e.g. sewage effluent, fuel contaminated drainage and receiving waters). Sample jugs will be replaced on a regular basis before they become stained.
5. Prior to collecting the sample, the sampling jug will be rinsed in the source water three times. Rinse water will be disposed of so that it does not contaminate the source water where the sample will be collected.
6. Care will be taken to avoid disturbance of sediments and inclusion of disturbed suspended solids in the sample.
7. For samples *not requiring preservatives*, the sample bottle will be rinsed three times with source water before filling the bottle to the top.
8. For samples *requiring preservatives*, the sample bottle will be filled to the top (or to the indicator line marked on the bottle) and securely sealed. Note that for some volatile contaminants (e.g. BTEX), the sample bottle must be filled with zero headspace.
9. Sample details e.g. date, sample ID and analysis will be clearly marked on the bottle in indelible ink.
10. For *dissolved metals* analyses, if possible, the water sample will be filtered in the field immediately after sampling using a 0.45μm disposable filter and syringe. A fresh syringe and filters must be used at each monitoring station. Alternatively, sample filtration can be carried out by the analytical laboratory.
11. All samples will be sealed by ensuring their lids are tightly secured before placing the bottles into the coolers.
12. All samples will be placed in an iced cooler as soon as possible after collection.

2.3.2 Lake Sampling

For monitoring of water quality arising from vertical stratification in lakes, a depth sampler will be used (e.g. a 'Van Dorn' or 'Kemmerer'). Generally, depth samplers consist of a clear polycarbonate sample tube with two spring mounted rubber bungs, one located at each end. The depth sampler is lowered to the correct depth attached to a cord, whereupon a metal weight is released. The weight slides down the cord and strikes a release mechanism button which releases the two bungs which then seal both ends of the tube. The water sample is then pulled back to the surface.

Regardless of the brand, water samplers that are used will be suitable for collection of water samples for ultra low metals analyses i.e. will have acrylic or PVC construction and silicone seals.

For depth sampling, the following considerations will be taken into account to ensure sample QA/QC:

1. Sampling station locations will be dependent upon the monitoring program objectives and the lake dimensions. Map coordinates for all lake sampling station locations will be recorded using a GPS unit.
2. The vertical stratification profile will be determined using a temperature probe equipped with a long cord with metre intervals marked on it.
3. The vertical temperature profile will be established by slowly lowering the temperature probe and recording the temperature change with depth.
4. Depending upon the purpose of the monitoring program, water quality samples may be collected from the different stratified layers. The depth sampler must be slowly lowered in the 'open' position (i.e. to let water enter it) until it reaches the required depth.
5. The depth sampler will be held at this depth for a few minutes to allow flushing of water inside it.
6. The metal weight (messenger) will be released (to activate the closing mechanism) and the depth sampler will be pulled back to the surface. Field measurements can be taken at depth or by filling a bottle with the sampled water and taking measurements from that immediately after sampling.
7. When collecting samples close to the lake bed care must be taken to ensure that the depth sampler does not disturb lake bed sediments (which could contaminate the sample).
8. Depending upon the lake area and depth, multiple sampling stations will likely be required to adequately characterize lake water quality.

2.3.3 River Sampling

Depending upon the size of the water body, river sampling methods are the same as those presented in Sections 2.3.1 and 2.3.2. To avoid inclusion of floating detritus in the sample, the sample bottle must be fully immersed in the river water. Care will be taken to ensure that disturbed sediments are not included in the sample.

When selecting water quality monitoring station locations on rivers, care will be taken where a tributary joins a river, since complete mixing of the two waters may not be achieved within several hundred metres downstream of the confluence (or further). When in doubt, vertical profile monitoring across the river's width using a field parameter such as pH, temperature or conductivity will be used to assess if complete mixing has occurred.

2.3.4 Sampling for Toxicity Testing

Sampling for sub-lethal toxicity testing is a condition of Environmental Effects Monitoring (EEM). Typically, a 4L effluent sample is sufficient. Depending upon the objectives of the toxicity testing, variables that will require confirmation prior to testing include:

- Type of effluent sample to be collected e.g. instantaneous grab sample, or composite sample collected over a period of time
- Type of dilution water to be used by the testing laboratory e.g. standard synthetic laboratory dilution water, receiving water collected upstream of the discharge etc.
- Preferred test organism e.g. *Daphnia magna* or rainbow trout

Brief details concerning laboratory methods are presented in Appendix D. For further details concerning acute lethality testing refer to Environment Canada (2002) and USEPA (2002).

2.4 QA/QC SAMPLES

For monitoring of QA/QC during sample collection and shipping, a set of QA/QC samples will be routinely submitted for analysis. Descriptions of the QA/QC samples that will be used (e.g. field blank, travel blank and field duplicate) are presented on Table 2.2. Ten percent of all samples will comprise QA/QC samples..

In the interest of transparency, the analytical laboratories will also be instructed to report the results of their own in-house QA/QC testing (e.g. results of random replicate analyses of submitted samples).

The results of QA/QC analyses will be routinely reviewed by Baffinland or their designate, and any anomalous results will be promptly investigated with the assistance of the analytical laboratory. Once the reason for the anomalous results is identified, Baffinland will ensure that operating procedures of field staff and/or the analytical laboratory will be altered in order to rectify the problem. Compliance monitoring and data management for water license sampling will be conducted by Baffinland, with the assistance of a designate as required.

2.5 MEASUREMENT OF FIELD PARAMETERS

Measurement of field parameters (e.g. temperature, pH, conductivity, redox potential, or dissolved oxygen, etc.), where warranted, will be carried out for each sample at the time of sampling. The required set of field parameters will vary according to sample type and monitoring objectives. For a complete list of required parameters please refer to the Site Water Management Plan (Knight Piésold, 2008). The exact methods used for monitoring field parameters will depend upon the type of monitoring probes being used. Field staff will read and be familiar with the instruction manual for the equipment being used on site.

Field staff will rinse the monitoring probe three times with the water to be monitored before immersing the probe in the water. Generally, the user will ensure that the probe being used has had sufficient time to equilibrate in the water before the reading is taken. This is generally regarded as the point at which the reading has stabilized.

Field parameter data will be recorded in notebooks, or preferably in a custom form designed for this purpose (see example in Appendix B). A copy of the data should be retained on site.

2.5.1 Monitoring Probe Calibration

Monitoring probes will be stored and calibrated in accordance with manufacturers' instructions. All probes will be calibrated before each sampling event and a written record of the calibration results will be maintained on site. Field staff will ensure that calibration solutions are of the correct specification and that they have not passed their expiry date (if applicable). Monitoring probes will be stored as per manufacturers' recommendations.

SECTION 3.0 - SAMPLE MANAGEMENT

3.1 SAMPLE SHIPPING AND CHAIN OF CUSTODY

Samples will be placed in iced coolers and shipped to the analytical laboratory as soon as possible after collection. Care will be taken to ensure that bottles are stored upright and are packed securely within the cooler. Preferably, leak-proof ice packs will be used for cooling the samples. If loose ice is used then this should be securely sealed in plastic bags to prevent leakage of melt water.

A chain of custody (COC) form will accompany the samples (see example forms presented in Appendix B). At a minimum, the COC form will list:

1. Project name and project assignment number.
2. Address of analytical laboratory, name of contact person and contact details.
3. Contact details and name of sampler.
4. Date and time of sampling.
5. Whether the sample has been filtered, or whether laboratory filtration is required.
6. List of sample I.D.'s, sample type (e.g. lake water, sewage effluent, etc.), number of sample bottles per sample and analysis requested.
7. Urgency of analysis (e.g. rush or normal). For rush samples the analytical laboratory should be notified ahead of time.
8. Whether sample contains preservative and if so, what preservative and when it was added.

SECTION 4.0 - LABORATORY ANALYSIS

4.1 LABORATORY ACCREDITATION

Currently, laboratory analysis of water samples is being carried out by two accredited analytical laboratories. Accutest Laboratories ('Accutest') located in Nepean, Ontario has been carrying out the majority of sample analyses due to its geographical proximity to site (with respect to sample holding times). ALS Laboratory Group ('ALS'), located in Vancouver, BC has been used when ultra low level metals analysis has been required. AquaTox Testing and Consulting Inc. ('AquaTox') located in Guelph, Ontario will provide toxicity testing services. Details on analytical laboratory accreditation are presented in Appendix C.

4.2 ANALYTICAL DETECTION LIMITS

Required analytical laboratory method detection limits for a range of parameters are listed in Table 2.1. It should be noted that on occasion, a loss of analytical sensitivity can be encountered due to excessively high concentrations of parameters within a sample. If this is encountered, Baffinland or their designate will work with the analytical laboratory to try and resolve the problem.

4.3 LABORATORY ANALYTICAL METHODS

Analytical methods used by the analytical laboratories generally conform to the standard methods outlined in *Standard Methods for the Examination of Water and Wastewater* (APHA et al, 1989). For some parameters alternative standard analytical methods are used, as listed in Appendix D.

4.4 ANALYTICAL LABORATORY QA/QC PROCEDURES

Each analytical laboratory carries out their own routine in-house QA/QC checks, which include:

- Use of calibration check standards and drift control standards
- Use of surrogate standards and internal standards
- Replicate analyses on submitted samples
- Use of standard reference materials (SRM's) and matrix spikes

Further details on the analytical laboratories in-house QA/QC protocols are presented in Appendix E.

SECTION 5.0 - DATA MANAGEMENT AND REPORTING

5.1 DATA MANAGEMENT

All water quality data collected by Baffinland or designate from the various environmental programs will be stored electronically in a spreadsheet database (Microsoft Excel) or using alternative software designed specifically for environmental data management.

QA/QC measures relating to data validation will include the following:

1. Designation of a suitable person to act as Water Quality Database Manager (WQDM).
2. Upon receipt, laboratory analytical data will be reviewed by the WQDM to check for completeness, typos, outlying values, etc. The analytical laboratory will be immediately notified of any anomalous results.
3. At a suitable frequency (e.g. once per month) the spreadsheet database should be updated by the WQDM using: i) results provided in electronic format by the analytical laboratories, and ii) copies of the field parameter monitoring records forwarded from site
4. The WQDM will be responsible for ensuring that a third party (e.g. another staff member) carries out a QA/QC check on a minimum of ten percent of newly entered data.

5.2 REPORTING

All documents prepared by Baffinland or their designate for submission to the regulators will be reviewed by senior staff and Baffinland prior to issue, as per the company's standard practice and quality management system.

SECTION 6.0 - REFERENCES

1. APHA *et al*, 1989. Standard Methods for the Examination of Water and Wastewater; AHPA, AWWA and WPCF, 17th ed.

2. Environment Canada, 2002. Metal Mining Guidance Document for Aquatic Environmental Effects Monitoring. http://www.ec.gc.ca/eem/English/MetalMining/Guidance/default.cfm.

3. INAC, 1996. Quality Assurance (QA) and Quality Control (QC) Guidelines for Use by Class "B" Licenses in Collecting Representative Water Samples and the Field and for Submission of a QA/QC Plan. Prepared by Department of Indian and Northern Affairs Canada Water Resources Division and the Northwest Territories Water Board, July 1996.

4. Knight Piésold, 2008. Baffinland Iron Mines Corporation - Mary River Project - Site Water Management Plan, Ref. No. NB102-00181/10-5, Rev. 1. North Bay: Knight Piésold, 2008.

5. USEPA, 2002. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms; 5th Ed., USEPA, ref. No. EPA-821-R-02-012.

TABLES

TABLE 2.1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SURFACE WATER SAMPLING PROGRAM - QUALITY ASSURANCE AND QUALITY CONTROL PLAN

SUMMARY OF RECOMMENDED WATER SAMPLE VOLUMES, METHOD DETECTION LIMITS, PRESERVATIVES AND SAMPLE STORAGE TIMES

Parameter	Method Detection Limit	Required Sample Bottle	Sample Preservative	Maximum Sample Storage Time	
				Preferred	Maximum
General Chemistry					
Total metals	variable	250mL plastic	0.5mL conc. nitric acid	6 months	-
Dissolved metals(1)	variable	250mL plastic	cool 4°C	7 days	-
Anions	variable	1L plastic	cool 4°C	7 days	-
TSS (4)	3 mg/L	1L plastic	cool 4°C	7 days	-
pH	0.01 pH unit	250mL plastic	cool 4°C	4 hours	14 days
Conductivity	0.2µS/cm	250mL plastic	cool 4°C	28 days	-
Total hardness	0.5mg/L	250mL plastic	cool 4°C	6 months	-
Total acidity / alkalinity	0.5mg/L	500mL plastic	cool 4°C	14 days	-
Nutrients					
BOD_5 (8)	5mg/L	1L plastic	cool 4°C	4 hours	7 days
Total ammonia	0.005mg/L	250mL plastic	2mL sulphuric acid, cool 4°C	28 days	-
Nitrate	0.005mg/L	500mL plastic	cool 4°C	48 hours	7 days
Nitrite	0.002mg/L	500mL plastic	cool 4°C	48 hours	7 days
Orthophosphate	0.002mg/L	250mL plastic	cool 4°C	48 hours	7 days
TOC (5)	0.01mg/L	125 ml, glas, amber	2ml HCl acid	28 days	-
Biological					
Chlorophyll	0.2mg/m^3	1 L amber glass	cool 4°C	72 hours	3 days (9)
Phenophytin	0.2mg/m^3	1 L amber glass	cool 4°C	72 hours	3 days (9)
Sub-lethal Toxicity Testing (7)	N/A	20L plastic tote	cool 4°C	7 days	
Bacterial					
Fecal coliforms	1MPN	125mL sterile plastic or glass	cool 4°C	6hrs	48hrs
Organics					
TPH (2)	1.0 mg/L	500mL brown glass (6)	2mL sulphuric acid	14 days	-
BTEX (3)	0.0005 mg/L	100mL two septum vial (6)	2mL sulphuric acid, cool 4°C	14 days	-

Notes:
1. Sample must be field filtered using a 0.45µm disposable filter and syringe.
2. Total petroleum hydrocarbons.
3. Benzene, toluene, ethyl benzene, xylenes.
4. Total suspended solids.
5. Total organic carbon.
6. Zero sample headspace.
7. Type of test organism selected will depend upon objectives of testing.
8. Biochemical oxygen demand - 5 day test.
9. For samples with pH >7, the sample may be preserved by filtering through a glass fibre filter and storing the filter and residue in an airtight plastic bag in a freezer for up to 3 weeks.

Rev. 1 - Issued for 2008 Field Season

TABLE 2.2

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

SURFACE WATER SAMPLING PROGRAM - QUALITY ASSURANCE AND QUALITY CONTROL PLAN

SUMMARY OF RECOMMENDED FIELD QA/QC WATER SAMPLES

QA/QC Sample	Purpose	Description	Frequency	Prepared By
Field blank	Identification of potential contaminants arising from sample collection. The field blank bottle is prefilled with laboratory deionized water and is handled in the same way as regular sample bottles (i.e., opened and closed during sample collection). The bottle is submitted as a routine sample.	Bottle contains prefilled deionized water. Bottle is handled the same as one would handle regular samples.	Ten percent of all samples collected will be QA/QC.	Field staff
Travel blank	Identification of potential contaminants arising from sample storage, shipping and laboratory handling. The travel blank accompanies the samples to the laboratory but is not taken out into the field, or opened.	Sealed bottle containing deionized water provided by analytical laboratory	Ten percent of all samples collected will be QA/QC.	Analytical laboratory
Field duplicate	Assesses sample variability and precision of laboratory analytical methods	Duplicate sample selected at random.	Ten percent of all samples collected will be QA/QC.	Field staff

Rev. 2 - Issued for 2009 Field Season

APPENDIX A

QUALITY ASSURANCE (QA) AND QUALITY CONTROL (QC) GUIDELINES FOR USE BY CLASS "B" LICENSEES IN COLLECTING REPRESENTATIVE WATER SAMPLES IN THE FIELD AND FOR SUBMISSION OF A QA/QC PLAN (INAC, 1996)

QUALITY ASSURANCE (QA) AND QUALITY CONTROL (QC)

GUIDELINES

FOR USE BY CLASS "B" LICENSEES IN COLLECTING REPRESENTATIVE WATER SAMPLES IN THE FIELD

AND FOR SUBMISSION OF A QA/QC PLAN

JULY 1996

DEPARTMENT OF INDIAN AND NORTHERN AFFAIRS CANADA
WATER RESOURCES DIVISION
AND THE
NORTHWEST TERRITORIES WATER BOARD

Table of Contents

1.0 Introduction and Definitions

The purpose of this guideline is to provide an outline for Licensees to follow when preparing a site-specific Quality Assurance/Quality Control (QA/QC) plan. The QA/QC plan will help ensure that water samples taken in the field maintain a high degree of quality, so that they accurately reflect the physical and chemical nature of the water being tested.

This guideline is divided into three sections:

1) Sample Collection
2) Sample Handling
3) Lab Analysis

It is recognized that there may be different interpretations as to what is covered by "Quality Assurance/Control" due to the fact that certain Licensees have their own laboratories, while others only use commercial laboratories. For licence purposes, "Quality Assurance" and "Quality Control" refer to the following:

Quality Assurance: is the system of activities designed to better ensure that quality control is done effectively; while

Quality Control: is the use of established procedures to achieve standards of measurement for the three principal components of quality: precision, accuracy and reliability.

2.0 Sample Collection

2.1 Location

A QA/QC plan must identify the locations of all sampling stations and the markers used to identify the stations. If the Surveillance Network Program (SNP) of the Water Licence does not specify sampling locations, locations should be chosen with help from an Inspector.

Buoys and landmarks identify sampling stations in tailings ponds and lakes, while sign post positioning usually marks stream sample stations. Stations should be used repeatedly, with the same personnel and techniques to reduce operational error. The use of Global Positioning System (GPS) to identify Latitude and Longitude for sampling stations is recommended.

2.2 Sampling Equipment

The Plan must include a detailed section on the equipment used for sampling and the rationale behind the choices of equipment. Equipment and bottles should be selected so that they do not contaminate or otherwise alter the concentrations of parameters of interest.

Sampling devices, sample bottles and filtration devices should be constructed of non-metallic material. Most samples are now collected in containers constructed of high density polyethylene plastic. However, there are some exceptions, when testing for oil and grease or phenols glass containers are to be used. When conducting a fish bioassay, plastic drums are used while hydrocarbon based containers are not to be used for the collection of organic samples.

This section should also identify whether new or used bottles are used for each sample analysis. New bottles are preferred, but sample containers may be used repeatedly with proper handling measures.

If old bottles are used, a detailed description should be included, noting how they are maintained, stored and cleaned. Usually, this will closely resemble the product manufacturer's instructions. An example of how bottles should be cleaned is outlined below:

- Rinse well with hot tap water for one minute or more.
- Empty bottle and add 30% HNO_3 to approximately 1/3 container capacity. Shake well for three to four minutes.
- Rinse vigorously with hot tap water for two minutes.
- Rinse thoroughly three times with tap water and three times with distilled water.
- Store with 0.2% HNO_3 for a minimum of one week.
- Rinse again with distilled water at least three times.

Bottles that are to be used for bacteria testing should be acid washed or autoclaved if possible.

Note: Additional information on bottle washing is also available from Water

Resources Division.

2.3 Sampling Methods

This Section will include details on how the samples are collected and the equipment that is to be used for each section.

In lakes and ponds, regular sample bottles are used the majority of the time, but Van Dorn samples are often utilized. The sample or the sample bottle is usually lowered to mid depth and washed three times before collecting the sample on the fourth submersion. Approximately 2% of the sample container capacity should remain to provide for mixing, preservative addition and thermal expansion.

Stream water sampling is usually done by plunging a sample bottle toward the current and allowing it to fill. Once again, the bottle should be rinsed three times before filling and room should be left for preservative addition and mixing.

A glass bottle should be used when sampling for oil and grease with the sample being collected during the first submersion and not rinsed three times first.

This section should also describe how often field blanks and replicate samples are to be collected. Field blanks are samples of distilled/deionized water that are to be treated in exactly the same manner as the other samples. Blanks should therefore be taken to the field and handled and preserved as part of the sample program. They indicate when a sample may be contaminated and are indicative of general sample integrity. Replicate samples (duplicates and triplicates) are two or three samples collected from the same station at the same time. They help to ensure sample precision at the laboratory.

3.0 Sample Handling

3.1 Preservation

After collection, most samples must be preserved in order to prevent chemical or biochemical changes to the sample. The QA/QC plan must describe how samples from each station are to be preserved.

Preservation is generally done by the addition of certain chemicals into the bottle immediately after the sample is collected. **Table 1** is a general guide to preservatives and their appropriate concentrations. The QA/QC plan should contain more detailed information on the concentrations and amount of preservatives that will be used.

3.2 Sample Identification

The plan should include a description of the system used to identify samples. The system must provide positive sample identification and ensure that the identification is maintained. It is advisable to keep a logbook of samples that have already been delivered.

The identification can be maintained by marking the bottle itself or a label, with a water resistant, non-smear felt pen. The information should be clear to persons uninvolved in the sampling and may include such details as company name, sample area, SNP number, time and date.

3.3 Transportation

The section on transportation will describe how sample integrity will be ensured from the time of collection to completion of delivery. Delivery to the lab should be done as soon as possible after the samples have been collected.

Usually, samples are sealed and stored upright in a box with other samples to provide a snug, immobile storage space during transfer. Any samples that require refrigeration for preservation should be kept cool during transport.

4.0 Lab Analysis

4.1 Lab Accreditation

The Licensee will identify in the plan the name of the commercial laboratory that will be conducting the analyses. A letter must be provided from the commercial lab indicating that they are accredited to conduct analyses on each of the required sampling parameters. Ideally, the lab should be accredited by the Canadian Associated for Environmental Analytical Laboratories (C.A.E.A.L.) and should provide a certificate stating parameters for which they are accredited.

4.2 Detection Limits

Detection limits for the commercial lab should be identified for all parameters and should be reported when any SNP data is submitted.

4.3 Methodology

Descriptions should be included for any methods of analysis used that are not outlined in "Standard Methods for the Examination of Water and Wastewater".

4.4 Reporting Requirements

The Licensee shall outline the number of replicate samples that will be collected and submitted with each SNP report. It is recommended that one set of duplicates or triplicates from an assigned SNP site, as well as the results from field blanks, be submitted with each required SNP report. These will serve as an internal/external check for the Licensee and the commercial lab.

FOR FURTHER INFORMATION, CONTACT THE WATER RESOURCES DIVISION AT:

Box 1500
Yellowknife, NWT
X1A 2R3
(403)669-2651 Phone
(403)669-2716 Fax

Appendix 1
Table 1: General Summary of Special Sampling or Handling Techniques

Determination	Container	Minimum Sample Size (ml)	Preservation	Maximum Storage Recommended
BOD	Sterile polyethylene	1000	Refrigerate 4°C	24 hours
Conductivity	Polyethylene	500	Refrigerate 4°C	28 days
Total Cyanide	Polyethylene	500	Add NaOH to raise pH>12 refrigerate in dark	24 hours
Hardness	Polyethylene	100	Add Conc. HNO_3 to lower pH<2 OR (*) unpreserved	6 months
Metals, General	Polyethylene	250	For dissolved metals filter immediately, add Conc. HNO_3 to pH<2	6 months
Mercury	Glass (rinsed with 1 + 1 HNO_3)	500	Add Conc. HNO_3 or pH<2 or H_2SO_4 + 1 ml of 5% $K_2Cr_2O_7$, refrigerate 4°C	28 days
Nitrogen:				
Ammonia	Polyethylene	500	Analyze as soon as possible or add H_2SO_4 to pH<2, refrigerate OR (*) unpreserved	7 days
Nitrate	Polyethylene	100	Analyze as soon as possible or refrigerate	48 hours
Oil and Grease	Glass or wide-mouth calibrated	1000	Add H_2SO_4 to pH<2, refrigerate	28 days
pH	Polyethylene	—	Analyze immediately	2 hours
Suspended Solids	Polyethylene	—	Refrigerate	7 days
Temperature	Polyethylene	—	Analyze immediately	0
Turbidity	Polyethylene	—	Analyze same day; store in dark up to 24 hours, refrigerate	24 hours
Bacteria	Polyethylene (sterilized)	—	None: Keep cool	6 - 48 hours

(*) Unpreserved = check with lab that will be analyzing the samples

Appendix 2

References:

Gilbert, Andrew (1993). "Echo Bay Mines Ltd. Environmental Laboratory Quality Assurance Plan".

Soniassy, R. (1980). "A Guide for the Collection of Water and Effluent Samples"; pp 1-16; INAC

"Standard Methods for the Examination of Water and Wastewater" (1989); AHPA, AWWA and WPCF, 17th edition.

Water Resources Division, Indian and Northern Affairs Canada (1990). "Generic Quality Assurance (QA) Plan Guidelines for Use by the Licensees in Meeting SNP Requirements for Submission of a QA Plan"; INAC.

APPENDIX B

EXAMPLE FORMS

Sample Chain of Custody - 1 page
Record of Water Sample Field Parameter Measurements - 1 page
Field Monitoring Data Form - 1 page
Analytical Request Form - 1 page
Chain of Custody Record - 1 page

BAFFINLAND MARY RIVER PROJECT

SAMPLE CHAIN OF CUSTODY

FROM: ....

....

....

....

TO: ....

....

....

....

F.A.O. ....

Note:

No.	Sample I.D.	Sampling Date	Sampler	Sample Type	Sample Filtered?	No. of Bottles	Rush?	Analyses																			
								General Chemistry									*Nutrients*						*Bacterial*	*Organics*	
								Metals	Arsenic	Mercury	Anions	TSS	pH	Conductivity	Total Hardness	Total Alkalinity / Acidity	BOD_5	Total ammonia	Nitrate	Nitrite	Orthophosphate	TOC	Faecal coliforms	TPH	BTEX
1																									
2																									
3																									
4																									
5																									
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<u>**BAFFINLAND MARY RIVER PROJECT**</u>

Record of Water Sample Field Parameter Measurements

No.	Sample I.D.	Sampling Date	Sampler	*Field Parameters*						Notes
				pH	Temperature (°C)	Conductivity (mS)	Redox (mV)	D.O. (mg/L)		
								mg/L	%	
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
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16										
17										
18										
19										
20										

Baffinland Iron Mines Corporation

DATE AND TIME: ____________________

FIELD MONITORING DATA FORM

STATION ID: ____________________

Environmental Department office – 519-397-9092

Site Information

Coordinates: Northing (m): __________ Easting (m): __________ Zone: __________ Datum: __________

Climate: Temp. (°C): ______________ Precipitation: ______________ Cloud cover (%): ______________

Wind speed (kn): ______________ Wind direction: ______________ Wave height (m): ______________

Description: ____

Field Data

Water Quality Meter: ______________________ Last Calibration: ______________________

Snow Depth (m): ________ Freeboard (m): ________ Ice Thickness (m): ________ Water Depth (m): ________

No.	Depth (m)	Temp. (°C)	pH		DO			SpC (µS/cm)	Cond. (µS/cm)	Sal.	TDS (g/L)
			(units)	(mV)	(mg/L)	(%)	(ch)				
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
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27											
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30											

Samples Information

Potable Water ☐	Wastewater ☐	Surface Water ☐
☐ Baffinland DW Micro	☐ Baffinland WW Micro	☐ Baffinland SW Micro
☐ Baffinland DW Chem	☐ Baffinland WW Chem	☐ Baffinland SW Chem
☐ Baffinland DW Metals	☐ Baffinland WW O&G Tot.	☐ Baffinland SW Metals
☐ Baffinland DW THMs		☐ Baffinland SW BTE
		☐ Baffinland SW O&G Tot.

Comments: ____

____

____

____

TECHNICIAN (please print): ______________________ SIGNOFF: ______________________

TAIGA ENVIRONMENTAL LABORATORY
LABORATOIRE ENVIRONNEMENTAL TAIGA

4601 – 52 Avenue, P.O. Box 1500, Yellowknife, NT, X1A 2R3
Tel: (867) 669-2788 • Fax: (867) 669-2718
www.taiga.gc.ca

Analytical Request Form

Page _1__ of _1__

REPORT TO :
Company/Client ID :
Address :
Attention :
Phone
Fax :
e-mail :
e-mail Fax Mail

INVOICE TO : SAME Y / N
Company : **(no charge)**
Address : ______________________________
____
Attention : ______________________________
Phone : ______________ Fax : ______________
e-mail : ______________________________
e-mail Fax Mail

INFORMATION TO BE INCLUDED ON REPORT & INVOICE:
Quotation No : ______________________
Client Project No : ______________________
Sampler : ______________________

Relinquished By : ______________________
Signature : ______________________
Date : ______________________

SERVICE REQUESTED:
Regular Service Rush Service
(Surcharge applies to rush service, please check with Laboratory for price and availability)
Note: Analysis may be subcontracted without prior notice.

Sample(s) are from a Drinking Water source servicing multiple households
Yes

	TAIGA Sample ID (Laboratory use only)	Client Sample ID	Location	Collected Date	Collected Time	Sample Type	Analysis Requested						No. of Containers
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													

For water samples, please indicate if sample container was filtered (F) and/or preserved (P).

Date Received : ______________
Time Received : ______________
Received By : ______________

Sample(s) state at receipt: Temperature: _____ °C Frozen
Comments : ______________________________
____

Hazardous material? Y / N
Highly Contaminated? Y / N

CHAIN OF CUSTODY RECORD

ACCUTEST LABORATORIES LTD.

☐ 146 Colonnade Rd., Unit 8
Ottawa, ON K2E 7Y1
Ph: (613) 727-5692 Fax: (613) 727-5222

☐ 608 Norris Court
Kingston, ON K7P 2R9
Ph: (613) 634-9307 Fax: (613) 634-9308

LABORATORY USE ONLY
Report #: ____________

Company Name:	Address:	☐ Fax Results to: ____________
Report Attention:	City/Prov: Postal Code:	☐ E-mail Results to: ____________
Phone: Ext:	Project # * Quotation #	☐ Copy of Results to: ____________
* Waterworks Name:	* Waterworks Number:	*Note that for drinking water samples, all exceedances will be reported where applicable legislation requires.*

Invoice to:
(if different from above)

____

____

SAMPLE ANALYSIS REQUIRED

⇦ Indicate: F=Filtered or P=Preserved

Sample ID	*** Date/Time Collected**	**Sample Matrix** i.e. Water, Soil, Paint	*** Sample Type** (see "Codes" below)	*** MOE Reportable?** Y = Yes N = No	**# of Containers**	**** Service Required** R=Rush S=Standard									**Criteria Required** (i.e. Reg.170, Reg.153, CCME, PWQO etc.)	**Laboratory Identification**

Sample Type Codes for Drinking Water Systems: **RW** = Raw Water, **RWFC** = Raw Water For Consumption, **TW** = Treated Water at point of entry to distribution, **DW** = Distribution/Plumbing Water
"MOE Reportable" refers to the requirements under the SDWA for immediate reporting of results, which are indicators of adverse water quality, to the Owner/Operator, MOE, and MOH Medical Officer.

Sampled By:	Date/Time:	Relinquished By:	Date/Time:	Comments	**Cooler Temp (°C) on Receipt**
Work Authorized By (signature):	Date/Time:	Received By Lab:	Date/Time:		

*** Indicates a required field.** If not complete, analysis will proceed only on verification of missing information. A quotation number is required, if one was provided.
**** There may surcharges applied to "Rush" service.** Please check with lab prior to submission of samples for rush analysis to confirm availability and pricing.

Page _____ of _____ AFCOCR.1 Copies: White – Sampler, Yellow – Laboratory, Pink – With Report

Please print and submit to the laboratory 2 copies of this form with your samples.

APPENDIX C

ANALYTICAL LABORATORY ACCREDITATION

ALS Laboratory Group - 2 pages
Accutest Laboratories - 2 pages
Aquatox Testing & Consulting Inc. - 2 pages

ALS LABORATORY GROUP

1.0 SCOPE

This Quality Manual describes the Quality Management System of the ALS Laboratory Group Environmental Division locations in Canada. Where appropriate, it refers to other documents for additional information. Throughout this manual, whenever ALS is used alone, it refers to the Environmental Division of the ALS Laboratory Group in Canada.

2.0 LOCATIONS, ACCREDITATIONS AND RECOGNITIONS

ALS has laboratories across Canada. Addresses and contact information are available by following the links at our web site: www.alsenviro.com.

Labs within our network are accredited or recognized by the following agencies, as appropriate to their fields of testing and geographical sectors.

- Canadian Association for Environmental Analytical Laboratories (CAEAL) – www.caeal.ca
- Standards Council of Canada (SCC) – www.scc.ca
- American Industrial Hygiene Association (AIHA) – IHLAP - www.aiha.org
- American Industrial Hygiene Association (AIHA) – EMLAP – www.aiha.org
- State of Washington Department of Ecology (WADOE) – www.ecy.wa.gov
- United States National Environmental Laboratory Accreditation Program (NELAP) - www.nj.gov/dep/oqa
- British Columbia Provincial Health Officer – EWQA – www.pathology.ubc.ca
- British Columbia Ministry of Environment – EDQA – www.env.gov.bc.ca
- Ontario Ministry of Environment – www.ene.gov.on.ca
- Health Canada Good Manufacturing Practices (GMP) - Establishment License - www.hc-sc.gc.ca

Copies of current certificates and licenses applicable to these programs are available on www.alsenviro.com. Scopes of accreditation and/or program information are available on the web sites linked above.

3.0 TERMS AND DEFINITIONS

The terms and definitions relevant to the national quality management system are described in a nationally controlled file. For instances where local and national documents describe similar terms and definitions, the local document takes precedence.

Refer to:

- Local Master List: DEFINITIONS OF KEY TERMS

ACCUTEST LABORATORIES

Methods of Quality Control

The objective of the Quality Assurance Program is to ensure that results provided by the laboratory to our clients or regulatory bodies are accurate and precise, as well as consistent over time. Various techniques; statistical, investigative, preventative, administrative, and corrective will be utilized to maximize the reliability of the data.

The analytical services provided by Accutest Laboratories are based on industry recognized methodologies published by the following:

- AWWA, APHA - "Standard Methods for the Examination of Water and Wastewater", 20th Edition, 1998.
- Ontario Ministry of Agriculture, Food, and Rural Affairs
- Ontario Ministry of the Environment
- ASTM - American Society for Testing Materials
- AOAC "Official Methods of Analysis"
- CCME
- USEPA 500, 600, and SW846 Series Methodologies, and
- other recognized regulatory and industry sources

Certification and Accreditation

Accutest maintains a rigorous program of certification and accreditation from several governing sources. In 1989 the laboratory received accreditation from the Ontario Ministry of Agriculture, Food, and Rural Affairs (**OMAFRA**) to provide analysis of farm soil for the agricultural community.

In 1991 the laboratory received certification from the Canadian Association of Environmental Analytical Laboratories (**CAEAL**), Registration Number 2602. The Kingston laboratory's registration number is 2970. In 1995, following an independent laboratory audit by CAEAL, under the direction of the Standards Council of Canada (**SCC**), Accutest achieved full accreditation for specific parameters to **ISO 17025** criteria (Registration Number 164).

For up to date accreditation details, the SCC's web site can be found at: www.scc.ca

CAEAL's web site is: www.caeal.ca

Accutest is a Ministry of Transportation for Ontario (**MTO**) approved laboratory for the analysis of chloride content in concrete.

Interlaboratory Studies

Accutest regularly takes part in interlaboratory studies. As part of the accreditation programs of both CAEAL/SCC and OMAFRA, the performance of Accutest is monitored through the analysis of unknown quality control samples submitted by an external agency.

AQUATOX TESTING & CONSULTING INC.

ACLAE

CAEAL

Canadian Association for Environmental Analytical Laboratories Inc.

Certificate of Accreditation

AquaTox Testing & Consulting Inc.
11B Nicholas Beaver Road, RR#3
Guelph, Ontario

COPY

This laboratory is accredited in accordance with the recognised International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer joint ISO-ILAC-IAF Communiqué dated 18 June 2005).

Accreditation No. *A2803*   Accreditation Date *January 3, 2005*

Issued on *March 14, 2007*   Expiry Date *March 14, 2010*

Chief Executive Officer

ilac-MRA

ACLAE

CAEAL

APPENDIX D

LABORATORY ANALYTICAL METHODS

ALS LABORATORY GROUP

5.4 TEST METHODS AND METHOD VALIDATION

5.4.1 General

All ALS locations use appropriate methods for all tests performed, including those for estimating uncertainty and statistical techniques for analyzing data. Test methods are documented and include all instructions needed to operate equipment and protect the integrity of samples and analytical results. Test method instructions and support information is kept current and accessible where needed.

Deviations from test methods occur only if the deviation has been documented, technically justified, authorized, and accepted by the customer where applicable. Analytical department supervisors and managers have the authority to approve method deviations for the analysis of samples and to impose appropriate quality control into the analysis. If the deviation is judged to alter the outcome of a test, client acceptance of the deviation will be obtained prior to approval. Documentation follows the same requirements as for data quality and method objective -refer to section 4.9

5.4.2 Selection of Methods

Customers rely on ALS to select test methods that are appropriate to meet their needs and are appropriate for the tests performed. ALS uses the latest versions of published standard methods developed by organizations such as American Public Health Association, United States Environmental Protection Agency, NIOSH, Environment Canada, and other international, regional or regulatory organizations or equipment manufacturers whenever possible. When needed, the standard method will be supplemented with additional instructions to ensure consistency of application and performance. Where an appropriate standard method is not available ALS may develop and validate an in-house test method, or adopt a third party validated method. ALS provides method information to clients upon request and on test reports.

For published reference methods, each ALS location confirms it can properly operate the standard method before introducing the test into the laboratory. If the standard method changes in a manner that may affect test results, the confirmation is repeated.

Unique circumstances may occur where a customer specifies the methodology to be used. The customer will be notified if ALS deems the recommended method is inappropriate or out of date.

5.4.3 Laboratory Developed Methods

When in-house development of a test procedure is needed, qualified individuals are assigned to the planning and development stages of the project. The plan is updated as development progresses and all changes are effectively communicated among all involved.

5.4.4 Non-standard Methods

If it is necessary to use methods not covered by standard methods, customer agreement will be obtained and will include clear specification of their requirements and the purpose of the test. The developed method will be appropriately validated before use.

5.4.5 Validation of Methods

Method validations are conducted to confirm that the methods are fit for their intended use. The validations are as extensive as necessary to meet the needs of the given application. The extent depends on the source of the method. For example, standard methods used for their intended application require a less extensive validation than non-standard methods or standard methods used outside of their intended scope.

All results relating to the validation of a given method, including the procedure used for validation and a statement of whether the method is fit for the intended use are retained in method validation records.

As appropriate, the validation studies performed will verify the range and accuracy of the results obtained, including uncertainty, detection limit, selectivity of the method, linearity, repeatability and/or reproducibility, robustness and/or sensitivity to interference. Measurement uncertainty values are reviewed to ensure they are sufficient to meet customers needs.

5.4.6 Estimation of Measurement Uncertainty

ALS has procedures for estimating measurement uncertainty. The procedures are based on accepted practices of identifying components contributing to uncertainty, compiling data that represents or includes these components, evaluating the data using appropriate statistical calculations, and reporting in a manner that prevents misunderstanding of the result. In those cases where the nature of the test precludes calculation of uncertainty, ALS will at minimum identify the components of uncertainty and make a reasonable estimation where needed. This estimation will be based on knowledge of the performance of the method and validation data.

5.4.7 Control of Data

Automated calculations and data transfer systems are checked in a systematic manner when first programmed and re-verified appropriately when changes are made.

When computers and automated equipment are used for the acquisition, processing, recording, reporting, storage or retrieval of test data, ALS ensures:

- in-house developed software is sufficiently documented and validated
- procedures are implemented for protecting data, including integrity and confidentiality of entry, collection, storage transmission and processing – refer to sections 4.13, 5.1 and 5.10
- computers and automated equipment are maintained to ensure proper functioning and adequate environmental conditions – refer to section 5.1

Refer to:

- Local Master List: METHOD VALIDATION
- Local Master List: LIMS CALCULATIONS AND DATA TRANSFERS
- Local Master List: SOFTWARE DEVELOPED IN-HOUSE

ACCUTEST LABORATORIES

Details of Quotation

BOD5

ANALYTE	METHOD REFERENCE	MDL	UNITS
BOD5	BOD5 - AMBODEE1 SM 5210B	1	mg/L

Chlorophyll / Pheophytin

ANALYTE	METHOD REFERENCE	MDL	UNITS
Chlorophyll-a	Chlorophyll C SM10200H	0.2	mg/m3
Pheophytin-a	Chlorophyll C SM10200H	0.2	mg/m3

Knight P - SW (no metals)

ANALYTE	METHOD REFERENCE	MDL	UNITS
pH	pH in water : Auto - AMAPCAE1 C SM4500-H+B	1	
Conductivity	Conductivity : Auto - AMAPCAE1 C SM2510B	5	uS/cm
Alkalinity as CaCO3	Alkalinity : Auto - AMAPCAE1 SM 2320B	5	mg/L
TDS (COND - CALC)	solids in water - AMSOLWE1 C SM2540	5	mg/L
Turbidity	Turbidity - AMTURBE1 C SM2130B	0.1	NTU
Phenols	Phenols 4-AAP - AMPHACE1 C SM5530D	0.001	mg/L
N-NH3	NH3 water low - AMNH3LE1 C SM4500-NH3D	0.02	mg/L
SO4	Anions by IC - DX-100 SM 4110C	1	mg/L
Cl	Anions by IC - DX-100 SM 4110C	1	mg/L
Br	Anions by IC - DX-100 SM 4110C	0.05	mg/L
N-NO2	Low NO2 - SKALAR C SM4500-NO2-B	0.005	mg/L
N-NO3	NO2/NO3 SKALAR - AMNOXSE1 C SM4500-NO3-F	0.1	mg/L
NO2 + NO3 as N	NO2/NO3 SKALAR - AMNOXSE1 C SM4500-NO3-F	0.1	mg/L
TOC	DOC/TOC in water Combustion C SM5310B	0.5	mg/L
DOC	DOC/TOC in water Combustion C SM5310B	0.5	mg/L
Total Suspended Solids	solids in water - AMSOLWE1 C SM2540	2	mg/L
Total P	Low Total P C SM4500-PF	0.003	mg/L
Total Kjeldahl Nitrogen	TKN low water - AMTKNLE1 C SM4500-Norg-C	0.1	mg/L

Reg 170 - Schedule 23

ANALYTE	METHOD REFERENCE	MDL	UNITS
Ba	ICP-MS PE6100 EPA 200.8	0.01	mg/L
B	ICP-MS PE6100 EPA 200.8	0.01	mg/L
Cd	ICP-MS PE6100 EPA 200.8	0.0001	mg/L
Cr	ICP-MS PE6100 EPA 200.8	0.001	mg/L
As	ICP-MS PE6100 EPA 200.8	0.001	mg/L
Se	ICP-MS PE6100 EPA 200.8	0.001	mg/L
Sb	ICP-MS PE6100 EPA 200.8	0.001	mg/L
Hg	Hg in water - AMHGCTE1 M SM3112B-3500B	0.0001	mg/L
U	ICP-MS PE6100 EPA 200.8	0.001	mg/L

SUBDIV. BACTI

ANALYTE	METHOD REFERENCE	MDL	UNITS
Total Coliforms	Bacteria - AMBCOLM1 SM 9222B	0	ct/100mL
Faecal Coliforms	Bacteria - AMBCOLM1 SM 9222B	0	ct/100mL

Faecal Streptococcus	Bacteria - AMBCOLM1 SM 9222B	0	ct/100mL
Escherichia Coli	Bacteria - AMBCOLM1 SM 9222B	0	ct/100mL
Heterotrophic Plate Count	SPC - AMBCOLM1 SM9215D	0	ct/1mL

SUBDIV. SUPPLY NO BACTI

ANALYTE	METHOD REFERENCE	MDL	UNITS
Fe	ICP-MS PE6100 EPA 200.8	0.03	mg/L
Mn	ICP-MS PE6100 EPA 200.8	0.01	mg/L
Hardness as CaCO3	Alkalis by FAA - AMAMFAE1 SM 3111B-3500B	5	mg/L
Alkalinity as CaCO3	Alkalinity : Auto - AMAPCAE1 SM 2320B	5	mg/L
pH	pH in water : Auto - AMAPCAE1 C SM4500-H+B	1	
Conductivity	Conductivity : Auto - AMAPCAE1 C SM2510B	5	uS/cm
F	F Autotitrator C SM4500-FC	0.1	mg/L
Na	ICP metals - AMMICPE8 M SM3120B-3500C	2	mg/L
N-NO3	NO2/NO3 SKALAR - AMNOXSE1 C SM4500-NO3-F	0.1	mg/L
N-NO2	NO2/NO3 SKALAR - AMNOXSE1 C SM4500-NO3-F	0.1	mg/L
N-NH3	NH3 water low - AMNH3LE1 C SM4500-NH3D	0.02	mg/L
SO4	Anions by IC - DX-100 SM 4110C	1	mg/L
Cl	Anions by IC - DX-100 SM 4110C	1	mg/L
Phenols	Phenols 4-AAP - AMPHACE1 C SM5530D	0.001	mg/L
Turbidity	Turbidity - AMTURBE1 C SM2130B	0.1	NTU
Colour	Colour - AMCOLSE1 C SM2120C	2	TCU
Ca	ICP metals - AMMICPE8 M SM3120B-3500C	1	mg/L
Mg	ICP metals - AMMICPE8 M SM3120B-3500C	1	mg/L
Tannin & Lignin	Tannin & Lignin - AMTNLNE1 C SM5550B	0.1	mg/L
Total Kjeldahl Nitrogen	TKN low water - AMTKNLE1 C SM4500-Norg-C	0.1	mg/L
K	ICP metals - AMMICPE8 M SM3120B-3500C	1	mg/L
DOC	DOC/TOC in water Combustion C SM5310B	0.5	mg/L
H2S	H2S water - AMH2SCE1 C SM4500-S2-D	0.01	mg/L
Ion Balance	Ion Balance C Ion Balance	0.01	
TDS (COND - CALC)	solids in water - AMSOLWE1 C SM2540	5	mg/L

TSS

ANALYTE	METHOD REFERENCE	MDL	UNITS
Total Suspended Solids	solids in water - AMSOLWE1 C SM2540	2	mg/L

AQUATOX TESTING & CONSULTING INC.

AquaTox Testing & Consulting Inc.
11B Nicholas Beaver Rd.
RR 3
Guelph ON N1H 6H9
Tel: (519) 763-4412 Fax: (519) 763-4419

To:	Cheryl Wray	From:		Lesley Novak, M.Sc.
Company:	Baffinland Iron Ore		☐	For Your Information
Date:	October 15, 2007		☐	For Your Approval
File:	162704515		☐	For Your Review
			x	As Requested

Reference: Toxicity Testing Services

I am pleased to provide you with a quotation for toxicity testing services for wastewater effluent monitoring (Table 1).

AquaTox's laboratory is accredited for all of the tests listed in Table 1. A copy of our SCC/CAEAL Certificate of Accreditation along with our scope of testing (which lists all of the specific tests that we are currently accredited for) can be provided at your request.

We appreciate your past support and look forward to a continued association. Please call me if you have any questions or require additional information.

AquaTox Testing & Consulting Inc.

Lesley Novak

Lesley Novak, M.Sc.
Vice President, Senior Aquatic Toxicologist
Tel: 519-763-4412
Fax: 519-763-4419
lnovak@aquatox.ca

AquaTox Testing & Consulting Inc.
11B Nicholas Beaver Rd.
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Guelph ON N1H 6H9
Tel: (519) 763-4412 Fax: (519) 763-4419

QUOTATION NO.: 162704515

CLIENT: Cheryl Wray
Baffinland Iron Ore
cheryl.wray@baffinland.com

PERIOD: October 15th to December 31st, 2008

DESCRIPTION: Toxicity Testing Services

Table 1. Summary of toxicity testing costs.

Test	Method	Unit Cost
48-h single concentration test using *Daphnia magna*	EPS 1/RM/14	$165
96-h single concentration test using rainbow trout	EPS 1/RM/13	$220
48-h multiple concentration (LC50) test using *Daphnia magna*	EPS 1/RM/14	$260
96-h multiple concentration (LC50) test using rainbow trout	EPS 1/RM/13	$385

TERMS AND CONDITIONS:

- Costs do not include collection or transportation of samples to our laboratory.
- Costs are based on turnaround of 15 business days from completion of test.
- Cost excludes applicable taxes (e.g., G.S.T., P.S.T.).
- Toxicity testing services to be provided on an as needed basis.
- AquaTox will provide all sampling materials including pails, lids, liners, coolers, sample bottles, self-adhesive return labels and chain-of-custody forms for all samples (at no additional cost).
- Limitation of Liability: The CLIENT (Baffinland Iron Ore) releases AquaTox Testing & Consulting Inc. (AquaTox) from any liability and agrees to defend, indemnify and hold AquaTox harmless from any and all claims, damages, losses, and/or expenses, direct and indirect, or consequential damages, including but not limited to lawyer's fees and charges and court and arbitration costs, arising out of, or claimed to arise out of, the performance of the services, excepting liability arising from the sole negligence of AquaTox. It is further agreed that the total amount of all claims the CLIENT may have against Aquatox under these Terms and Conditions, including but not limited to claims for negligence, negligent misrepresentation and breach of contract, shall be strictly limited to the lesser of professional fees paid to AquaTox for the services or five hundred thousand dollars ($500,000). No claim may be brought against AquaTox more than two (2) years after the cause of action arose. As the CLIENT's sole and exclusive remedy under these Terms and Conditions any claim, demand or suit shall be directed and/or asserted only against AquaTox and not against any of AquaTox's employees, officers or directors.
- Submission of samples assumes acceptance of these Terms and Conditions

APPENDIX E

ANALYTICAL LABORATORY QA/QC PROCEDURES

ALS Laboratory Group - 4 pages
Accutest Laboratories - 2 pages
Aquatox Testing & Consulting Inc. - 3 pages

ALS LABORATORY GROUP

Refer to:
- Local Master List (where applicable): FIELD SAMPLING
- Local Master List (where applicable): SUB-SAMPLING

5.8 HANDLING OF SAMPLES

ALS procedures for sample handling include transportation conditions, receipt, handling, protection, storage, retention, and disposal. The procedures are designed to protect the integrity of the test samples and the interests of the customer and ALS.

ALS requests that our customers use our Chain of Custody (COC) for every shipment of samples. The form includes sufficient space to record field sampling date, time and location of sampling, sample ID and information relating to the integrity of the field sample. COCs are shipped with field supplies, and are also available on the alsenviro.com web site.

Samples are given a unique identification upon receipt. The identification is retained by the sample throughout its life in the laboratory, and ensures samples are not confused either physically or in records or reports. Where appropriate, the system allows for subdivision of test items and transfer within and from the laboratory.

Abnormalities or other departures from specified sampling or transportation procedures are documented. Where there is doubt concerning the integrity of the sample, its identification or suitability for testing, or the requested tests, the customer is consulted for further instructions before proceeding, and the discussion is documented.

All ALS locations have appropriate facilities to securely maintain sample integrity, both before testing and where archiving for future testing is required. Sample storage and handling criteria are recorded in individual test methods. Traceability and monitoring of critical temperatures is maintained and discussed in section 5.6.

Refer to:
- Local Master List: SAMPLE RECEIPT AND LOGIN
- Local Master List: SAMPLE STORAGE

5.9 ASSURING THE QUALITY OF TEST RESULTS

ALS has established quality control (QC) procedures for monitoring the validity of tests performed by its laboratories. Individual test methods specify the in-batch quality control requirements, frequency of use and data quality objectives. Where appropriate, in-batch QC is recorded on control charts to detect trends, statistical techniques are used to monitor method performance, and planned action is taken to correct problems and prevent incorrect results from being reported. In-batch QC tools include reference samples, control samples and standards, verification standards, blanks, duplicates, surrogates and spikes as appropriate to the field of testing.

ALS laboratories participate in an extensive proficiency testing program where available. Where appropriate proficiency testing samples are not available, other monitoring tools are used.

Samples may be maintained for retesting where the integrity of the test result will not be compromised by the additional storage time.

All test data is reviewed and approved prior to release to the customer. The data review process includes manual transcription review, data-set review, inter-parameter relationship evaluation where appropriate to the tests performed, and report review. Manual transcriptions are reviewed for transcription errors. Data set review is conducted by authorized individuals and includes confirmation that quality control criteria are met and that anomalous data are qualified. Report review confirms that requested tests have been carried out and that all report information and formatting is correct for the specific customer.

Refer to:

- Local Master List: DATA QUALITY AND METHOD OBJECTIVES
- Local Master List: RECHECKS
- Local Master List: CONTROL CHARTS
- Local Master List: RELATIONAL CHECKS
- Local Master List: PROFICIENCY TESTING PROGRAMS
- Local Master List: DATA VALIDATION AND AUTHORIZATION

5.10 REPORTING RESULTS

All information listed below is either included in the final report or kept on file at ALS in the case of abbreviated or customized reports, and can be provided upon request.

- Title
- Name and address of the laboratory issuing the report
- Location where each test was conducted
- Unique identification of the test report on each page, and the total number of pages
- Customer name and address
- Identification of test method(s) used
- Unique identification of each sample, description of the sample such as matrix and customer identification, and condition where applicable
- Date of sample receipt
- Date of analysis
- Test results and units
- Report Qualifiers
- Name, function, and signature of the person authorizing the report
- Statement that the results relate only to the samples identified in the report

Other information necessary for the interpretation of results or requested by the customer may also be included in reports, such as test method deviations or exclusions, specific test conditions, uncertainty estimations, date of sampling, location of sampling and other sampling information.

Statements of compliance, opinions and interpretations may be included on test reports for specific analyses. In all such cases, the basis on which they have been made will be documented, and they will be clearly identified in the test report.

ALS obtains subcontract laboratory results in hard or electronic reports. When these results are presented to the customer in ALS reports, the identification of the subcontractor is clearly indicated on the final report.

When test reports are transmitted by telephone, facsimile, e-mail or other electronic means, the procedure for protecting the integrity and confidentiality of data includes:

- only providing results to those individuals specified by the client for each sample submission
- use of a standardized facsimile cover page that relates the procedures to follow if received in error
- use of an e-mail footer that relates the procedures to follow if received in error

It is ALS practice to never disclose information about a client's analysis to a third party without the prior consent of the client, or unless compelled to by law. If we are obligated by law to disclose such information, we will inform the client prior to doing so.

Final results are reported in a manner that minimizes the possibility of misunderstanding or misuse.

Test report amendment(s) are made by issuing a replacement report identifying that a revision was made and describing all changes in the cover page comment section.

Refer to:

- Local Master List: REPORTING TEST RESULTS

6.0 REFERENCES

ISO/IEC 17025:2005(E) General Requirements for the competence of testing and calibration laboratories, Second Edition, 2005-05-15. L:\Quality System Documents\External Documents\17025 (E) 2005.pdf

Program, policy and guidance documents of the following accreditation bodies:

- Canadian Association for Environmental Analytical Laboratories (CAEAL), located at: www.caeal.ca
- Standards Council of Canada (SCC), located at: www.scc.ca
- American Industrial Hygiene Association (AIHA), located at: www.aiha.org
- National Environmental Laboratory Accreditation Conference (NELAC), located at: www.epa.gov/nelac

ACCUTEST LABORATORIES

In-house QA/QC

Utmost care is taken to provide our clients with analytical data of the highest quality. Accutest maintains several layers of data approval where, at any point in the analytical process, the reviewer has the authority to reject a data set based upon rigid QA/QC protocol. In addition, the following steps are taken during routine analyses, though not limited to:

- reagent blanks/standard reference materials are analyzed within each sample batch
- where appropriate, internal standards and/or spikes are analyzed within each sample batch to verify instrument calibration
- all reagents are prepared from ACS or better grade chemicals
- a minimum of 10% of all samples are analyzed in duplicate
- samples are retained for 2 months after receipt
- all standard, blank, and spike values are catalogued for reference
- travel blanks, field blanks, equipment blanks, and travel spikes are provided on request

Instrumentation

Accutest operates and maintains the following analytical instruments in a high degree of repair and routine calibration for the tests performed:

- Varian Star 3900 Gas Chromatograph, 70-Port Autosampler, Varian 2200 Mass Spectrometer (GC/MS);
- Varian CP-3800 Gas Chromatograph, SOLATek 72-Port Autosampler, Varian 2200 Mass Spectrometer (GC/MS) in parallel with a Flame Ionization Detector (FID);
- Varian CP-3800 Gas Chromatograph, SOLATek 72-Port Autosampler, Varian 2100T Mass Spectrometer (GC/MS) in parallel with a Flame Ionization Detector (FID);
- Agilent 6890N Gas Chromatograph, 7683 Autosampler, 5973 Mass Selective Detector (GC/MS);
- Varian CP-3800 Gas Chromatograph, autosampler with direct injection, Varian 2000 Mass Spectrometer (GC/MS);
- Agilent 6890N Gas Chromatograph, autosampler with dual direct injection, dual FIDs;
- Varian CP-3800 Gas Chromatograph, autosampler with dual FIDs;
- Varian CP-3800 Gas Chromatograph, autosampler direct injection, dual analytical column, dual Electron Capture Detection (GC/ECD);
- Agilent 6890N Gas Chromatograph, autosampler direct injection, dual analytical column, dual Electron Capture Detection (GC/ECD);
- Varian ProStar HPLC with PDA and Fluoresence Detection, 84-Port Autosampler;
- Varian Vista AX ICP/AES;
- Perkin-Elmer Elan 6100 ICP/MS;
- Perkin-Elmer Elan 9000 ICP/MS;
- Atomic Absorption Spectrometers, Hydride Generator, Mercury Analyzer;
- Dionex Ion Chromatographs, Spectrophotometers, TOC Analyzers;
- Automated 56-Port PC-Titrate pH, Alkalinity, Conductivity analyzer; and
- pH and Specific Ion Meters, Turbidity Meter, COD Digestor, Incubators, Digestors, Filtration Apparatus, and Microscopes.

AQUATOX TESTING & CONSULTING INC.

AQUATOX QA/QC PRACTICES RELATED TO TOXICITY TESTING

It is the policy of AquaTox to provide the highest standards of testing service to its clients by conducting tests in accordance with the required methods and client requirements. AquaTox is committed to good professional practice, quality service and compliance with CAN-P-4D.

AquaTox requires that all personnel concerned with testing activities within the laboratory familiarize themselves with the quality documentation and implement the policy and procedures in their work.

The overall QA objective is to develop and implement procedures for chain-of-custody, laboratory analysis and reporting that will provide accurate data. The purpose of the QA/QC program is to define goals for the level of QA effort; accuracy, precision, and sensitivity of analyses; and completeness, representativeness, and comparability of measurement data from the toxicity testing laboratory.

Quality Assurance (QA) and Quality Control (QC) practices for effluent toxicity tests include aspects of the test that affect the accuracy and precision of the data, including (1) sampling handling and storage, (2) laboratory conditions, (3) test organisms, (4) reference toxicants, and (5) record keeping and data evaluation. Below is a summary of our quality objectives and standard QA/QC practices related to the conduct of our ecotoxicity tests.

Quality Objectives

- To ensure a Quality System that is documented and incorporates adequate review and internal quality control.
- To ensure personnel are adequately supervised and are proficient to carry out assigned activities.
- To ensure test methods and related procedures are validated and incorporate adequate quality control.
- To ensure all equipment, supplies and services are functioning properly and/or meet required specifications.
- To ensure that facilities are adequate to carry out the testing activity.
- To ensure sample management procedures that incorporate adequate procedures for the security, receipt, identification, checking, routing, storage and disposal of all samples.
- To ensure data management procedures that incorporate adequate procedures for the security, recording, calculation, validation, authorization, transmittal, storage and disposal of all test data and related records.
- To ensure workload management procedures that incorporate acceptable turnaround time and verification of resource availability prior to the acceptance of additional testing.

QA/QC Data Related to Individual Toxicity Tests

Test Validity Criteria:

- A test will be considered valid if the test validity criteria stated in the test method are met. Otherwise the test should be repeated.

Reference Toxicant Testing:

- A reference toxicant test will be conducted on the same batch of organisms used for conducting the definitive test.
- Each reference toxicant test will be conducted following the same procedures and conditions used for the test substance(s) although may involve a reduced duration of exposure.

Use of Warning Chart:

- A warning chart will be made available when testing involves test organisms are cultured or tested by AquaTox on a regular basis.

A test result is suspect if it falls outside the warning limits. In this event, a thorough check of the testing conditions is conducted at this time.