APPENDIX E.8

DECOMMISIONING REPORTS

APPENDIX E.8.1

MINE SITE

Baffinland

Technical Memorandum

To: Jim Millard

From: William Bowden

cc:

Date: March 17, 2015

Re: Mine Site - □L □uonset Decommissioning □Remediation and Close-out

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1.0 Introduction

The large □L □uonset (the □uonset) located at the Mary River Exploration Camp was commissioned in 2007 (Figure 1). Prior to its commissioning, geosynthetic liner was installed below the footprint of the □uonset to contain any contaminants spilled inside the □uonset during its lifetime. Once installed the liner was backfilled with sand followed by gravel, forming the floor of the □uonset.

Although it has been used for various purposes, the □uonset was mainly used to store generators, pumps, tools, vehicles and the small heavy machinery.

2.0 Guidance

Tier 1 criteria for the remediation of petroleum hydrocarbon (PHC) contaminated coarse-grained soil for commercial and industrial land use (Tier 1 Guidelines), outlined in the Government of Nunavut□s *Environmental Guideline for Contaminated Site Remediation* (GN, 2009), was used to determine the remediation objectives for the soil underneath the □uonset at the Mary River Exploration Camp (refer to Table 1 of Attachment B). The Tier 1 Guidelines outlined by Government of Nunavut are equivalent to the Tier 1 Guidelines outlined in the *Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil* (CCME, 2008) published by the Canadian Council of Ministers of the Environment (CCME).

3.0 Field Program

In mid-August, 2014 the □uonset was relocated to the new aerodrome apron on the East side of the airstrip. Using an excavator, the liner and the soil on top of the liner were removed and deposited at the Milne Port landfarm for petroleum hydrocarbon remediation. The final dimensions of the □uonset□s excavated footprint was approximately 15 m x 5 m x 0.5 m. To confirm the absence of PHC contamination underneath the liner, a total of six(6) soil samples were taken at the corners and center of the □uonset footprint (see Figure 2) on September 4, 2014.

4.0 Sample Methodology

Soil samples were collected in 250 mL glass jars using a spade and nitrile gloves. The soil samples were taken at depth of 0.5 m. A total of 500 mL of soil was collected at each sample location. To avoid cross contamination, the spade was rinsed with potable water between samples and a new pair of nitrile gloves was worn for each soil sample that was collected.

Soil samples were analyzed for lead (Pb), PHC fractions and volatile organic compounds (i.e. benzene, toluene, etc.) associated with PHCs. Sample analysis was conducted by a CALA accredited lab in Nepean, ON operated by Exova Canada Corp.

5.0 Closure

Based on the methodologies used, the soils underlying the uonset footprint are confirmed to have met referenced Tier 1 CCME criteria for PHCs under industrial land use. The work was completed under the supervision and guidance of a Professional Geologist registered in Nunavut using industry accepted methodologies.

Prepared by:	Reviewed by:
William Bowden Environmental Coordinator	James Millard, M.Sc., P.Geo. Environmental Manager

6.0 References

GN (Government of Nunavut), 2009. Environmental Guideline for Contaminated Site Remediation. Prepared by the Department of Environment of the Government of Nunavut, March 2009.

CCME (Canadian Council of Ministers of the Environment), 2008. Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil. Prepared by the CCME, January 2008.

Attachment A – Figures

Figure 1 - □L □uonset location at the Mary River Exploration Camp.

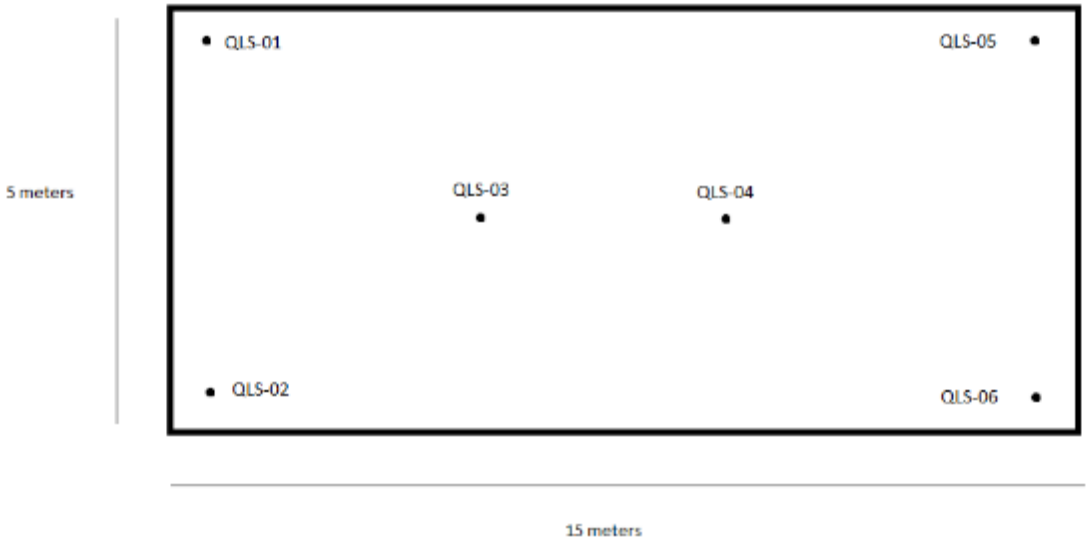

Figure 2 - □uonset footprint soil sample locations.

Attachment B – Tables

Table 1 - Tier 1 Remediation Criteria (mg/kg) for Petroleum Hydrocarbons in Surface Soil

Land Use	Soil Texture	Fraction 1 (C6-C10)	Fraction 2 (>C10-C16)	Fraction 3 (>C16-C34)	Fraction 4 (>C34)
Agricultural/Wildland	Fine-grained soil	210 (170[a])	150	1300	5600
	Coarse-grained soil	30[b]	150	300	2800
Residential/Parkland	Fine-grained soil	210 (170[a])	150	1300	5600
	Coarse-grained soil	30[b]	150	300	2800
Commercial	Fine-grained soil	320 (170[a])	260 (230[a])	2500	6600
	Coarse-grained soil	320 (240[a])	260	1700	3300
Industrial	Fine-grained soil	320 (170[a])	260 (230[a])	2500	6600
	Coarse-grained soil	320 (240[a])	260	1700	3300

a - Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body or for protection of notable groundwater

b - Assumes contamination near residence

Table 2 - Mary River QL Quonset Footprint - Soil Sampling Results

SAMPLE ID	F1 (C6-C10)	F2(C10-C16)	F3 (C16-C34)	F4 (C35+)	Benzene	Ethylbenzene	Toluene	Xylene	Lead
CCME Tier 1 Industrial coarse-grain[1]	**320 (ug/g)***	**260**	**1700**	**3300**	**0.0068****	**0.018****	**0.08****	**2.4**	**600**
QLS-01	<10	20	<20	<20	<0.02	<0.05	<0.20	<0.05	5
QLS-02	<10	<10	<20	<20	<0.02	<0.05	<0.20	<0.05	4
QLS-03	20	260	430	<20	<0.02	<0.05	<0.20	<0.05	7
QLS-04	<10	50	50	<20	<0.02	<0.05	<0.20	<0.05	5
QLS-05	<10	<10	40	<20	<0.02	<0.05	<0.20	<0.05	4
QLS-06	<10	20	<20	<20	<0.02	<0.05	<0.20	<0.05	6

[1]Government of Nunavut, 2009. Environmental Guideline for Contaminated Site Remediation. Prepared by the Department of Environment of the Government of Nunavut, March 2009.

* all results in ug/g
** guidelines less than detection limit

APPENDIX E.8.2

MILNE PORT

Technical Memorandum

To: Jim Millard

From: Lea Willemse

Cc:

Date March 16, 2015

Re: Milne Port Fuel Bladder Facility and Hazardous Waste Storage Areas Decommissioning

Introduction

This technical memorandum describes the activities completed as part of the 2014 Milne Port - Fuel Bladder Facility Decommissioning Program for the decommissioning and close-out of the north portion of the fuel bladder storage facility. This was the remaining one third of the entire fuel bladder facility that was not decommissioned as part of the 2013 Program. The decommissioning activities completed as part of this program followed those completed in August 2013, which focussed on the southern portion of the fuel bladder facility. The results of that work were provided previously in the 2013 IA and NWB Annual Report.[1] The technical memorandum, herein, is to be read in conjunction with the 2013 decommissioning report, which is reproduced in Attachment A to this memorandum.

In addition to the fuel bladder facility, the 2014 decommissioning activities also included the decommissioning of two hazardous waste storage berms located at Milne Port. The results of that work are also included in this document.

Background

The decommissioning of the Milne Port fuel bladder storage facility commenced in August 2013, and was conducted in four key steps:

1. Removal and disposal of fuel bladders, piping and refueling infrastructure;
2. Removal of the HDPE geosynthetic liner and the excavation/relocation of contaminated soil within the lined containment berm and refueling station (south bladder);
3. Further assessment and excavation of the soil underneath the facility where there was indication of petroleum hydrocarbon (PHC) contamination exceeding referenced criteria (see below). The walls and floor of the excavated areas were sampled to confirm the requirement for additional excavation; and

[1] *Technical Memorandum - Re: Milne Port - Interim Fuel Bladder Facility Decommissioning* (March 22, 2014), presented in the 2013 IA and NWB Annual Report.

4. The stockpiling of contaminated soils (approximately 8,800 m^3) and discarded liner on the existing engineered HDPE liner located at the north end of the facility. A containment berm wall stretching east to west was constructed to separate and structurally contain the decommissioned south fuel bladder facility from the cell to the north. An HDPE cover was subsequently welded in place to fully contain the stockpiled contaminated soils and to shield the material from meteoric water contact.

As part of the 2013 Decommissioning Program, contaminated oily stormwater in the facility was treated or removed and shipped off site. A small volume of water remained (approximately 100,000 L) following the removal of the fuel bladder infrastructure and was temporarily stored within the containment area constructed at the north end of the facility, described in item 4, above.

For additional information on the above, refer to Attachment A.

Sampling Methodology

At test pit locations (north portion of fuel bladder facility), soil was collected at several depths from each wall to provide a representative depth composited soil sample. Similarly, soil samples were taken from the excavation walls and floor of each contaminated area following remediation efforts. All soil samples were collected in 250 mL glass jars using a spade and nitrile gloves. To avoid cross contamination, the spade was rinsed with potable water between samples and a new pair of nitrile gloves were worn for each soil sample that was collected.

Soil sample analyses were conducted by a CALA accredited lab in Nepean, ON operated by Exova Canada Corp. (Exova lab).

Guidance

Tier 1 Remediation Criteria for the remediation of petroleum hydrocarbon contaminated coarse-grained soil for commercial and industrial land use (Tier 1 Criteria), outlined in the Government of Nunavut's *Environmental Guideline for Contaminated Site Remediation* (GN, 2009), was used to determine the remediation objectives for the soil underneath the fuel bladder facility at Milne Port (refer to Table 1 of Attachment B).

2014 Decommissioning Program

2014 decommissioning activities commenced in August at the following four locations (refer to Figure E.8-1 of Attachment C):

1. South Fuel Bladder Storage Facility;
2. North Fuel Bladder Storage Facility;
3. Hazardous Waste Berm 2 (HWB2) located at south west corner of Milne Port site; and
4. Hazardous Waste Berm 3 (HWB3) located northwest of the north fuel bladder facility.

The footprints on which the Milne Port - Fuel Bladder Storage Facility (both north and south berm areas) and hazardous waste storage berms were located were required to be cleared and levelled to allow for the final grading of the Approved Early Revenue Phase Ore Stockpile Pad and Conveyor Berm construction commencing in September 2014. A description of the 2014 decommissioning activities by area is provided in the following sections, below.

South Fuel Bladder Facility

Prior to clearing and final grading of the South Fuel Bladder Farm footprint, confirmatory sampling of specific areas was conducted based on 2013 sample results that indicated that there were several potential "hot spots" remaining. In addition, the entire external berm for the south area was re-sampled as part of the confirmation program.

Specifically, the following activities were completed at the South Fuel Bladder Facility:

1. Soil sampling to identify areas of residual PHC contamination and confirm 2013 sampling results;
2. Delineation and excavation of contaminated soils identified by the results of the re-sampling, followed by soil disposal at the newly constructed Milne Port Landfarm Facility[2]; and
3. Confirmatory sampling to ascertain successful remediation (PHC levels below guideline criteria) following the delineation and excavation of identified areas.

The analytical results obtained from the confirmation sampling program (refer to Table 2 Attachment B) confirmed the areas of contamination identified during the 2013 decommissioning work. These areas were identified along the berm wall at the former refueling location (west side) and former Jet-A offloading area (east side). As acknowledged in the 2013 Technical Memorandum (Attachment A) there were identified areas that required additional excavation and removal of soil to the depth of permafrost to complete decommissioning activities. After excavation of the contaminated soil, confirmation resampling was completed on September 24th and 27th. A review of analytical results (refer to Table 3 and Table 4 of Attachment B) indicated that PHC concentrations were below Tier 1 Criteria and the South Fuel Bladder Facility and the underlying area was cleared for construction.

Figure E.8-2 of Attachment C provides confirmatory sampling locations, identified hot spots, excavation limits for contaminated areas and resample locations.

North Fuel Bladder Facility

To decommission the remaining north portion of the Milne Port Fuel Bladder Facility, the following tasks were undertaken:

1. Removal of the stockpiled contaminated soils and discarded liner *within* the lined encapsulated area placed during the 2013 South Fuel Bladder Decommissioning Program in the northern third of the bladder containment area, and transfer of these materials to the Milne Port Landfarm Facility;
2. Removal of the 100,000 L bladder of PCH contaminated water from the 2013 decommissioning of the South Fuel Bladder Storage Facility was also located within the lined encapsulated area to a secure lined area for storage and future treatment/disposal;

[2] The Milne Port Landfarm Facility was constructed in August 2014 and is comprised of a 136 m x 63 m containment berm in addition to a 47 m x 43 m contaminated snow containment berm.

3. Further assessment of soils and excavation, as required, beneath the facility, where there was indication of PHC contamination exceeding referenced Tier 1 PHC criteria;
4. Excavation of soil with obvious contamination (visual staining, olfactory assessment), followed by soil disposal at Milne Port Landfarm Facility;
5. Sampling to determine extent of PHC contaminated areas, following the initial delineation and excavation of obvious visual/olfactory contamination;
6. Delineation and excavation of contaminated soils identified by analysis, followed by transport and disposal at the Milne Port Landfarm Facility; and
7. Confirmatory sampling to ascertain there was no further excavation of soils was required in delineated areas.

Commencing in late August 2014, the HDPE cover was removed with an excavator and transported to the Milne Port Landfarm Facility. The exposed contaminated soils (approximately 8,800 m3) and geosynthetic liner, in addition to the bottom underlying HDPE liner were also removed with an excavator and transported to the Landfarm Facility where the liner will be stored until the 2015 backhaul. The contaminated soil in the Landfarm Facility will undergo biotreatment until it meets applicable criteria and the soils are suitable for reuse on site.

The methodology used for the 2013 Decommissioning Program was based on the concept that if hydrocarbons had leaked through the underlying HDPE liner during the lifespan of the fuel bladder facility, the hydrocarbons would have likely migrated to, and settled at, the soil-permafrost interface. Although not visually observed during decommissioning activities, potential contamination could have resulted from minor tears and defects in the HDPE liner system. Therefore, to determine the depth and extent of potential fuel contamination underneath the fuel bladder facility at Milne Port, the exposed soil (classified mainly as medium grained sands with some gravel and little silt) was partitioned into 15 m x 15 m (225 m^2) grid sections. Within each grid section, a single test pit was advanced by a mechanical excavator and assessed for PHC. Test pits were excavated to the depth of the permafrost (less than one metre depth) and sampled at several depths within the test pit to create a composite soil sample representative of each section. A total of 12 test pits were excavated and sampled. The analytical results from test pit soil samples identified contaminated areas that exceeded the PHC Fraction 2 (F2) Tier 1 Criteria at sample locations: MP-BF-G1, MP-BF-G2, MP-BF-H3 and MP-BF-I2 (refer to Table 5 of Attachment B). Two areas were staked for excavation. Excavation delineations encompassed the test pit locations where there were exceedances for Tier 1 Criteria. Material excavated from the contaminated areas was transported to the Milne Port Landfarm Facility for containment and biotreatment. To confirm successful removal of the contaminated soils, composite soil samples along the walls and floor of each excavation were collected.

Confirmation soil resamples from the excavated areas identified one area (MP-RBF-06) with PHC concentrations present at a level exceeding the PHC F2 Tier 1 Criteria for F2 (refer to Table 6 of Attachment B). The confirmation samples collected adjacent and around MP-RBF-06 displayed results below referenced criteria, therefore, the elevated PHC result was determined to be localized in nature. Additional excavation was completed in this area to remove the remaining PHC-impacted soils.

Figure E.8-3 of Attachment C provides test pit sampling locations, excavation limits for contaminated areas and soil resample locations.

South and Northwest Hazardous Waste Berms

There was a requirement to decommission the hazardous waste berm located southwest of the Milne Port facility footprint to allow for the construction of the south end of the ore conveyor berm (refer to Figure E.8-1 of Attachment C). Decommissioning activities commenced in late August and began with the removal and transport of the contaminated soil placed within the berm to the Milne Port Landfarm Facility for containment and biotreatment. The uncovered geosynthetic liner was also transported to the Landfarm Facility for temporary disposal until off-site transport during the 2015 backhaul.

The exposed soils beneath the HDPE liner were assessed for PCH contamination by visual and olfactory inspection. While removing the liner, tears were observed and their locations were noted. PHC contamination of underlying soil was identified at tear location and immediate excavation and transport of approximately 175 m^3 of contaminated soil to the Milne Inlet Landfarm were completed.

Once the contaminated soil was removed and PHC presence could no longer be detected by visual and olfactory assessment, soil sampling of the area was completed. The area was partitioned into 3.7 m x 3.7 m (12□x 12□) grid sections (15 samples in total). Soil samples were collected on September 29, 2014, and sent off-site for PHC analysis. Test pits (30 cm x 30 cm) were advanced by manual excavation utilizing a spade. Refer to Figure E.8-4, Attachment C, for berm perimeter and sampling locations.

Laboratory analyses of soils determined the PHCs did not exceed Tier 1 Criteria (refer to Table 7 of Attachment B) and the area was subsequently levelled and graded in preparation for the construction of the conveyor berm.

The hazardous waste berm located northwest of the Milne Port ore conveyor berm was also required to be decommissioned to allow for the construction west ore stockpile footprint (refer to Figure E.8-1 of Attachment C). Decommissioning of the lined containment area commenced in late August and included the transport of contaminated soil placed within the berm to the Landfarm Facility. The uncovered geosynthetic liner was examined for visual tears and also transported to the Landfarm Facility for temporary placement until off-site transport during the 2015 backhaul.

The exposed soils beneath the geosynthetic liner were assessed for PCH contamination by visual and olfactory inspection. Since tears were not observed in tears and PHC contamination was not detected in the underlying soil, and the area was cleared for construction.

Closure

Based on the methodologies used, the soils underlying the Milne Port Bladder Farm Facility, the Northwest Hazardous Waste Storage Area, and the South Hazardous Storage Area, are confirmed to have met referenced Tier 1 Criteria. The work was completed under the supervision and guidance of a Professional Geologist registered in Nunavut using industry accepted methodologies.

Prepared by:	Reviewed by:
Lea Willemse Environmental Coordinator	James Millard, M.Sc., P.Geo. Environmental Manager

References

Government of Nunavut, 2009. Environmental Guideline for Contaminated Site Remediation. Prepared by the Department of Environment of the Government of Nunavut, March 2009.

ATTACHMENTS

ATTACHMENT A Technical Memorandum - Re: Milne Port - Interim Fuel Bladder Facility Decommissioning (March 22, 2014)

ATTACHMENT B Tables

ATTACHMENT C Figures

ATTACHMENT A

Technical Memorandum - Re: Milne Port - Interim Fuel Bladder Facility Decommissioning (March 22, 2014)

Baffinland

Technical Memorandum

To: Jim Millard

From: Andrew Vermeer

cc:

Date: March 22, 2014

Re: Milne Port - Interim Fuel Bladder Facility Decommissioning

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1.0 - Introduction

The bulk fuel bladder facility (fuel bladder facility) at Milne Port was constructed in late 2007 to store a combined 8.25 million litres of Jet-A and P-50 (diesel) for future Baffinland mineral exploration activities. The facility consisted of 74 114,000 L fuel bladders in a lined containment facility, including a lined refueling station.

In July, 2011 a new 5 million litre capacity bulk fuel tank facility (bulk fuel tank facility) at Milne Port was constructed, consisting of a single 5 million litre steel tank and a refueling station in a lined containment facility. In May of 2013, the capacity of the bulk fuel tank facility was expanded to 34 million litres of P-50 diesel and 2.25 million litres of Jet-A to support the Project development as outlined in the approved NIRB Project Certificate No. 005.

With the interim expansion[1] of the bulk fuel tank facility at Milne Port complete in September 2013, the fuel bladder facility at Milne Port was no longer needed and therefore was decommissioned starting in late August, 2013.[2] Decommissioning of the fuel bladder facility involved following the objectives outlined in Baffinland's approved Abandonment and Reclamation Plan. Tier 1 criteria for the remediation of petroleum hydrocarbon contaminated fine-grained soil for commercial and industrial land use (Tier 1 guidelines), outlined in the Government of Nunavut's *Environmental Guideline for Contaminated Site Remediation* (GN, 2009), was used to determine the remediation objectives for the soil underneath the fuel bladder facility at Milne Port.

2.0 - Scope of Work

The decommissioning of the fuel bladder facility at Milne Port involved four (4) phases:

1) Removal and disposal of the fuel bladders, piping and refueling infrastructure.
2) Removal of the geosynthetic liner and the excavation of contaminated soil within the lined containment berm and refueling station.

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[1] The capacity of bulk fuel tank facility at Milne Port will be expanded again during the summer of 2014 by constructing one additional 12 million litre tank for P-50 diesel fuel storage.

[2] The fuel bladder facility at Milne Port was slowly decommissioned over its lifespan by limiting the amount of bladders that were used to store fuel. During each open water season, an oily water separator was used to treat the contaminated water from the spring melt that had become entrained in the berm. Oily water emulsions that were difficult to treat and excess oily water were stored in unused fuel bladders until August, 2013 when all oily water, with the exception of one bladder, was backhauled on the 2013 sealift.

3) Further assessment and excavation of the soil underneath the facility where there was indication of petroleum hydrocarbon contamination exceeding referenced Tier 1 petroleum hydrocarbon criteria. The walls and floor of the excavated areas were sampled to confirm whether additional excavation would be required in the future.
4) The stockpiling of contaminated soils and discarded liner within a lined area located at the north end of the facility which was covered with geosynthetic liner to minimize meteoric water infiltration and contaminated runoff.

3.0 Field Program

Starting in late August, 2013, 73 fuel bladders and all unsalvageable flexible fuel hoses were drained and backhauled in lined sea containers during the 2013 sealift for proper disposal at a licensed facility. Fuel pumps and steel piping used at the fuel bladder facility were removed and are currently being stored at Milne Port.

Following the removal of the fuel bladder facility infrastructure, all contaminated water within the containment berm that could not be treated onsite was consolidated into an empty fuel bladder located at the north end of the containment berm. Starting at the south end of the facility, excavators removed the contaminated soil and geosynthetic liner from the lined refueling station and two thirds of the containment berm. During the excavation process, the liner condition was observed to be intact with no observable tears or breaches. All removed contaminated soil and geosynthetic liner were transferred to the remaining one third of the containment berm located at the north end of the facility. A containment berm wall stretching east to west was constructed to separate the remaining one third of the containment berm from the recently exposed underlying soil.

Once the soil underneath the geosynthetic liner was exposed, the freshly exposed soils were assessed for petroleum hydrocarbon contamination by visual and olfactory inspection and the systematic advancement of test pits throughout the area. The soils were classified mainly as fine to medium grained sands with some gravel and little silt. Contaminated areas that were identified during the inspection and as determined from test pits were excavated until petroleum hydrocarbon (PH) contamination could no longer be detected by visual or olfactory assessment. All excavated materials from the contaminated areas were transported to the remaining one third of the containment berm (north end). To confirm that contaminated areas had been substantially excavated, composite soil samples of the walls and floor of each excavated contaminated areas were collected. Six (6) PH contaminated areas were identified within the footprint of the removed containment berm and one (1) PH contaminated area was identified within the footprint of the lined refueling station.

In addition to the collecting soil samples from the excavation limits of each contaminated area, test pits were dug and allowed to fill with water after each contaminated area was excavated in order to collect water samples and gauge the level of residual and free phase petroleum hydrocarbons. A single test pit was dug for each contaminated area except for contaminated area no. 5 in which two test pits were dug to account for the contaminated area's larger size. Overall, eight (8) test pits were excavated and sampled within the PH contaminated areas.

If substantial volumes of hydrocarbons had leaked through the geosynthetic liner during the lifespan of the fuel bladder facility, the hydrocarbons would have likely migrated to and settled at the soil-permafrost interface. Therefore, to determine the depth and extent of the fuel contamination underneath the fuel bladder facility at Milne Port the exposed soil was partitioned into 15 m x 15 m (225 m^2) grid sections and assessed for petroleum hydrocarbon contamination by excavating a test pit in the center of each grid section. Test pits were excavated to the depth of the permafrost and soil was sampled at several depths within the test pit to create a composite depth soil sample for each section. Overall, 29 test pits were excavated and sampled (see Figure E.8-1).

To prevent snow melt from mixing with the contaminated soil and liner in the spring, the remaining one third of the containment berm that included stockpiled contained soils, discarded liner material and the single remaining bladder with stored oily water was covered and sealed with geosynthetic liner for the winter. The total volume of stockpiled contaminated soil is estimated to be 8795 m^3 (see Figure E.8-2).

4.0 - Sampling Methodology

Soil and water sample analyses were conducted by an accredited lab in Nepean, ON operated by Exova Canada Corp (Exova lab).

4.1 – Soil Samples

For each test pit, soil was collected at several depths from each wall so as to provide a representative depth composited soil sample. Similarly, soil samples were taken from the excavation walls and floor of each contaminated area following remediation efforts. All soil samples were collected in 250 mL glass jars using a spade and nitrile gloves. To avoid cross contamination, the spade was rinsed with potable water between samples and a new pair of nitrile gloves were worn for each soil sample that was collected.

4.2 – Water Samples

Water samples were collected from test pits of identified contaminated areas following excavation efforts. Water samples were collected from the standing water in each test pit and tested internally for total oil and grease (TOG). Water samples that exceeded a TOG concentration of 15 ppm[3] were sent to the Exova lab for external testing. All water samples were collected in new 500 mL plastic bottles using a clean pair of nitrile gloves for each sample so as to minimize the potential for cross contamination during sampling.

5.0 – Analytical Results

The laboratory results for the composite soil samples collected from the test pits and excavation limits of identified PH contaminated areas were compared to the Tier 1 guidelines for commercial/industrial land use, as outlined in Table 1.

Of the soil samples collected from the test pits, none of the samples exceeded any of the Tier 1 guidelines for commercial/industrial land use. However, when PH results for the test pit soil samples were compared to the most conservative land use Tier 1 guidelines, agriculture/parkland, the soil sample from test pit MP-BF-C6 marginally exceeded the PH F2 guideline of 150 mg/kg with a F2 concentration of 210 mg/kg.

Soil samples from the excavation limits of identified contaminated areas that exceeded the PH F2 guideline for all land use types included: MP-BF-S7, MP-BF-S8, MP-BF-S10, MP-BF-CA5A and MP-CA5. These samples were collected from either contaminated area no. 5 or the containment berm sump area (see Figure E.8-3).

Soil samples from the excavation limits of identified contaminated areas with PH levels below the Tier 1 guidelines for commercial/industrial land use but above the agricultural/parkland land use Tier 1 guidelines for PH F1 or F2 included MP-BF-REFUEL-2, MP-BF-S3 and MP-BF-S5.

[3] All water discharges into the receiving environment must not exceed 15 ppm TOG according to Baffinland's Type A Water License No. 2AM-MRY1325 (NWB, 2013).

Of the water samples taken from the contaminated area test pits, only the samples collected at the sump (MP-BF-STP1) and the first test pit of contaminated area 5 (MP-BF-CA5TP1) tested above the 15 ppm threshold for total oil and grease (TOG). When the water samples were tested externally by the Exova lab, MP- BF-STP1 and MP-BF-CA5TP1 showed TOG concentrations of 31 and 33 ppm, respectively.

6.0 - Conclusions and Recommendations

The low PH concentrations seen in the soil samples of the test pits and excavation limits of most of the identified PH contaminated areas suggests that the fuel contamination of the soil underneath the fuel bladder facility at Milne Port was localized and was most likely due to slow, pinhole type leaks in the liner system. Of the seven (7) PH contaminated areas that were identified and excavated during the decommissioning of the facility, only the containment berm sump area and contaminated area no. 5 registered residual PH levels above the Tier 1 guidelines for fine-grained soil in a commercial/industrial setting.

Out of all the PH contaminated areas that were excavated, the sump area of the containment berm registered the highest concentrations of residual PH contamination. The soil underneath the sump area of the containment berm was the most prone to potential PH contamination due to the longer term oily water residing at this location during each open water season. Both the refueling area and containment berm sump area required substantial excavation and removal of soil to the depth of permafrost in some areas.

Finally, the low TOG concentrations seen in the water samples collected from contaminated area test pits confirm that remediation excavations were successful in reducing PH contamination below Tier 1 guidelines for five (5) of the seven (7) PH contaminated areas. The excavated contaminated areas and test pits that registered a residual PH concentration greater than the Tier 1 guidelines for fine-grained soil for commercial/industrial land use will be reassessed and excavated/stockpiled further as required during the 2014 open water season.

The area under the northern third of the containment berm, currently the site of the stockpiled contaminated soil and liner material still requires liner removal and assessment using techniques similar to those undertaken during 2013. The stockpiled contaminated soils will be resampled and transported to the planned landfarm treatment facility at Milne Port, slated for construction during the spring of 2014.

7.0 - References

NWB (Nunavut Water Board), 2013. Baffinland Iron Mines Corp. Class A Water License No: 2AM-MRY1325. Issued by the Nunavut Water Board, 2013.

GN (Government of Nunavut), 2009. Environmental Guideline for Contaminated Site Remediation. Prepared by the Department of Environment of the Government of Nunavut, March 2009.

Appendices

Appendix A - Figures (Maps)

Appendix B – Tables

Appendix C - Photos

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503 300 E

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7 975 800 N

MP-BF-C1
MP-BF-E1
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MP-BF-E10
NEW BERM WALL
MP-BF-W10
MP-BF-S
MP-BF-CA5
MP-BF-C9
MP-BF-E9
MP-BF-W9
MP-BF-SUMPTP1
MP-BF-REFUEL
MP-BF-W8
MP-BF-E8
MP-BF-C8
MP-BF-REFUELTP1
MP-BF-CA5TP2
MP-BF-W7
MP-BF-C7
MP-BF-E7
MP-BF-C6
MP-BF-E6
MP-BF-W6
MP-BF-E5
MP-BF-W5
MP-BF-C5
MP-BF-CA5TP1
MP-BF-C4
MP-BF-E4
MP-BF-W4
MP-BF-CA4
MP-BF-E3
MP-BF-CA4TP1
MP-BF-CA3
MP-BF-W3
MP-BF-C3
MP-BF-CA3TP1
MP-BF-CA2
MP-BF-E2
MP-BF-CA2TP1
MP-BF-W2
MP-BF-C2
MP-BF-CA1
MP-BF-CA1TP1

LEGEND

- EXCAVATION LIMITS FOR CONTAMINATED AREAS
- NEW BERM WALL
- TEST PIT SOIL SAMPLES WITH PH LEVELS BELOW TIER 1 GUIDELINES FOR ALL LAND USE TYPES
- TEST PIT SOIL SAMPLES WITH PH LEVELS BELOW TIER 1 GUIDELINES FOR AGRICULTURAL/PARKLAND LAND USE
- CONTAMINATED AREA TEST PIT WATER SAMPLE LOCATIONS

NOTES

1. COORDINATE GRID IS UTM NAD83 ZONE 17N.
2. PLAN/SECTION BASED ON INFORMATION PROVIDED BY HATCH, DATED (JAN 31,2014).
3. SURVEY COORDINATES FOR THE EXCAVATION LIMITS AND THE NEW BERM WALL COLLECTED BY MARG CALEY FROM NAMPCY SOLUTIONS LTD. (SEPT 18, 2013). COORDINATES FOR THE SAMPLE AND TEST PIT LOCATIONS WERE COLLECTED BY ANDREW VERMEER FROM BIM USING A HANDHELD GPS (2013).

SCALE A: 5 2.5 0 5 10 15 20 25 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	25MAR'14	ISSUED WITH 2013 QIA AND NWB ANNUAL REPORT	AV	AS	AV	JM

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

MILNE PORT
FUEL BLADDER FACILITY
TEST PITS SAMPLING MAP

Knight Piésold CONSULTING

P/A NO. NB102-181/34

REF NO. 4

FIGURE E8.1

REV 0

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XREF FILE(S): Contours-2.5m_Interval-Milne_to_Mine_Site-02-Oct_16_2008; QMR2 QMR1 - BOUNDARY LIMIT AND MINING LIMIT; MILNE SITE LAYOUT; MILNE-CONTAMINATED SOIL IMAGE FILE(S): Baffinland logo-big corp Progress Print Feedback

503 250 E

503 300 E

7 976 100 N

7 976 050 N

7 976 000 N

7 975 950 N

9.0

9.0

SCALE B

VOLUME OF CONTAMINATED
SOIL OCTOBER 3, 2013 - 8795 m³

NEW BERM WALL

SCALE A 5 2.5 0 5 10 15 20 25 m

SCALE B 60 30 0 100 200 300 m

LE□EN□□

- EXCAVATION LIMITS FOR CONTAMINATED AREAS
- NEW BERM WALL
- CONTAMINATED STOCKPILE EXTENTS

NOTES□

1. COORDINATE GRID IS UTM NAD83 ZONE 17N.
2. PLAN/SECTION BASED ON INFORMATION PROVIDED BY HATCH, DATED (JAN 31,2014).
3. SURVEY COORDINATES FOR THE EXCAVATION LIMITS AND THE NEW BERM WALL COLLECTED BY MARG CALEY FROM NAMPCY SOLUTIONS LTD. (SEPT 18, 2013).
4. CONTAMINATED STOCKPILE VOLUME AND BOUNDARY PROVIDED BY MONTEITH & SUTHERLAND LIMITED, MARCH 21, 2014. VOLUME CALCULATED BY MEASURING VOLUME OF THE SOIL PILE FROM TOE OF SLOPE AND UP.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	25MAR'14	ISSUED WITH 2013 QIA AND NWB ANNUAL REPORT	AV	AS	AV	JM

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

MILNE PORT
F□EL BLA□□ER FACILIT□
CONTAMINATE□ STOC□PILE AREA

Knight Piésold CONSULTING

P/A NO. NB102-181/34

REF NO. 4

FI□□RE E□8□□

REV 0

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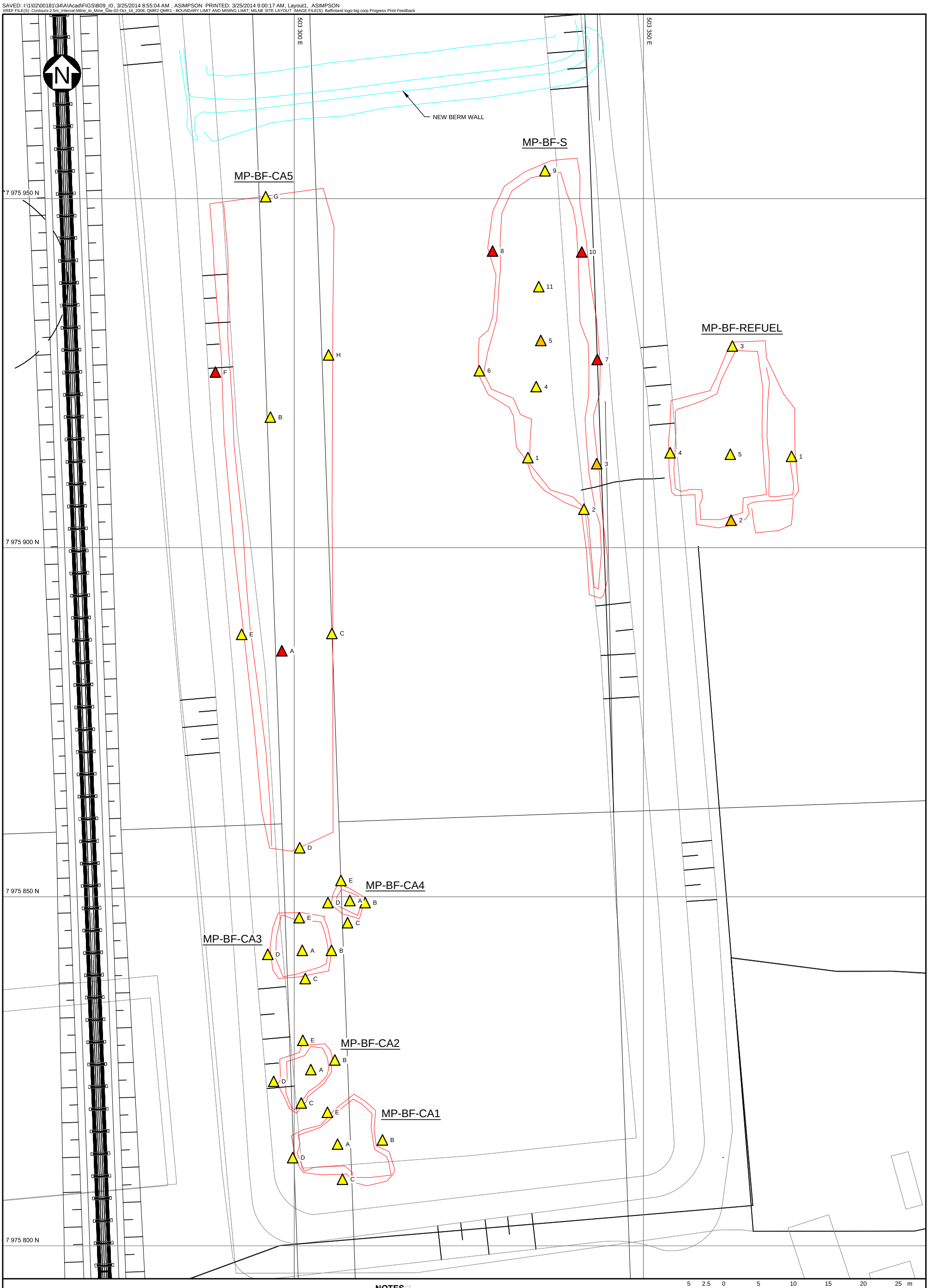
XREF FILE(S): Contours-2.5m_Interval-Milne_to_Mine_Site-02-Oct_16_2008; QMR2 QMR1 - BOUNDARY LIMIT AND MINING LIMIT; MILNE SITE LAYOUT IMAGE FILE(S): Baffinland logo-big corp Progress Print Feedback



LEGEND

- EXCAVATION LIMITS FOR CONTAMINATED AREAS
- NEW BERM WALL
- SOIL SAMPLES WITH PH LEVELS BELOW TIER 1 GUIDELINES FOR ALL LAND USE TYPES
- SOIL SAMPLES WITH PH LEVELS ABOVE TIER 1 GUIDELINES FOR COMMERCIAL/INDUSTRIAL LAND USE
- SOIL SAMPLES WITH PH LEVELS ABOVE TIER 1 GUIDELINES FOR AGRICULTURE/PARKLAND LAND USE

NOTES

1. COORDINATE GRID IS UTM NAD83 ZONE 17N.
2. PLAN/SECTION BASED ON INFORMATION PROVIDED BY HATCH, DATED (JAN 31,2014).
3. SURVEY COORDINATES FOR THE EXCAVATION LIMITS AND THE NEW BERM WALL COLLECTED BY MARG CALEY FROM NAMPCY SOLUTIONS LTD. (SEPT 18, 2013). COORDINATES FOR THE SAMPLE AND TEST PIT LOCATIONS WERE COLLECTED BY ANDREW VERMEER FROM BIM USING A HANDHELD GPS (2013).

SCALE A: 5 2.5 0 5 10 15 20 25 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	25MAR'14	ISSUED WITH 2013 QIA AND NWB ANNUAL REPORT	AV	AS	AV	JM

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

MILNE PORT
FUEL BLADDER FACILITY
CONTAMINATED AREAS SOIL SAMPLING MAP

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-181/34	4

FIGURE E83 — REV 0

Appendix B – Analytical Results

Table 1 - Tier 1 Remediation Criteria (mg/kg) for Petroleum Hydrocarbons in Surface Soil

Land Use	Soil Texture	Fraction 1 (C6-C10)	Fraction 2 (>C10-C16)	Fraction 3 (>C16-C34)	Fraction 4 (>C34)
Agricultural/Wildland	Fine-grained soil	210 (170[a])	150	1300	5600
	Coarse-grained soil	30[b]	150	300	2800
Residential/Parkland	Fine-grained soil	210 (170[a])	150	1300	5600
	Coarse-grained soil	30[b]	150	300	2800
Commercial	Fine-grained soil	320 (170[a])	260 (230[a])	2500	6600
	Coarse-grained soil	320 (240[a])	260	1700	3300
Industrial	Fine-grained soil	320 (170[a])	260 (230[a])	2500	6600
	Coarse-grained soil	320 (240[a])	260	1700	3300

a - Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body or for protection of notable groundwater

b - Assumes contamination near residence

Table 2 - Soil Sample Results for Test Pits (Row 1 -3)

Parameter Group	Analyte	MRL	Units	Sample ID / Date and Time / *Tier 1 PHC Guidelines	**MP-BF-W1	MP-BF-C1	MP-BF-E1	MP-BF-W2	MP-BF-C2	MP-BF-E2	MP-BF-W3	MP-BF-C3	MP-BF-E3
				Date and Time	N/A	13/09/2013 13:35	13/09/2013 13:30	Sept 13, 2013 16:15	Sept 13, 2013 16:10	Sept 13, 2013 16:05	Sept 13, 2013 16:30	Sept 13, 2013 16:25	Sept 13, 2013 16:20
General Chemistry	Moisture	0.1	□	-	-	6.3	6.9	7.9	6.4	39.7	5.9	8	8.1
Hydrocarbons	F1 (C6-C10)	10	□g/g	320	-	<10	<10	<10	<10	<10	<10	<10	<10
	F1-BTEX (C6-C10)	10	□g/g	320	-	<10	<10	<10	<10	<10	<10	<10	<10
	F2 (C10-C16)	10	□g/g	260	-	<10	<10	<10	<10	<10	<10	<10	<10
	F3 (C16-C34)	20	□g/g	2500	-	<20	<20	<20	<20	<20	<20	<20	<20
	F4 (C34-C50)	20	□g/g	6600	-	<20	<20	<20	<20	<20	<20	<20	<20
Metals	Pb	1	□g/g	-	-	3	3	2	2	4	3	3	3
Oil and Grease	Total Oil □ Grease	100	□g/g	-	-	<100	180	<100	<100	200	170	110	<100
VOCs	Benzene	0.02	□g/g	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	Ethylbenzene	0.05	□g/g	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	m/p-xylene	0.05	□g/g	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	o-xylene	0.05	□g/g	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Toluene	0.2	□g/g	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Toluene-d8	0	□	-	-	91	87	92	90	90	98	90	99

□Tier 1 remediation guidelines for petroleum hydrocarbon contaminated fine-grained soil for commerical/industrial land use.

□□Section W1 was not sampled because the section had already been covered by material for the new berm wall when the test pit samples were taken. Section W1 will be assessed when the remaining one third of the containment berm is decommissioned and remediated.

Table 3 - Soil Sample Results for Test Pits (Row 4 -6)

Parameter Group	Analyte	MRL	Units	Sample ID	MP-BF-W4	MP-BF-C4	MP-BF-E4	MP-BF-W5	MP-BF-C5	MP-BF-E5	MP-BF-W6	MP-BF-C6	MP-BF-E6
				Date and Time	Sept 13, 2013 16:45	Sept 13, 2013 16:40	Sept 13, 2013 16:35	Sept 13, 2013 17:00	Sept 13, 2013 16:55	Sept 13, 2013 16:50	Sept 14, 2013 13:05	Sept 14, 2013 13:10	Sept 14, 2013 13:15
				*Tier 1 PHC Guidelines									
General Chemistry	Moisture	0.1	□	-	6.2	7.3	8.9	15.7	4.6	6.3	13.3	12.9	10.9
Hydrocarbons	F1 (C6-C10)	10	□g/g	320	<10	<10	<10	<10	<10	<10	<10	<10	<10
	F1-BTEX (C6-C10)	10	□g/g	320	<10	<10	<10	<10	<10	<10	<10	<10	<10
	F2 (C10-C16)	10	□g/g	260	50	<10	<10	20	<10	<10	<10	**210**	<10
	F3 (C16-C34)	20	□g/g	2500	<20	<20	<20	<20	<20	<20	<20	70	<20
	F4 (C34-C50)	20	□g/g	6600	<20	<20	<20	<20	<20	<20	<20	<20	<20
Metals	Pb	1	□g/g	-	3	2	3	2	2	3	1	2	2
Oil and Grease	Total Oil □ Grease	100	□g/g	-	<100	<100	<100	<100	<100	<100	220	220	<100
VOCs	Benzene	0.02	□g/g	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	Ethylbenzene	0.05	□g/g	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	m/p-xylene	0.05	□g/g	-	<0.05	<0.05	<0.05	0.1	<0.05	<0.05	<0.05	<0.05	<0.05
	o-xylene	0.05	□g/g	-	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Toluene	0.2	□g/g	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Toluene-d8	0	□	-	97	93	98	95	96	99	87	87	96

□Tier 1 remediation guidelines for petroleum hydrocarbon contaminated fine-grained soil for commerical/industrial land use.

Exceedance of Tier 1 remediation guidelines for petroleum hydrocarbon contaminated fine-grained soil for agricultural/parkland land use.

Table 4 - Soil Sample Results for Test Pits (Row 7 -9)

Parameter Group	Analyte	MRL	Units	Sample ID	MP-BF-W7	MP-BF-C7	MP-BF-E7	MP-BF-W8	MP-BF-C8	MP-BF-E8	MP-BF-W9	MP-BF-C9	MP-BF-E9
				Date and Time	Sept 14, 2013 13:20	Sept 14, 2013 13:25	Sept 14, 2013 13:30	Sept 14, 2013 13:35	Sept 14, 2013 13:40	Sept 14, 2013 13:45	Sept 14, 2013 13:50	Sept 14, 2013 13:55	Sept 14, 2013 14:00
				*Tier 1 PHC Guidelines									
General Chemistry	Moisture	0.1	□	-	7.5	6.7	11.3	9.4	11.2	17	9	12.9	13.5
Hydrocarbons	F1 (C6-C10)	10	□g/g	320	<10	<10	<10	<10	<10	<10	<10	<10	<10
	F1-BTEX (C6-C10)	10	□g/g	320	<10	<10	<10	<10	<10	<10	<10	<10	<10
	F2 (C10-C16)	10	□g/g	260	<10	<10	<10	<10	<10	<10	<10	<10	<10
	F3 (C16-C34)	20	□g/g	2500	<20	<20	<20	<20	40	<20	<20	<20	<20
	F4 (C34-C50)	20	□g/g	6600	<20	<20	<20	<20	<20	<20	<20	<20	<20
Metals	Pb	1	□g/g	-	2	2	2	2	2	2	2	2	2
Oil and Grease	Total Oil □ Grease	100	□g/g	-	<100	<100	<100	280	250	250	<100	<100	140
VOCs	Benzene	0.02	□g/g	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	Ethylbenzene	0.05	□g/g	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	m/p-xylene	0.05	□g/g	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	o-xylene	0.05	□g/g	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Toluene	0.2	□g/g	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Toluene-d8	0	□	-	88	86	91	88	87	86	95	90	90

□Tier 1 remediation guidelines for petroleum hydrocarbon contaminated fine-grained soil for commerical/industrial land use.

Table 5 - Soil Sample Results for Test Pits (Row 10) and Excavation Limits of Refueling Area

Parameter Group	Analyte	MRL	Units	Sample ID	MP-BF-W10	MP-BF-C10	MP-BF-E10	MP-BF-REFUEL-1	MP-BF-REFUEL-2	MP-BF-REFUEL-3	MP-BF-REFUEL-4	MP-BF-REFUEL-5	MP-BF-JETA
				Date and Time	Sept 14, 2013 14:05	Sept 14, 2013 14:10	Sept 14, 2013 14:15	Sept 11, 2013 11:30	Sept 11, 2013 11:35	Sept 15, 2013 16:00	Sept 15, 2013 16:10	Sept 15, 2013 16:05	Sept 11, 2013 13:00
				*Tier 1 PHC Guidelines									
General Chemistry	Moisture	0.1	□	-	10.4	9.8	13.6	5.5	27.8	44.5	6.5	6.1	3.4
Hydrocarbons	F1 (C6-C10)	10	□g/g	320	<10	<10	<10	<10	<10	<10	<10	<10	<10
	F1-BTEX (C6-C10)	10	□g/g	320	<10	<10	<10	<10	<10	<10	<10	<10	<10
	F2 (C10-C16)	10	□g/g	260	<10	<10	<10	<10	250	20	<10	140	20
	F3 (C16-C34)	20	□g/g	2500	<20	<20	<20	<20	30	<20	<20	50	<20
	F4 (C34-C50)	20	□g/g	6600	<20	<20	50	<20	<20	<20	<20	<20	<20
Metals	Pb	1	□g/g	-	4	2	2	2	2	2	2	2	2
Oil and Grease	Total Oil □ Grease	100	□g/g	-	100	<100	<100	<100	<100	240	<100	160	<100
VOCs	Benzene	0.02	□g/g	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	Ethylbenzene	0.05	□g/g	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	m/p-xylene	0.05	□g/g	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	o-xylene	0.05	□g/g	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Toluene	0.2	□g/g	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Toluene-d8	0	□	-	97	101	87	101	86	88	86	89	85

□Tier 1 remediation guidelines for petroleum hydrocarbon contaminated fine-grained soil for commerical/industrial land use.

Exceedance of Tier 1 remediation guidelines for petroleum hydrocarbon contaminated fine-grained soil for agricultural/parkland land use.

Table 6 - Soil Sample Results for Excavation Limits of Containment Berm Sump Area

Parameter Group	Analyte	MRL	Units	Sample ID	MP-BF-S1	MP-BF-S2	MP-BF-S3	MP-BF-S4	MP-BF-S5	MP-BF-S6	MP-BF-S7	MP-BF-S8	MP-BF-S9	MP-BF-S10	MP-BF-S11	MP-BF-S12
				Date and Time	Sept 15, 2013 13:10	Sept 15, 2013 13:10	Sept 15, 2013 13:10	Sept 15, 2013 13:10	Sept 15, 2013 13:10	Sept 15, 2013 13:10	Sept 15, 2013 13:10	Sept 15, 2013 13:10	Sept 15, 2013 13:10	Sept 15, 2013 13:10	Sept 15, 2013 13:10	Sept 15, 2013 13:10
				*Tier 1 PHC Guidelines												
General Chemistry	Moisture	0.1	□	-	6.2	7.5	8.8	12.8	12.9	8.9	5.1	10.6	7.6	12.6	8.1	6.5
Hydrocarbons	F1 (C6-C10)	10	□g/g	320	<10	<10	20	30	70	<10	**287**	<10	14.2	71	<10	<10
	F1-BTEX (C6-C10)	10	□g/g	320	<10	<10	20	30	70	<10	**277.3**	<10	14.2	70	<10	<10
	F2 (C10-C16)	10	□g/g	260	<10	20	**160**	80	**200**	20	**3700**	**420**	80	**960**	50	30
	F3 (C16-C34)	20	□g/g	2500	<20	<20	60	20	40	<20	560	130	40	220	<20	<20
	F4 (C34-C50)	20	□g/g	6600	<20	<20	<20	<20	<20	<20	30	<20	<20	<20	<20	<20
Metals	Pb	1	□g/g	-	3	2	4	2	2	2	4	2	3	4	2	2
Oil and Grease	Total Oil □ Grease	100	□g/g	-	<100	<100	100	200	100	120	600	420	360	890	<100	240
VOCs	Benzene	0.02	□g/g	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	Ethylbenzene	0.05	□g/g	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	m/p-xylene	0.05	□g/g	-	<0.05	<0.05	<0.05	0.25	0.94	<0.05	5.14	<0.05	<0.05	0.26	<0.05	<0.05
	o-xylene	0.05	□g/g	-	<0.05	<0.05	<0.05	0.16	0.59	<0.05	4.55	<0.05	<0.05	0.92	<0.05	<0.05
	Toluene	0.2	□g/g	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Toluene-d8	0	□	-	96	95	100	103	99	88	99	98	98	106	100	101

□Tier 1 remediation guidelines for petroleum hydrocarbon contaminated fine-grained soil for commerical/industrial land use.

Exceedance of Tier 1 remediation guidelines for petroleum hydrocarbon contaminated fine-grained soil for commerical/industrial land use.

Exceedance of Tier 1 remediation guidelines for petroleum hydrocarbon contaminated fine-grained soil for agricultural/parkland land use.

Table 7 - Soil Sample Results for Excavation Limits of Contaminated Areas 1 and 2

Parameter Group	Analyte	MRL	Units	Sample ID	MP-BF-CA1A	MP-BF-CA1B	MP-BF-CA1C	MP-BF-CA1D	MP-BF-CA1E	MP-BF-CA2A	MP-BF-CA2B	MP-BF-CA2C	MP-BF-CA2D	MP-BF-CA2E
				Date and Time	Sept 16, 2013 11:05	Sept 16, 2013 11:10	Sept 16, 2013 11:15	Sept 16, 2013 11:20	Sept 16, 2013 11:25	Sept 16, 2013 11:30	Sept 16, 2013 11:35	Sept 16, 2013 11:40	Sept 16, 2013 11:45	Sept 16, 2013 11:50
				*Tier 1 PHC Guidelines										
General Chemistry	Moisture	0.1	□	-	5.6	4.8	2.5	4.7	5.9	9.8	11.5	3.8	5.8	7.4
Hydrocarbons	F1 (C6-C10)	10	□g/g	320	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	F1-BTEX (C6-C10)	10	□g/g	320	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	F2 (C10-C16)	10	□g/g	260	40	<10	10	20	<10	<10	10	<10	<10	<10
	F3 (C16-C34)	20	□g/g	2500	20	<20	<20	40	<20	<20	<20	<20	<20	20
	F4 (C34-C50)	20	□g/g	6600	<20	<20	<20	30	<20	<20	<20	<20	<20	<20
Metals	Pb	1	□g/g	-	2	3	4	7	3	3	3	3	4	3
Oil and Grease	Total Oil □ Grease	100	□g/g	-	200	400	190	200	200	200	100	100	<100	160
VOCs	Benzene	0.02	□g/g	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	Ethylbenzene	0.05	□g/g	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	m/p-xylene	0.05	□g/g	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	o-xylene	0.05	□g/g	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Toluene	0.2	□g/g	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Toluene-d8	0	□	-	95	92	93	98	96	95	95	93	95	96

□Tier 1 remediation guidelines for petroleum hydrocarbon contaminated fine-grained soil for commerical/industrial land use.

Table 8 - Soil Sample Results for Excavation Limits of Contaminated Areas 3 and 4

Parameter Group	Analyte	MRL	Units	Sample ID	MP-BF-CA3A	MP-BF-CA3B	MP-BF-CA3C	MP-BF-CA3D	MP-BF-CA3E	MP-BF-CA4A	MP-BF-CA4B	MP-BF-CA4C	MP-BF-CA4D	MP-BF-CA4E
				Date and Time	Sept 16, 2013 11:55	Sept 16, 2013 12:00	Sept 16, 2013 12:35	Sept 16, 2013 12:40	Sept 16, 2013 12:45	Sept 16, 2013 12:50	Sept 16, 2013 12:55	Sept 16, 2013 13:00	Sept 16, 2013 13:05	Sept 16, 2013 13:10
				*Tier 1 PHC Guidelines										
General Chemistry	Moisture	0.1	□	-	5.2	7.5	6.1	4.5	5.3	3.7	4.4	4.3	4.9	4.1
Hydrocarbons	F1 (C6-C10)	10	□g/g	320	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	F1-BTEX (C6-C10)	10	□g/g	320	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	F2 (C10-C16)	10	□g/g	260	<10	80	<10	<10	50	<10	140	<10	<10	<10
	F3 (C16-C34)	20	□g/g	2500	<20	80	<20	<20	40	<20	150	<20	30	<20
	F4 (C34-C50)	20	□g/g	6600	<20	<20	<20	<20	<20	30	<20	<20	<20	<20
Metals	Pb	1	□g/g	-	3	3	4	5	2	3	4	4	3	4
Oil and Grease	Total Oil □ Grease	100	□g/g	-	<100	<100	260	200	100	<100	300	<100	<100	100
VOCs	Benzene	0.02	□g/g	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	Ethylbenzene	0.05	□g/g	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	m/p-xylene	0.05	□g/g	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	o-xylene	0.05	□g/g	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Toluene	0.2	□g/g	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Toluene-d8	0	□	-	93	97	97	96	96	94	99	86	101	99

□Tier 1 remediation guidelines for petroleum hydrocarbon contaminated fine-grained soil for commerical/industrial land use.

Table 9 - Soil Sample Results for Excavation Limits of Contaminated Area 5

Parameter Group	Analyte	MRL	Units	Sample ID	MP-BF-CA5A	MP-BF-CA5B	MP-BF-CA5C	MP-BF-CA5D	MP-BF-CA5E	MP-BF-CA5F	MP-BF-CA5G	MP-BF-CA5H
				Date and Time	Sept 16, 2013 13:15	Sept 16, 2013 13:20	Sept 16, 2013 13:25	Sept 16, 2013 13:30	Sept 16, 2013 13:35	Sept 16, 2013 13:40	Sept 16, 2013 13:45	Sept 16, 2013 13:50
				*Tier 1 PHC Guidelines								
General Chemistry	Moisture	0.1	□	-	7.1	9.1	6.5	8.7	4.5	3	4.1	7.5
Hydrocarbons	F1 (C6-C10)	10	□g/g	320	<10	<10	<10	<10	<10	22.4	<10	<10
	F1-BTEX (C6-C10)	10	□g/g	320	<10	<10	<10	<10	<10	22.4	<10	<10
	F2 (C10-C16)	10	□g/g	260	**290**	20	<10	<10	<10	**800**	10	<10
	F3 (C16-C34)	20	□g/g	2500	50	50	<20	<20	30	250	50	30
	F4 (C34-C50)	20	□g/g	6600	<20	<20	<20	<20	<20	<20	40	20
Metals	Pb	1	□g/g	-	3	3	3	4	6	3	3	3
Oil and Grease	Total Oil □ Grease	100	□g/g	-	100	300	<100	320	300	500	170	210
VOCs	Benzene	0.02	□g/g	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	Ethylbenzene	0.05	□g/g	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	m/p-xylene	0.05	□g/g	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	o-xylene	0.05	□g/g	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Toluene	0.2	□g/g	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Toluene-d8	0	□	-	98	98	102	91	99	98	101	104

□Tier 1 remediation guidelines for petroleum hydrocarbon contaminated fine-grained soil for commerical/industrial land use.

Exceedance of Tier 1 remediation guidelines for petroleum hydrocarbon contaminated fine-grained soil for commerical/industrial land use.

Table 10 - Water Sample Results for Excavated Contaminated Area Test Pits that exceeded 15 ppm TOG

				Sample ID	MP-BF-CA5TP1	MP-BF-STP1
				Date and Time	Sept 18, 2013 13:30	Sept 18, 2013 13:45
Laboratory	**Parameter Group**	**Analyte**	**MRL**	**Units**		
BIM Internal	Oil and Grease	Total Oil □ Grease	1	mg/L	27	37
Exova	Oil and Grease	Total Oil □ Grease	1	□g/L	33	31
	VOCs	Benzene	0.5	□g/L	3.2	7.3
		Ethylbenzene	0.5	□g/L	3.4	<0.5
		Toluene	0.5	□g/L	4.8	3.4
		Toluene-d8	0	□	103	113

Appendix C - Photographs

Photo 1 – Fuel Bladder Storage Facility at Milne Port (2012)

Photo 2 - Removing Fuel Bladders (September, 2013)

Photo 3 – Loading Fuel Bladders into Lined Sea Containers for Backhaul

Photo 4 – New Containment Berm Wall Construction after Removal of Fuel Bladders and Piping (September, 2013)

Photo 5 – Transferring the Contained Contaminated Soil to the North End of the Containment Berm

Photo 6 – Demobilization and Remediation of the Refueling Area

Photo 7 – Final Excavation of the Containment Berm Sump Area

Photo 8 – Final Excavation of the Refueling Area

Photo 9 – Test Pits

Photo 10 – Sealed Containment Berm on North End of the Facility

Table 1 - Tier 1 Remediation Criteria (mg/kg) for Petroleum Hydrocarbons in Surface Soil

Land Use	Soil Texture	Fraction 1 (C6-C10)	Fraction 2 (>C10-C16)	Fraction 3 (>C16-C34)	Fraction 4 (>C34)
Agricultural/Wildland	Fine-grained soil	210 (170[a])	150	1300	5600
	Coarse-grained soil	30[b]	150	300	2800
Residential/Parkland	Fine-grained soil	210 (170[a])	150	1300	5600
	Coarse-grained soil	30[b]	150	300	2800
Commercial	Fine-grained soil	320 (170[a])	260 (230[a])	2500	6600
	Coarse-grained soil	320 (240[a])	260	1700	3300
Industrial	Fine-grained soil	320 (170[a])	260 (230[a])	2500	6600
	Coarse-grained soil	320 (240[a])	260	1700	3300

a - Where applicable, for protection against contaminated groundwater discharge to an adjacent surface water body or for protection of notable groundwater

b - Assumes contamination near residence

ATTACHMENT B
Tables

APPENDIX B: ANALYTICAL RESULTS

TABLE 2: South Fuel Bladder Facility Confirmatory Soil Sampling 28 July 2014

SAMPLE ID	F1 (C6-C10)	F2 (C10-C16)	F3 (C16-C34)	F4 (C35+)	Benzene	Ethylbenzene	Toluene	Xylene
Tier 1 Criteria - Industrial Coarse-grain[1]	***320 (ug/g)****	***260***	***1700***	***3300***	***0.03****	***0.082****	***0.37***	***11***
MP-FBF-01	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-02	30	400	100	<20	<0.02	<0.05	<0.2	0.12
MP-FBF-03	40	1200	190	<20	<0.02	<0.05	<0.2	0.17
MP-FBF-04	10	1000	240	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-05	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-06	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-07	<10	180	110	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-08	<10	180	190	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-09	<10	<10	60	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-10	<10	<10	20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-11	<10	<10	30	30	<0.02	<0.05	<0.2	<0.05
MP-FBF-12	<10	<10	60	40	<0.02	<0.05	<0.2	<0.05
MP-FBF-24	<10	<10	60	30	<0.02	<0.05	<0.2	<0.05
MP-FBF-13	<10	<10	20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-14	<10	<10	40	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-15	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-16	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-17	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-18	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-19	<10	100	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-20	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-21	<10	<10	<20	20	<0.02	<0.05	<0.2	<0.05
MP-FBF-22	<10	<10	<20	70	<0.02	<0.05	<0.2	<0.05
MP-FBF-23	<10	10	80	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-25	<10	<10	20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-26	<10	50	110	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-27	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-28	<10	<10	40	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-29	<10	70	110	<20	<0.02	<0.05	<0.2	<0.05

SAMPLE ID	F1 (C6-C10)	F2 (C10-C16)	F3 (C16-C34)	F4 (C35+)	Benzene	Ethylbenzene	Toluene	Xylene
Tier 1 Criteria - Industrial Coarse-grain[1]	***320 (ug/g)****	***260***	***1700***	***3300***	***0.03****	***0.082****	***0.37***	***11***
MP-FBF-30	<10	<10	20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-31	<10	<10	60	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-32	<10	<10	40	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-33	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-34	50	3400	1200	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-35	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-36	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-37	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-38	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05

* all results in ug/g

** guideline less than detection limit

Exceeding Tier 1 Criteria

[1]Government of Nunavut, 2009. Environmental Guideline for Contaminated Site Remediation. Prepared by the Department of Environment of the Government of Nunavut, March 2009.

APPENDIX B: ANALYTICAL RESULTS

TABLE 3: South Fuel Bladder Facility - East Side - Soil Resampling After Excavation 24 August 2014

SAMPLE ID	F1 (C6-C10)	F2 (C10-C16)	F3 (C16-C34)	F4 (C35+)	Benzene	Ethylbenzene	Toluene	Xylene
Tier 1 Criteria - Industrial Coarse-grain[1]	***320 (ug/g)****	***260***	***1700***	***3300***	***0.03****	***0.082****	***0.37***	***11***
MP-FBF-34A	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-34B	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-34C	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-34D	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-34E	<10	70	<20	<20	<0.02	<0.05	<0.2	<0.05

* all results in ug/g

** guideline less than detection limit

Exceeding Tier 1 Criteria

[1]Government of Nunavut, 2009. Environmental Guideline for Contaminated Site Remediation. Prepared by the Department of Environment of the Government of Nunavut, March 2009.

APPENDIX B: ANALYTICAL RESULTS

TABLE 4: South Fuel Bladder Facility - West Side - Soil Resampling After Excavation 27 August 2014

SAMPLE ID	F1 (C6-C10)	F2 (C10-C16)	F3 (C16-C34)	F4 (C35+)	Benzene	Ethylbenzene	Toluene	Xylene
Tier 1 Criteria - Industrial Coarse-grain[1]	***320 (ug/g)****	***260***	***1700***	***3300***	***0.03****	***0.082****	***0.37***	***11***
MP-FBF-A01	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-A02	<10	<10	30	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-A03	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-A04	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-A05	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-A06	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-A07	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-FBF-A08	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05

* all results in ug/g

** guideline less than detection limit

Exceeding Tier 1 Criteria

[1]Government of Nunavut, 2009. Environmental Guideline for Contaminated Site Remediation. Prepared by the Department of Environment of the Government of Nunavut, March 2009.

APPENDIX B: ANALYTICAL RESULTS

TABLE 5: North Fuel Bladder Facility Soil Sampling After Lined Encapsulation was Removed 24 August 2014

SAMPLE ID	F1 (C6-C10)	F2 (C10-C16)	F3 (C16-C34)	F4 (C35+)	Benzene	Ethylbenzene	Toluene	Xylene
Tier 1 Criteria - Industrial Coarse-grain[1]	***320 (ug/g)****	***260***	***1700***	***3300***	***0.03****	***0.082****	***0.37***	***11***
MP-BF-G1	103	2000	70	<20	<0.02	<0.05	<0.2	1.49
MP-BF-G2	28	480	100	<20	<0.02	<0.05	<0.2	0.09
MP-BF-G3	<10	80	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-BF-G4	<10	180	110	<20	<0.02	<0.05	<0.2	<0.05
MP-BF-H1	<10	20	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-BF-H2	15	200	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-BF-H3	31	380	<20	<20	<0.02	<0.05	<0.2	0.17
MP-BF-H4	<10	20	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-BF-I1	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-BF-I2	<10	980	280	<20	<0.02	<0.05	<0.2	<0.05
MP-BF-I3	<10	20	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-BF-I4	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05

* all results in ug/g

** guideline less than detection limit

Exceeding Tier 1 Criteria

[1]Government of Nunavut, 2009. Environmental Guideline for Contaminated Site Remediation. Prepared by the Department of Environment of the Government of Nunavut, March 2009.

APPENDIX B: ANALYTICAL RESULTS

TABLE 6: North Fuel Bladder Facility - West Side - Soil Resampling After Excavation 1 September 2014

SAMPLE ID	F1 (C6-C10)	F2 (C10-C16)	F3 (C16-C34)	F4 (C35+)	Benzene	Ethylbenzene	Toluene	Xylene
Tier 1 Criteria - Industrial Coarse-grain[1]	***320 (ug/g)****	***260***	***1700***	***3300***	***0.03****	***0.082****	***0.37***	***11***
MP-RBF-01	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-RBF-02	<10	70	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-RBF-03	<10	30	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-RBF-04	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-RBF-05	<10	30	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-RBF-06	<10	30	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-RBF-09	<10	40	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-RBF-10	<10	50	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-RBF-11	<10	20	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-RBF-12	70	740	50	<20	<0.02	0.09	<0.2	1.2
MP-RBF-13	<10	90	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-RBF-14	<10	40	<20	<20	<0.02	<0.05	<0.2	<0.05

* all results in ug/g

** guideline less than detection limit

Exceeding Tier 1 Criteria

[1]Government of Nunavut, 2009. Environmental Guideline for Contaminated Site Remediation. Prepared by the Department of Environment of the Government of Nunavut, March 2009.

APPENDIX B: ANALYTICAL RESULTS

TABLE 7: Hazardous Waste Berm 2 Soil Sampling 29 September 2014

SAMPLE ID	F1 (C6-C10)	F2 (C10-C16)	F3 (C16-C34)	F4 (C35+)	Benzene	Ethylbenzene	Toluene	Xylene
Tier 1 Criteria - Industrial Coarse-grain[1]	***320 (ug/g)****	***260***	***1700***	***3300***	***0.03****	***0.082****	***0.37***	***11***
MP-HWB2-01	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-HWB2-02	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-HWB2-03	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-HWB2-04	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-HWB2-05	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-HWB2-05Dup	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-HWB2-06	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-HWB2-07	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-HWB2-08	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-HWB2-09	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-HWB2-10	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-HWB2-11	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-HWB2-12	20	210	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-HWB2-13	<10	<10	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-HWB2-14	<10	50	<20	<20	<0.02	<0.05	<0.2	<0.05
MP-HWB2-15	<10	40	40	<20	<0.02	<0.05	<0.2	<0.05

* all results in ug/g

** guideline less than detection limit

Exceeding Tier 1 Criteria

[1]Government of Nunavut, 2009. Environmental Guideline for Contaminated Site Remediation. Prepared by the Department of Environment of the Government of Nunavut, March 2009.

ATTACHMENT C
Figures

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503 200 E
503 250 E
503 300 E
503 350 E

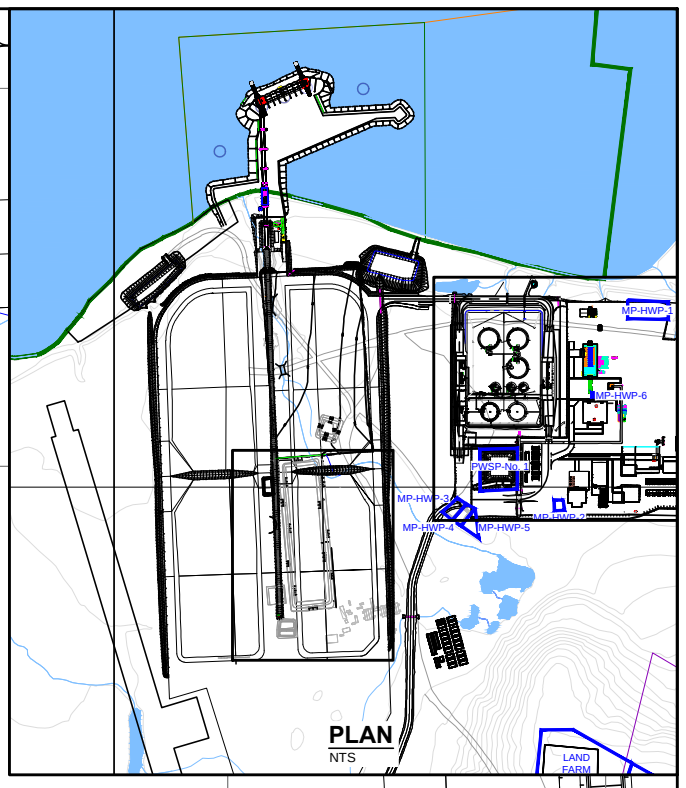
HAZARDOUS WASTE BERM 3

NORTH FUEL BLADDER FACILITY

SOUTH FUEL BLADDER FACILITY

HAZARDOUS WASTE BERM 2

7 976 000 N
7 975 950 N
7 975 900 N
7 975 850 N
7 975 800 N
7 975 750 N



PLAN
NTS

LEGEND

- WATER
- LAYDOWN AREA (CONSTRUCTION PHASE)
- RIVER/STREAM/DRAINAGE
- ROAD
- POTENTIAL DEVELOPMENT AREA

NOTES

1. COORDINATE GRID IS UTM NAD83 ZONE 17N.
2. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
3. PLAN/SECTION BASED ON INFORMATION PROVIDED BY HATCH, DATED (JAN 13, 2015).
4. CONTOUR INTERVAL IS 2.5 METRES.

xqiz 10 5 0 10 20 30 40 50 m
SCALE A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	13MAR'15	ISSUED WITH 2014 QIA AND NWB ANNUAL REPORT	LW	AS	LW	JM

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

MILNE PORT
2014 FUEL BLADDER FACILITY DECOMMISSIONING
SITE OVERVIEW

Knight Piésold CONSULTING

P/A NO. NB102-181/36
REF NO. NB15-00029
FIGURE E8.1
REV 0

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LE□EN□□

- BERM WALL
- EXCAVATION LIMITS FOR CONTAMINATED AREAS
- SOIL SAMPLE LOCATION
- SOIL SAMPLE LOCATION IN EXCEEDANCE OF APPLICABLE CRITERIA
- SOIL RE-SAMPLE LOCATION

NOTES□

1. COORDINATE GRID IS UTM NAD83 ZONE 17N.
2. PLAN/SECTION BASED ON INFORMATION PROVIDED BY HATCH, DATED (JAN 31,2014).
3. SURVEY COORDINATES FOR THE EXCAVATION LIMITS AND THE NEW BERM WALL COLLECTED BY MARG CALEY FROM NAMPCY SOLUTIONS LTD. (SEPT 18, 2013). COORDINATES FOR THE SAMPLE AND TEST PIT LOCATIONS WERE COLLECTED BY ANDREW VERMEER FROM BIM USING A HANDHELD GPS (2013).

SCALE A 5 2.5 0 5 10 15 20 25 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
0	13MAR'15	ISSUED WITH 2014 QIA AND NWB ANNUAL REPORT	LW	AS	LW	JM

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

MILNE PORT
SO□TH F□EL BLA□□ER FACILIT□
SAMPLIN□ LOCATIONS AN□ E□CA□ATION LIMITS

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-181/36	NB15-00029

FI□ □RE E□8□□ REV 0

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LEGEND

- EXCAVATION LIMITS FOR CONTAMINATED AREAS
- BERM WALL
- SOIL SAMPLE LOCATION
- SOIL SAMPLE LOCATION IN EXCEEDANCE OF APPLICABLE CRITERIA (REFER TO REPORT)
- SOIL RE-SAMPLE LOCATION
- SOIL RE-SAMPLE LOCATION IN EXCEEDANCE OF APPLICABLE CRITERIA (REFER TO REPORT)

NOTES

1. COORDINATE GRID IS UTM NAD83 ZONE 17N.
2. PLAN/SECTION BASED ON INFORMATION PROVIDED BY HATCH, DATED (JAN 31,2014).
3. SURVEY COORDINATES FOR THE EXCAVATION LIMITS AND THE NEW BERM WALL COLLECTED BY MARG CALEY FROM NAMPCY SOLUTIONS LTD. (SEPT 18, 2013).

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0	05MMM'15					

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

MILNE PORT NORTH FUEL BLADDER FACILITY SAMPLING LOCATIONS AND EXCAVATION LIMITS

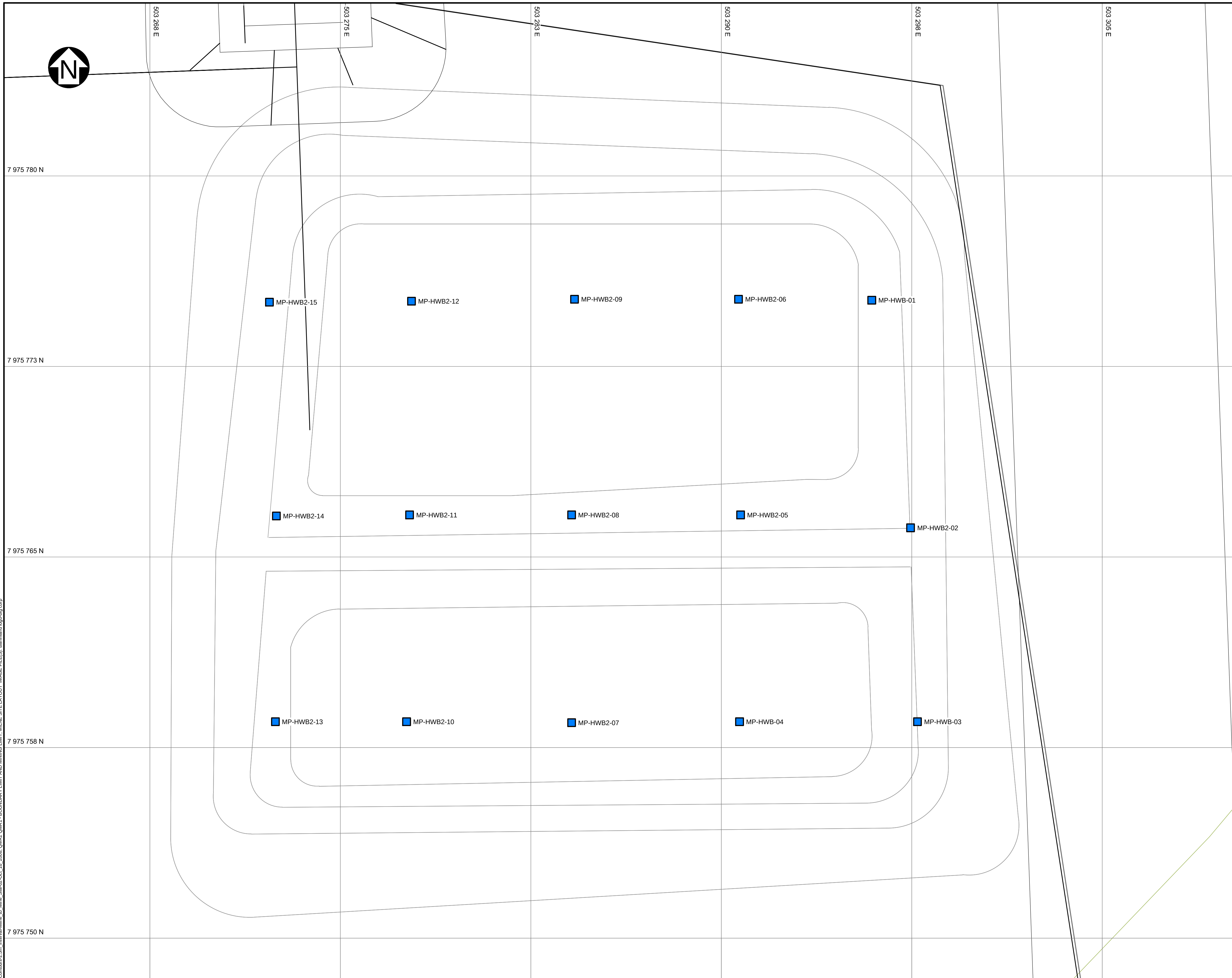
Knight Piésold CONSULTING

P/A NO. NB102-181/36

REF NO. NB15-00029

FIGURE B3

REV 0



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LE□EN□

- RIVER/STREAM/DRAINAGE
- ROAD
- SOIL SAMPLE LOCATION

NOTES□

1. COORDINATE GRID IS UTM NAD83 ZONE 17N.
2. TOPOGRAPHY PROVIDED BY EAGLE MAPPING (2005).
3. PLAN/SECTION BASED ON INFORMATION PROVIDED BY HATCH, DATED (JAN 31,2014).
4. CONTOUR INTERVAL IS 2.5 METRES.

SCALE A 1.5 0.75 0 2.5 5.0 7.5 m

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

MILNE PORT
HA□AR□O□S □ASTE BERM □
SAMPLE LOCATIONS

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-181/36	NB15-00029

FIGURE	REV
FI□□RE E□8□□	0

APPENDIX E.8.3

TOTE ROAD BORROW PIT INVESTIGATION

TETRA TECH EBA

INSPECTION OF THE MILNE INLET TOTE ROAD AND ASSOCIATED BORROW SOURCES



PRESENTED TO

Baffinland Iron Mines Inc.

MARCH 2015
ISSUED FOR USE
FILE: E14103210-01

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1.0 INTRODUCTION

Tetra Tech EBA Inc. (Tetra Tech EBA) is pleased to submit this report to Baffinland Iron Mines Corporation (BIM) regarding the assessment of permafrost conditions along the Milne Inlet "Tote Road" and associated borrow sources. This work is a follow up to a 2009 site visit and report by Tetra Tech EBA (EBA, 2009).

The Tote Road was redesigned for heavy hauling in 2013 and is currently being upgraded.

This inspection/assessment involved visual assessment of the "Tote Road" and borrow sources to observe any changes since 2009.

1.1 Project Description

An access road was constructed to connect the Mary River Camp to tidewater at Milne Inlet on Baffin Island from August 2007 to October 2008. The original purpose of the road was to provide a route for trucks to haul a bulk sample of the iron ore from the Mary River deposit to a port site at Milne Inlet, a distance of about 100 km. Initial construction plans were to use three permitted quarries and borrow sites, but the haul distances were considered impractical and construction materials were supplemented by sources within the 30 m road alignment right-of-way (ROW). This resulted in over 90 borrow sources along the length of the road, of which 81 were documented and evaluated in 2009 (EBA, 2009).

The routing follows an overland cat-train access route established in the 1960s. The road design and construction are described in a comprehensive as-built report by Knight Piésold Consulting, entitled "Milne Inlet Tote Road Construction Summary," dated February 5, 2009.

BIM is currently upgrading some portions of the tote road; this includes some realignment, widening and repairs because the road will be used to haul iron ore to the Milne Port during the early revenue phase of the mining operation. The ore is to be hauled in purpose built B-train trucks, each capable of hauling a total of 150 tonnes of ore.

In September 2014 Tetra Tech EBA undertook follow up work based on the 2009 inspection, targeting and identifying changes from the previous work and the ongoing upgrading of the road. This included:

1. Inspection of the majority of borrow and quarry areas, noting changes from the 2009 inspection;
2. Commenting on the applicability of previously developed reclamation objectives and criteria;
3. Development of a conceptual work plan for each borrow/quarry site as required;
4. Inspection of the tote road to evaluate areas of potential instability; and
5. Preparation of a report (this report) that documents the above.

This report follows the precedent established by the 2009 work, and groups the borrow sources into priority areas.

- Priority A areas are those where active ground ice thaw is affecting both the borrow source and adjacent road. These constitute a potential safety hazard for continued use of the road. The current evaluation adds another level of Priority (A+) to the ranking system used in 2009 to break out areas where there is the potential for failure of the road embankment posing risk to vehicle and operator safety, given the increased level of road utilization.
- Priority B areas are those where active thaw and sinkhole formation is ongoing. These are not currently affecting the road but are trapping surface runoff.

- Priority C areas are those where the terrain has been judged to be relatively stable. They will require some site grading and surface dressing, but the timing is not as significant.

Corrective actions are recommended below for the various borrow sources.

1.2 2014 Reconnaissance

The field assessment of the tote road and borrow sources was carried out by Kevin Jones, P.Eng, from September 4 to 9, 2014. Mr. Jones worked together with Mr. Trevor Myers, Environmental Superintendent for BIM. Mr. Myers is a long-term employee of BIM and his knowledge of site conditions and the changes that have been occurring along the road over the past 5 years and was invaluable in determining the performance of the road and pits since last inspected in 2009. The field work involved both truck based and helicopter supported reconnaissance of the road and borrow pits.

2.0 SITE CONDITIONS

2.1 Permafrost

The Mary River Mine is located in North Central Baffin Island. The closest community is Pond Inlet, on the coast about 150 km north of the mine. The normal mean annual air temperature reported for Pond Inlet is -14.6ºC (1981–2010 Canadian Climate Normals). The cold climate sustains continuous permafrost throughout Northern Baffin Island with ground temperatures anticipated to be -8ºC to -10ºC along the route. For the most part, the tote road routing follows glacial valleys that have been infilled with granular material that varies in texture from silty sand to sandy gravel with cobbles and some boulders. Most of the deposits are either post-glacial river terraces or proglacial lacustrine basins. The lake basin segments are table-top flat with finer grained silt and fine sand prevalent. The terrace-like features are poorly sorted (dirty) gravels. The active layer is expected to be thin in the lake sediments (less than 0.5 m) whereas the higher, well-drained terraces probably support an active layer of 1.5 m or more.

Ground ice occurs throughout the region in the upper permafrost soils as predominantly:

- wedge ice (vertical crevasses of ice),
- segregated ice (horizontal lenses), or
- massive ice (tabular bodies).

The wedge ice is the most striking feature in the region of naturally well-drained granular uplands. These show up in aerial oblique photos, such as Photo 1 as polygonal patterned ground comprising a series of orthogonal cracks that are the surface expression of ice wedges that occur to depths up to 3 m into the permafrost.

Wedge ice that is exposed at the surface within the pits after the thawed active layer soils have been removed will begin to thaw from the top down, resulting in a linear depression such as shown in Photo 2. The thaw-depression will typically trap water that sometimes becomes mobile, running along the top of the ice. These features often extend under the road embankment. The thaw initiating within the adjacent pit can feed water into the ice wedge under the side slope of the road embankment resulting in thermal erosion that frequently leaves a transverse void below the side slope. When this happens in a road that is in service, the expanding void can precipitate a failure of the slope of the embankment and occasionally a failure under the travelling surface as well. This is a safety concern for operations over the road in these types of areas. This mechanism of wedge ice thaw, feeding water into cavities that extend under the road is the cause of a number of significant settlements on side slopes, shoulders and under the travelling surface of the road observed during the route reconnaissance such as the site shown in Photo 3.

Segregated ice occurs as thin lenses in all the finer grained silty soils. It is most prominent in soils of glaciolacustrine origin. The ground ice distribution is erratic, but it is commonly found with greater concentrations in naturally wet basins. When these soils are exposed within the pit bottom, the consequences are sinkhole depressions that soon become water-filled, interrupting any natural surface drainage. An example of a pit floor affected by melt out of segregated ice is shown in Photo 4.

In 2009 massive ice was identified at only one location (km 63.7). Massive ice is generally large tabular bodies of ground ice. They have been attributed to either regions of groundwater discharge or buried ancient glacial ice. Observations of the deposit at km 62.5 in 2014 indicate that there was also probably lots of massive ice in this deposit. Extensive settlement has occurred in this deposit due to thaw resulting from removal of the material in the active layer in this deposit since 2009 as shown in Photos 5 and 5A from 2009 and 2014, respectively.

A massive ice body was found at km 89.3 in a shallow cut on the south side of a section of the tote road that was being realigned at the time of the 2014 reconnaissance (Photo 6). Discussion with the construction crew indicated that the cut along this section had encountered much of this type of material. It is understood that the road embankment fill is a minimum of 1.5 m thick and therefore should provide suitable thermal protection to the centre of the road embankment. The cut outside the road embankment was supposed to be covered with some rip rap material to lessen the potential for erosion. However, a relatively thin fill over massive ice will not entirely eliminate thaw and it is expected that thaw settlement will happen at the toe of the slope, potentially leading to instability of the side slope of the road embankment that could eventually impact the travelling surface. Additional stabilization may eventually be required. Further discussion of potential road instability locations is presented in Section 4.0.

Both massive ice and wedge ice must be protected from retrogressive thaw by replacing the stripped active layer soils with an appropriate new cover to arrest further thaw and settlement that can carry on for decades.

2.2 Borrow Site Summary and Grouping

The 2009 work was carried out to guide possible progressive reclamation activities for the numerous borrow pits. Minor reclamation has been conducted to date. Ongoing road upgrades include: minor changes to the alignment, minimizing grades, and increasing embankment widths for the purpose of improving safety and compliance with applicable Mine Safety Regulations. Cut and fill construction methodologies have been used to source and obtain materials adjacent to the road alignments for the purpose of supporting this work. In most locations, the current condition of some of the pits can be directly compared to the conditions observed in 2009. A summary of the 2014 conditions noted at each of the 81 sites examined in 2009 plus an additional 20 locations is included in Table 1. The sites have been grouped into four broad categories that reflect the reclamation criteria and stability of the road embankment as follows:

- Priority A+ pits (7%) – where thaw settlement initiated by pit excavation is actively affecting the road integrity, and there is a higher risk of failure,
- Priority A pits (11%) – where thaw settlement initiated by pit excavation is actively affecting the road integrity and safety,
- Priority B pits (26%) – where active thaw settlement and water accumulation is ongoing in unstable terrain within an abandoned pit, and
- Priority C pits (57%) – are relatively stable but will need reclamation attention to improve site aesthetics and ensure long-term stability.

There are quite a few sites that are not on the list. They are generally small, shallow depressions where limited material was removed. They can be considered as Priority C

In comparison with the 2009 evaluation it can be noted that there has been an increase in the percentage of Priority A plus A+ sites since 2009 from 9% to 18%. This indicates that continued degradation in the pits has led to an increase in the number of higher risk sites. In a few locations the priority has been downgraded because the pits seem to have self-stabilized.

A detailed photographic record from the route reconnaissance was prepared and is included on a DVD with this report. The photos taken during the 2014 aerial reconnaissance phase range from numbers 1531 to 1672 and 1716 to 1720, and the ground reconnaissance photos range from 1487 to 1530 and 1673 to 1716. It should be noted that not all of the photos pertain to borrow pits, rather some have simply been included in the record and in Table 1 to document locations where the road is particularly stable or in two instances, to document the condition of the new bridges. The photo locations are shown by number on the route maps in Figures. The route maps also show the locations of photos taken during the 2009 reconnaissance. The 2009 photos are also reproduced in the included DVD. These constitute a useful reference of the condition of the pits at the time of the reconnaissance and the changes in the condition of the pits and road since 2009.

3.0 BORROW PIT RECLAMATION METHODS

Table 1 includes a brief comment for each site on where the reclamation focus should be and is followed by more detailed comments on suggested processes to follow. The reclamation process should be structured around the basic principles of:

- Restoring stability to actively thawing ground ice by replacing some of the cover material removed during excavation;
- Developing drainage that will limit standing water that can exacerbate thaw within the pit;
- Caring for natural runoff from the pits in a manner that will reduce the risk of erosion and sedimentation over undisturbed tundra; and
- Improving site topography to encourage natural revegetation and enhance site aesthetics.

The sites identified as Priority C are the least sensitive and could generally be reclaimed by site grading and dressing of the slopes. A typical Priority C site is shown in Photo 8. The Priority A and B sites are judged as not currently stable and therefore will require attention directed to the ongoing thaw of permafrost and surface water management. The following discussion provides guidance for planning reclamation that will address these objectives. The Priority A+ sites warrant immediate attention because there is a potential for failure of the road surface which is particularly worrisome given the significant increase in traffic that the road will be seeing now that ore is being hauled to Milne Inlet.

3.1 Restoring Surface Stability

The Priority A+ and A pits are experiencing ground ice melt out that is affecting the adjacent road embankment. Past experience has shown that the consequences can be a serious safety hazard. It is recommended that the road embankment be upgraded at these sites on a first priority basis, with the A+ sites being the highest priority. The upgrading will require strategic placement of granular cover over the thawing soil with the ultimate purpose of drawing the permafrost back up into the fill. The steps for reclamation should include the following:

- Construction of side berms a minimum of 3 m wide on the road shoulders where active cracking and settlement is observed. The berms should be a minimum of 1.5 m thick and also to an elevation above any that where there is possibility of being overtopped by ponded water in the future. It is also preferable for them to be at an elevation of 1 to 1.5 m below the final top of road fill at the location.

- Add material to raise the embankment height. Suggested final fill height increases at the various sites is included in Table 1. The height increase should be a minimum of 1 m, and in some cases, 1.5 m to 2 m is suggested.
- Improve drainage such that water does not pond at the toe of the embankment. In some cases this may require filling sinkholes and ice wedge melt out features with imported gravel.

An alternative to berm construction for sites where the thaw has not yet progressed under the road embankment but is affecting the sideslopes is to widen the grade and flatten the sideslopes. The current road shoulder should be widened 0.5 m to 1 m and the slope flattened to 4H to 1V. Table 1 provides guidance on those sites where slope flattening is an option. They include many of the Priority B sites. Where slope flattening is applied, consideration should be given to the extent that water can continue to pond at the toe of the slope. One of the primary benefits to be gained from slope flattening is to push any ponded water further from the embankment slope.

Some Priority A and B sites have developed substantial sinkholes within their pit bottoms. Where these have been observed, regrading the surface to fill the sinkholes has been recommended. In some cases, this may require importing fill from another nearby site that is still active and can confidently produce material without exposing new wedge ice. Those sites are identified in Table 1.

3.2 Drainage Improvements and Erosion Protection

Ponded water within the borrow pits retards winter freeze-back of the active layer and will result in retrogressive thickening of the active layer. Once this process starts, it is difficult to reverse. Shallow ponding (less than 0.5 m deep) that is short-lived following freshet is not a particular concern. Those ponds that are retained throughout the summer and continue to deepen with time will be counter-productive to the reclamation efforts.

Table 1 identifies a number of options for improving site drainage at specific pits. In most cases, there is an obvious routing for trapped surface water from the pit to a nearby stream or onto the tundra. In some cases, it will be necessary to install a new culvert under the road embankment. Some pits are identified in the table where additional field work will be required to determine the drainage improvement options for those sites. This will probably involve site surveys to establish the natural topographic grades or if there are options that involve minor ditching.

Substantial ditch excavation into undisturbed active layer soils should be avoided wherever practical. Where new ditching is the only practical option, care should be taken to determine the nature of soils and ground ice that will remain exposed following excavation.

In cases where surface water will be directed to undisturbed tundra, it must be dissipated rather than channelled to avoid local erosion. Dissipation can be achieved by strategic use of cobbles and boulders to dissipate energy just before the water exits the pit area.

3.3 Surface Grading

All the pits will require surface grading that will range from filling sinkholes in the Priority A and B pits to simply dressing the current surface in most Priority C pits. Obvious ridges that can impede surface drainage should be removed and final surface contour developed to ensure drainage. The surface should not be left completely smooth. It is common practice at the end of surface grading to track the surface with tractor grouser bar ruts. These will trap fines and dissipate energy from runoff. The shallow grooves left in this manner will also improve the possibility for long-term natural revegetation by providing seed traps.

The backslopes in most pits are remarkably stable. Those steep slopes greater than 2 m in height should be graded to a final slope of 3H to 1V. It is preferable to flatten the slopes by mounding new fill at the toe rather than cutting

further into undisturbed tundra. The steeper pit slopes observed were generally of a height less than 2 m and were not visibly active. These shallow cut slopes that are currently stable are better left to seek their own long-term condition rather than risk further disturbance to the underlying permafrost.

4.0 TOTE ROAD INSTABILITY

As noted in Section 2.2, some of the borrow pits (the Priority A+ and Priority A pits) are adversely affecting the stability of the road due to thaw of ice-rich materials immediately at the edge of the road or toe of the road embankment. In many cases the road surface is unstable and settlements are extending under the road, indicating thaw of ice-rich soils and in particular wedge ice. In other locations, thaw in the adjacent borrow pit has led to embankment side slopes at the natural angle of repose with deep holes of up to 5 or 6 m immediately at the edge of the embankment. Roads in other Arctic locations have sometimes displayed sudden collapse of the road surface when vehicles pass over an area where the road structure has bridged over a void resulting from thaw of an ice body. This type of failure has led to vehicle crashes and in some instances operator fatality. In other locations, loss of support for the toe of the embankment has led to near instantaneous collapse of the road slope sometimes significantly reducing the width of the travelling surface.

Although not a problem at the time of the inspection during September 2014, it is anticipated that the rather extensive cut recently excavated along much of the road between roughly km 87 and km 90 may significantly degrade, leading to potential instability of the road. Removal of the active layer soils and in some locations cuts into the permafrost have left frozen soils exposed, some of which are very ice-rich as shown in Photo 6. These can be expected to thaw for the first time in the summer of 2015.

The areas where more significant safety hazards are felt to exist on the tote road are identified in Table 1 as Priority A+. Photos of these areas are presented in Photos 8 to 14.

With the recent move to much higher traffic volumes and much heavier loaded vehicles on this road, it is strongly recommended that the identified areas of observed instability on the tote road be addressed as soon as possible to remove safety hazards.

5.0 CONCLUSIONS

The focus of this project has been to compare the state of the previously existing borrow pits used in the construction of the Tote Road with the conditions observed today, roughly 5 years later. The 2009 evaluation identified general guidelines for developing a practical and acceptable plan for reclamation of the borrow pits. Both the 2009 and 2014 site observations have established that there are clear links between some borrow pit locations adjacent to the road and the thaw settlement observed on the road embankment. In some cases, tundra disturbance caused by pit excavation is affecting road integrity.

Although not a problem at all locations examined, sourcing material from areas by means of roadside borrows immediately next to the road embankment can be problematic. Consideration should be given where practical to leave an untouched “buffer” zone between the edge of the road and roadside borrow pits. This would eliminate the potential for thaw induced settlements impacting the stability of the road surface. Also, visual examination of permafrost terrain features evident on the surface of a borrow prospect can identify in advance, those deposits that may be potentially prone to thaw settlements and instability if disturbed.

The photo library and documentation in this report and the 2009 report have provided a basis for monitoring changes and adapting the reclamation process in a step-wise manner. The Priority A+ and A pits should be addressed first with attention to the Priority A+ pits, immediately. Where new gravel cover is necessary for protection of the

permafrost, care must be taken to ensure it is harvested at a location that does not contribute to further degradation of the permafrost.

6.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
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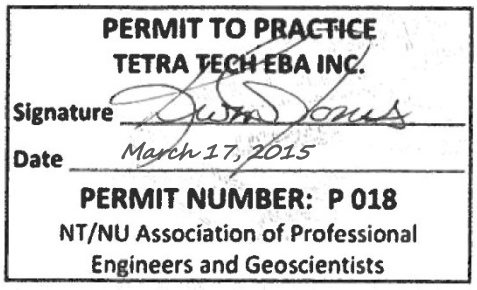

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TABLES

TABLE 1: SUMMARY OF PIT OBSERVATIONS AND CLOSURE RECOMMENDATIONS

		2009 DWH										2014 KWJ			
Site WP No. 2009	Km Post	General Location Comments	Pit Water 2009	Erosion Potential	Ground Ice Features	Active Layer Stability	Reclamation Focus	Priority	Ground Photos	Aerial Oblique Photos	2009 Comments	Priority	Ground Photos	Aerial Oblique Photos	2014 Comments
8	98.2	Off ROW permitted	Minor ponding	Low	Abundant wedge ice	Fair	Drainage improvements	C		557, 558	This pit is within off ROW permitted and should be regraded and closed with future material taken from Area 1.1	C	1496, 1497, 1498, 1499	1531	No change
9	97.8	Off ROW permitted	Minor ponding		Extensive wedge ice	Fair	Regrading surface and slope	B		559, 560	This pit within permit area should be reclaimed. Pad and flatten south slope of road to limit further thaw of wedges and erosion. Improve drainage without further impact on natural tundra wedge ice lying to the south of disturbed area.	B			Some regrading has been carried out which has improved drainage and pit remains stable
10	97.4	Off ROW permitted	Major ponding	Low	Massive ice	Unstable, extensive thaw occurring	Pump out ponds, berm road sideslope on south side such that no water can pond at toe. Regrade pit bottom	B	675	561	Pit is still within quarry permit area but should be reclaimed soon. Extensive thaw settlement is occurring. Future materials should be taken from source 11.	B			Thaw settlement is continuing and pit should be reclaimed as noted in 2009.
11	97.3	Off ROW permitted	Major ponding	Low	Wedge ice	Moderately stable	Improve natural drainage and develop a plan for an ongoing pit at this location	C	676	562	This is currently the best source of gravel in the vicinity of Mary River Camp. It is permitted for development off the ROW, and the material is relatively well-graded alluvial gravel. This pit has ongoing value for the development. A pit development plan should be prepared that will allow efficient stockpiling of the material in a manner that deals with surface water and thaw generated water. The plan should include site reclamation.	B	1487, 1488, 1489, 1490, 1491	1532, 1663, 1665, 1666, 1667, 1668, 1669	Separate memo issued by Tetra Tech to comment on the Hatch 2013 reclamation plan for this pit. In general there has been a considerable amount of thaw and associated settlement since 2009. Plan calls for regrading, filling low areas and making provision for draining collected pit water.
11A	96.6											C		1533	Road realignment and new pit. Ice wedges are visible but as yet there has been no melt out. This should be monitored as the materials have been removed from immediately beside the road.
11B	95.4									563, 564		C		1662	Active borrow pit on left side, some evidence of thaw subsidence, will require regrading
11C	93.8											C		1661	Reclaimed borrow area that has recently been used as a source of material, pit/quarry is in very stable condition, no further work required.
12	93.0		Runoff impounded	Severe	Unknown	Unknown	Culvert needed	A	677		The road crosses a natural valley at this site, and water is trapped against the upstream road embankment. The pond must be drained by culvert installation to prevent thaw and collapse of the embankment and risk of significant downstream erosion. The disturbance from scavenging active layer material on ROW is minor at this site.	B		1660	Water continues to pond at this location but is now released through a culvert. Water is quite turbid in the pond. The road has been regraded and widened at this location and now appears to be stable
13	92.5		Runoff impounded	Moderate	Unknown	Unknown	Culvert replacement/repairs needed	A			This site has a drainage interruption issue that needs attention. Not a soil borrow site.	C			The drainage issue has been addressed at this location with the installation of a culvert that is operable.
13A	90.9											C		1659	Realignment to improve grade. It appears that material has been obtained from roadside pits both north and south of this location. So far these pits appear to be stable.
14	89.8		Substantial	Moderate	Unknown	Unstable	Pit directly adjacent to south toe of road embankment. Ponding threatens to undermine road	B	678		The active layer was pushed up to form the embankment at this site. Substantial ponding is present in disturbed area. Site needs to be regraded and drainage established to the south where a new culvert can be installed that will lead to a natural drainage course.	A		1534, 1657, 1658	Thaw settlement and ponding is continuing to worsen and pit reclamation should be considered very soon to avoid potential road embankment instability. This pit is located immediately beside a large pond that is obviously a natural thermokarst pond, indicative of massive ground ice at this location
	89.3											A	1712, 1713	1656, 1716, 1717	Realignment of road with a cut on the west side of road exposed massive ground ice in the ditch, extensive thaw settlement is expected unless this exposed ice is covered by 1.5 m or more of fill to re-establish an active layer.
	89.0											B	1495	1535, 1718	Realignment of road is in a cut section, cut has exposed frozen soils in the west side ditch, with the removal of the active layer it is expected that thaw settlement will occur perhaps leading to loss of support for the toe of the embankment.
15	87.7		Moderate	Moderate	Substantial segregated ice throughout silty material	Unstable	Improve drainage along the south embankment sideslope convey ponded water to the existing culverts	B		567	Material exposed at this site is predominantly silt. Thaw-subsidence will continue. The strategy for reclamation must be to improve drainage using existing culverts and continue to regrade the surface until the active layer stabilizes. Keep ponded water from accumulating against the toe of the embankment. The exposed silt at this site is very mobile; thus, erosion protection measures may be required when improving site grading.	B		1536, 1655	Thaw subsidence has continued, road has been recently regraded and raised but water is still ponding at the toes of the very steep side slopes of the embankment at this location. There is concern for embankment stability and the side slopes should be flattened to enhance stability
	87.0											C		1654	Not a borrow pit but water is being impounded on the upslope side of the embankment and appears to be leading to some thaw settlement. A culvert should be installed at this location to remove the ponding issue.

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15A	86.5											**C**		1537, 1653	Material was actively being removed from this location, it is a silty sandy gravel material and there is potential for sediments to be released from this pit which is simply cut into the hillside beside the road, Pit should be monitored to evaluate thaw and sediment generation.
16	86.2		Moderate	Severe	Minor	Stable	Long-term drainage improvements	B	679		This is a deep pit pond that has established on the south side of the road. Soils in this area are controlled by a weak carbonate sandstone that readily decomposes into fine uniform sand. The pond is currently functioning as an effective sedimentation pond. Water is clear and the pond seems to be stable in a region of minor thaw-subsidence. It is recommended that the pond remain and that a new and higher culvert be placed through the road to allow the surface water to drain into the creek and subsequently the lake. The road embankment should be raised a minimum of 1.5 m at this location to protect the permafrost and provide cover for the new culvert.	**B**		1652, 1719	Recommendations for raising the road embankment should be followed but in general the area displays little change since 2009.
16A	84.3											**C**		1539, 1651, 1720	New pit on left appears very stable
16B	82.3											**C**		1540	New pit on left appears very stable
	80.6													1541	Photo of stable road
16C	80.0											**C**		1542	Assumed new pit near south abutment of new bridge. Materials assumed to have been used for bridge approach fill construction. Pit appears stable, requiring little reclamation effort.
	78.3													1543, 1544	Stable road embankment and multi culvert installation
	77.6													1545	Photo of stable road
17	74.9		Not practical	Low	Not apparent	Stable	Surface dressing and erosion protection	**C**	681, 682	580	This is a long section where the active layer soils have been pushed up from both sides to form the embankment. North (left) side is dry and stable — surface dressing only required. The south (right) side has a deep pond (Photo 681). The surrounding terrain is flat thus little opportunity for natural drainage. The ponds are not affecting the embankment, and ground ice seems minimal. The ponds can be left following site grading with some armour placed on the adjacent sideslope to prevent erosion and dusting.	**C**		1546	Pond on south side of the road looks the same as it did in 2009. Overall there is very little change in the borrow pit.
18	74.6			High	Not apparent	Stable	Protect outlet at north end from erosion	B	683		Sandy active layer soils have been removed on ROW for embankment construction. Minor thaw subsidence or ponding within pit floor. Outlet for water at north end flows downhill into a creek. Substantial risk of erosion on that sandy slope during freshet. Recommend armouring the outlet with coarse materials and cross berm for erosion protection. Dress pit floor.	**C**		1546	There does not seem to be evidence of sediment movement downslope to the creek so armouring may not be necessary.
19	73.7		Uncertain	Moderate	Substantial wedge ice	Unstable	Protection of road sideslope	**B**		581, 582	This site is locally very ice rich. Water ponded along road shoulder is a threat to the road. Drainage improvement options are not obvious and should be reviewed further in the field. If ponds cannot be drained, construct a berm to an elevation above water level that will push water back 3 m from embankment slope.	**B**		1650	Site seems to have stabilized somewhat and there is less ponded water. Some of the thaw settlement areas have deepened. There is no immediate concern for the stability of the road embankment so berms may not be required. However, the stability would be enhance by some reclamation activity including regrading.
20	73.3		No	Low	Not apparent	Stable	Dress pit floor	**C**			Small active layer pit. Dry and stable. Dress the surface.	**C**		1649	No change
21	73.0		No	Low	Not apparent	Stable	Potential future use	**C**			Top of hill, small quarry in rock. Could be a source of materials for road repair and dressing or filling sink holes in nearby pits. Can be easily reclaimed by surface grading.	**C**		1648, 1649	No change, remains an excellent source of material for the future.
22	72.3		Drain and fill all ponds within 3 m of the toe of embankment	Moderate	Wedge ice, possibly massive ice	Active sinkhole formation	Road embankment safety	**A**	684, 685, 686, 687	584	The pit on the north (left) side has become a large sink hole that is actively undermining the sideslope and crest of the embankment. Wedge ice appears to extend under the road, and there is a potential for water to flow through any wedge cavities. Active cracking is occurring well into the driving lane. This is a priority site for repairs. Substantial risk of a road surface collapse exists. The sinkhole pond should be either drained or pumped and the road grade raised. A berm 3 m wide should be constructed in areas of active embankment sloughing. The site should be frequently observed when the road is used for haul traffic.	**A+**	1500, 1501, 1502, 1503, 1509, 1510	1547, 1548, 1549, 1646, 1647	Sinkholes continue to increase in size with water being impounded immediately at the toe of the embankment in many locations. The road grade has been raised here which will help to protect the permafrost underlying the embankment. However, the extensive ponded water and large settlements point to the need to fill in the pits or at a minimum create toe berms along both sides of the embankment where water is currently ponding. This remains a particular priority pit as there is potential for catastrophic failure of the road embankment.

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23	71.6		Regrade and fill	Low	Extensive, distributed	Sinkholes active in pit floor	Regrade and fill	B	691		This site has active sinkholes below surrounding terrain. Some water trapped. May require imported fill from other sources to regrade the pit floor.	B		1645	No change
	69.8													1550, 1644	Photos of stable road
24	67.8	Communication Tower		Low	Not apparent	Stable	Flatten embankment slope by filling out into pond displacing water	C			Small water-filled pothole left following material excavation. No obvious natural drainage potential. Complete reclamation would require infilling. Nearby material sources are not obvious.	C	1504, 1505, 1506	1551	No change
24A	66.4											C		1643	Pit is stable and requires no reclamation other than simple regrading.
25	66.0		Clean ditch along toe of slope	Low	Not apparent	Stable	Regrade surface	C		585	Colluvial soils scavenged from hillside above road for embankment. Site is stable requires cleanup and dressing with improvements to drainage along toe of slope.	C			No change
26	64.4	Active Pit	Well drained	Low	Not apparent	Stable	Regrade surface	C	692	586	This pit remains active with reasonable construction material. Drainage is currently good, but further excavation within ROW will probably initiate ponding. Should material continue to be removed, a pit development and reclamation plan should be prepared.	C			No change
27	64.0		Poorly drained	Low	Not apparent	Moderate	Fill and regrade	C			This is a small pothole filled with water. Site should be regraded and fill added to improve drainage.	C		1552	No change
28	63.3	Active Pit	Dry	Low	Not apparent	Stable	Dress surface	C			Both sides of road. Naturally well-drained silty gravel. No sinkholes. Grade surface at closure.	A+	1513, 1514,	1553, 1641	Ice wedge melt out is visible on both sides of the road and settlement along the wedge is visible across the road. There is now concern for failure of the road. Reclamation requires filling in the settlement areas on both shoulders as soon as possible. Increasing the road surface elevation by 0.5 m would also help in changing the thermal regime in the embankment itself.
29	63.0			Severe	Massive ground once observed in pit. Wedge ice under road.	Unstable, extensive thaw	Rebuild road grade	A	693, 694, 695, 696, 697, 698	587	This is the most ice rich site noted. Remnants of massive ice were found in large thaw depression on south side of road. Ice wedges are actively melting under road sideslope Cracks and depressions extend to the shoulder. To reduce risk of road collapse, the grade should be raised at least 1 m through this area and berms a minimum 3 m wide constructed on the south sideslope. Final reclamation of this site will require further assessment of the best method for ensuring drainage from the sink hole without risking siltation of the creek valley immediately to the south.	A	1515, 1516, 1517	1554, 1640	Extremely ice-rich material exists on both sides of the road. Thaw settlements have been significant since 2009. Many areas of settlement exist immediately beside the road embankment and there is evidence of settlement of the road itself. There is a risk of road collapse in several locations. Settlement areas beside the road should be backfilled as soon as possible to arrest further thaw settlements from impacting the stability of the road.
30	62.3L											B	1529	1638, 1743	New alignment is visible. Considerable material was recently removed from the active layer on the east side of the old alignment over a very large area. Ice wedge melt out was already being noted in this area. There is potential for some slope instability and sediment transport towards the river from this area. This should be monitored to see if some form of sediment capture system might be required downslope from the pit development area.
30	62.2R		Dry	Low	Not apparent	Stable	Regrade	C	703	593, 653	River terrace. Active layer gravel removed over a large area. Site is dry and naturally well drained. Regrade surface for reclamation.	B	1518, 1519	1555, 1638	Recent removal of material from the active layer has initiated thaw and instability in this kame type deposit. It is anticipated that there is considerable ground ice in this deposit. It is suggested that further material should not be removed from this deposit. The stability of the deposit should be monitored closely because of its proximity to the river.
	62.1												1520, 1522, 1523, 1524		New bridge, note some apparent movement/tilting in the bin wall foundations for the new bridge.
31	61.7	Midway Pit, Off ROW permitted	Minor ponding	Low	Wedge ice on south-facing slope	Stable	Regrade	C	706	590, 653	The active layer has been stripped over a substantial surface area. Gravel is well graded and free draining. The site can potentially produce more gravel by progressive stripping as it thaws or by drill and blast. A pit development plan including reclamation planning should be developed if borrow material harvesting is continued at this location.	B	1525, 1526, 1527, 1528, 1530	1637, 1746	Extensive thaw settlement is occurring in the large area where the active layer soils were removed. This is indicative of massive ice in this deposit. Material is of good quality and lots of additional material could be obtained from this pit. Care must be exercised to control runoff from the area during development. Photo 1530 does show some instability due to thaw settlement near the road. this area should be stabilized by regrading combined with placement of fill at the toe of the slope to arrest thaw.
	61.0													1636	Photo of stable road north of borrow pit 31

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	58.0													1556, 1635	Photos of stable road and old airstrip (1635)
32	56.2R		Moderate	High	Substantial wedge ice	Unstable	Improve site drainage	B	710	594, 595, 649	Pit excavated in ice-rich sandy gravel. Active thermokarst and ponding. Regrading to fill ponds required. Develop drainage to the east along north side of road. Construct a coarse boulder apron at outfall onto tundra.	A	1711	1557, 1633, 1634	Thaw and settlement has continued and there is now considerably more ponded water. Discussion with the construction crew indicated that the road might be realigned at this location but the new road would likely go through the large ponds. The pond should be filled to reduce the potential for further thaw settlement and the loss of support for the road embankment.
33	56.2L		Severe	Moderate	Not visible	Unknown	Drainage enhancement	B		594, 595, 649	Pit water is intended to drain to a small culvert under road at west end of pit. Continued settlement has left invert of culvert too high. Consider draining along north (left) toe of road grade to natural draw about 100 m south and placing a new culvert through road at that location. Consult Photo 649.	A	1711	1557, 1633, 1634	Thaw and settlement has continued and there is now considerably more ponded water. Discussion with the construction crew indicated that the road might be realigned at this location but the new road would likely go through the large ponds. The pond should be filled to reduce the potential for further thaw settlement and the loss of support for the road embankment.
34	55.3		Minor	Low	Not apparent	Unknown	Grading	C			Regrade and improve drainage.	C			No change
35	54.8	Risk of road collapse	None	Low	Wedge ice	Unstable	Protecting road embankment	A	711, 712	596, 597, 648	A small excavation on the upslope side of the embankment has allowed water to penetrate into Wedge Ice initiating thermal erosion. The road grade was actively collapsing into thaw depressions at the time of the visit. There is a high safety risk of total collapse. The road must be bermed on both sides for a distance of 3 to 4 m and the embankment raised to accommodate settlements that have occurred. The side slopes should be dressed along with disturbed areas. The site should be monitored during periods of high road use until stability of the permafrost is assured.	B		1632	Stability has improved with some berming of the embankment and the embankment does not seem to be at risk of failure now but should be monitored once the road sees increased traffic.
36	52.5		Minor	Low	Not apparent	Stable	Protecting road embankment	C			Small pothole pit beside road. Material stockpile. The shoulders of the road should be dressed and slopes flattened.	C		1559	No change
36A	52.4							C				C		1560	Some material removed from the edge of this kame type deposit. There is obviously massive ground ice in the deposit as evidenced by the settlement in the portions of the deposit where material was removed from the active layer. Stability should be monitored as there may be potential for sediment release. At present there is no impact on the stability of the road
37	52.2	Road collapse	Dry	Low	Wedge	Unstable	Protecting road embankment	A	713, 714	598	Active sinkhole on immediate north side of embankment has extended under the road resulting in grade collapse about 1/2 m. Selective excavation of the road fill and underlying ice at this site is recommended followed by rebuilding grade with compacted material. Raise the final grade 1 m or more above current elevation and flatten side slopes.	A+	1709, 1710		Settlement continues and the road embankment is now very steep on the north side, recent extraction of material has removed more of the active layer and thaw is ongoing. The embankment side slope is very unstable and this is a safety issue as there is a risk of failure. The large sinkhole should be backfilled as soon as possible.
38	51.9		Dry	Low	Not apparent	Stable	Grading	C			Dress the slopes and bottom.	C		1631	No change
39	51.7			Low	Wedge ice extending under road	Unstable	Stabilize road surface, dress side slopes and fill sinkholes	B			Sinkhole under road at north end, cracking onto road surface. Build road grade up, dress disturbed area, and flatten embankment side slopes.	B		1631	Continued settlement away from the road, some recent regrading has improved the stability of the road but this area should be closely monitored to see if the sinkhole redevelops.
40	51.2	Hole in Road		Low	Wedge ice extending under road	Unstable	Ensure safety of road	A	715, 716, 717	645	Wedge Ice that extends under the road has thawed resulting in collapse. Road grade dropped about 1 m. Sinkholes in pit allow standing water adjacent to sideslope. Raise the road grade about 1 m at this location, and construct side berms to protect permafrost and push any free water 3 m minimum away from toe of slope. Regrade the abandoned pit and upgrade the site drainage.	A			Pit and road in similar state although ponded water seems to have decreased. Recent road grading may have obscured any recent settlements
41	50.0L		Minor	Low	Localized wedge ice	Moderately stable	Regrading	C			Regrade and improve drainage from sinkholes.	C			No change
42	49.7L		Mostly dry	Low	Ice wedges, south end	Sinkholes south end	Regrading	C			Regrade to fill and cover sinkholes at south end.	C			No change
43	49.6R		Dry	Low	Not apparent	Stable	Dress surfaces	C			Long pit where active layer soils have been pushed up to make embankment.	C			No change
	49.0													1563	Photo of stable road
	47.2													1564	Photo of stable road
	46.8													1565	Photo of stable road
44	46.2L		Minor	Low	Not apparent	Stable	Dress surfaces	C			Pothole pit, some water. Dress slopes and improve drainage.	C			No change
45	45.6		Dry	Low	Not apparent	Stable	Dress slopes	C			This is a confined but deep pit, currently dry. The backslopes are steep and may require minor cleanup and dressing.	C			No change
46	43.5		Dry	Low	Not visible	Moderately stable	Repair grade	A	718, 719		This road cut exposed ground ice that is actively thawing. The road grade should be built up at this location about 1/2 m.	B		1630	Road stability has improved at this location but should be monitored closely with increased traffic.

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47	41.7R		Partial	Low	Not visible	Moderate	Regrade	C		603, 604	Small pit with one large sinkhole. Regrade and fill sinkhole — not affecting road.	C		1566, 1567	Sinkhole has increased in size but has not yet affected the road, should regrade and fill in hole.
48	37.5R		Dry	Low	Not visible	Stable	Regrade	C			Dry pit on ridge. Regrade to dress surfaces.	C			No change
48A	37.2	new pit										C		1568	New pit?, active layer has been scraped off, some limited settlement near the road but no water ponding was observed.
49	37.0R		Dry	Low	Not visible	Stable	Dress surface	C		605	Linear pit from pushup. Well drained. Dress the surface.	C			No change
50	36.7R		Dry	Low	Not visible	Stable	Dress surface	C			Similar to 49.	C			No change
51	36.0 L&R		Ponding on left	Low	Wedge Ice	Moderate	Improve drainage and regrade	B		606	Active layer removed along road on both sides. Well developed ice wedge cracks evident across pits and continuing under embankment. Beginning to affect road at north end. Stockpiles remain in left pit. Further removal of surface soils at this location not recommended without a pit development plan. Reclamation should grade pit surface, infill ice wedge cracks and flatten embankment side slopes in regions showing distress. Improve drainage.	C		1569, 1570, 1571,1629	Drainage seems to have improved and this may have lead to improved road stability, still do not recommend additional material removal without a pit plan. Reclamation recommendations remain the same.
52	35.6R		Dry	Low	Not apparent	Stable	Regrade	C			A relatively large pit but dry and stable bottom. Dress slopes and bottom.	C		1572	No change
53	35.0		Dry	Low	Not visible	Moderately stable	Regrade and fill sinkholes	C			Long, linear pit with a few sinkholes. Regrade and fill sinkholes. Material removed recently	C		1573	No change
54	34.7		Dry	Low	Not apparent	Stable	Regrade	C			Dress all surfaces.	C			No change
55	33.5		Minor ponding	Low	Minor wedge ice	Stable	Regrade	C	720		Regrade to fill wedge cracks and dress surface.	C		1574	No change
56	33.4R		Dry	Low	Not apparent	Stable	Regrade	C			Small square pit. Dress all surfaces.	C			No change
57	33.0R		Partial	Low	Not apparent	Moderate	Partial infill and regrade	C			Three small pits, two dry and one with water. Regrade or import fill to flatten or berm embankment sideslope beside water-filled pit. Grade surface.	C		1575	No change
58	32.4R		Partial	Low	Not apparent	Moderate	Regrade	C	721		Pushup pit. Rough bottom. Grade surface, improve drainage. Defined pit on left about 300 m further south is dry and needs no work.	C		1576, 1627, 1628	Some recent removal of material but pit remains stable. More material might be available
59	30.1R		Dry	Low	Not apparent	Stable	Dress surfaces	C			High, well-drained side borrow site. Dress bottom and slopes.	C		1626	No change
60	30.0L		Dry	Low	Not apparent	Stable	Dress surfaces	C			Similar to Site 59.	C		1626	No change
61	29.7L		Dry	Low	Not apparent	Stable	Dress surfaces	C			Similar to Sites 59 and 60.	C			No change
61A	29.4											A+	1706, 1707, 1708		New pit? If not a new pit it is a pit that was not reported in 2009. Extensive thaw settlement from melt out of massive ice immediately beside the road on the east side leading to very steep unstable side slopes. There is a risk of collapse of the road. The settlement areas should be filled in and at a minimum a 3 to 4 m wide toe berm should be constructed.
61B	29.1											A	1704, 1705		Site not reported on in 2009. Recent construction has removed considerable material from this location, extensive settlement is occurring (5 to 6 m) and is undermining the road embankment on the east side. Settlement and ice wedge melt out is also occurring on the west side. There is a significant risk of failure of the embankment at this location. Material should be imported to fill in all of the settlement areas and improve the potential to arrest these extensive thaw settlements.
62	28.6		Minor ponding	Low	Not apparent		Regrade	C		611	Near vertical slope on side hill pit. Slope pit back at 3H:1V and add some shoulder to road. Improve drainage.	A	1703	1625	There has been extensive melt out of massive ice immediate at the edge of the road since 2009, Settlement areas should be filled to limit additional thaw settlement that has the potential to lead to failure of the road embankment.
62A	27.8											B		1579, 1624	Not reported on in 2009, appears that more material has been recently removed, thaw of ice wedges and ground ice is leading to ponding but it is away from the toe of the slope, road embankment seems stable for now. Pit could be regraded to reduce ponding and resulting thaw settlements.
63	27.0R		Minor ponding	Low	Not apparent	Stable	Regrade vertical slope	C	722		Pit has a near vertical slope 2 to 3 m high. Slope back to 3H:1V and dress pit bottom to improve drainage away from road embankment.	C			No change, currently stable
64	26.7L&R		Major ponding	Low	Not apparent	Stable	Regrade backslope, develop drainage plan	B		682	Deep pits on both road shoulders, both flooded. Slope sides to 3H:1V and develop a drainage plan. It may be practical to ditch to the creek about 100 m to the north.	B		1580, 1622, 1623	Water continues to pond on the east side of the road but road embankment continues to appear stable at this time.
65	25.8L&R		Minor	Low	Not apparent	Stable	Dress surfaces	C	723, 724		Pushup pits on both sides. Well drained. Dress slopes and ensure future drainage.	B		1581	Water continues to pond on the east side of the road but road embankment continues to appear stable at this time.
66	23.7L&R		Minor	Low	Not apparent	Stable	Dress surfaces	C			Pushup pits both sides. Currently self-draining to tundra. Not obvious erosion or sinkholes. Grade sideslope into pond lying to the left side.	C		1582	More water is now ponding in the NE corner of the pit and due to settlement is no longer free draining to the tundra
67	23.3L		dry	Low	Not apparent	Stable	Dress surfaces	C			Well drained pit on top of natural rise. Dress bottom and slopes.	C			No change

TABLE 1: SUMMARY OF PIT OBSERVATIONS AND CLOSURE RECOMMENDATIONS

		2009 DWH										2014 KWJ			
Site WP No. 2009	Km Post	General Location Comments	Pit Water 2009	Erosion Potential	Ground Ice Features	Active Layer Stability	Reclamation Focus	Priority	Ground Photos	Aerial Oblique Photos	2009 Comments	Priority	Ground Photos	Aerial Oblique Photos	2014 Comments
68	21.9R		Minor ponding	Low	Massive ice	Unstable	Fill and Cover Sinkholes	B	726, 727, 728	616	Melt out of massive ice actively developing sinkholes at toe of embankment sideslope. A berm should be built on sideslope and sinkholes infilled at 2 locations. Regrade to improve drainage to the northwest.	A		1621	Thaw continues and is threatening embankment stability on the west side of the road. This pit should be regraded and backfilled with material to improve embankment stability.
69	23.4R	Out of sequence — returned to inspect this site	Minor ponding	Moderate	Segregated ice	Unstable	Control drainage and limit sediment transport	C			Pit cut into side of knob. Thaw of icy soils is producing meltwater and sediment. Selective use of a boulder rip-rap blanket is recommended. Use rip-rap to control and filter drainage that is being dispersed onto tundra.	C			Drainage seems to have ceased and pit seems stable, may not need to consider the rip rap blanket now
70	21.2L		Water-filled pothole pit beside road	Low	Unknown	Unstable	Water-filled pit	C		641	Pothole immediately beside embankment sideslope. Drain and install culvert under road. May require widening shoulder and partial infilling to maintain long-term drainage.	C			No change
71	20.7R		Water-filled wedge cracks	Moderate	Substantial wedge ice	Unstable	Prevent further ice wedge thaw	B	729, 730	618, 617, 641	Active layer removed from top of hill, exposing substantial wedge ice. Substantial melt out and continued activity. Water collecting in wedge cracks. Develop drainage and fill expanding wedge cracks. Berm the sideslope to prevent further thaw under road embankment.	A+	1693, 1694, 1695, 1695, 1696, 1697, 1698	1585, 1620	Wedge ice has substantially degraded since 2009. Thaw settlement is now undermining the road and road settlement is obvious. There is potential for collapse of the road surface at this location. Reclamation should occur as soon as possible. This must involve complete filling of all the settlement areas to eliminate ponded water and arrest continuing thaw settlements.
71A	20.4											B	1692	1619	Not reported on in 2009, Note settlement on road surface and shoulder but no water ponding. Monitor this location closely to see if settlements continue
72	19.7L		Water-filled pit	Moderate	Unknown	Moderate	Develop pit drainage	B			A 2 m deep pit with water. No obvious opportunities to develop drainage. Survey and determine options to drain while minimizing further cuts. May require berming along road to prevent thaw from undercutting embankment side slopes.	A+	1689, 1690, 1691	1586	Extensive settlement is ongoing on the east side of the road and is now estimated to be upwards of 6 m deep, cracking is evident on the west side and settlement is evident in several location in the road. This area needs to be reclaimed immediately to reduce the potential for failure of the road
73	18.4R		Large water-filled pit	Moderate	Not apparent	Moderate	Develop pit drainage	B		619	Large pit pond immediately adjacent to road. Appears to be deep water. Currently no drainage. Can be drained by installing a culvert under the road. Flatten side slopes into pit to push	B		1587	Water in pit is much less than in 2009 and it appears that some additional material may have been recently removed. 2009 reclamation notes are still appropriate.
	17.1										New Bridge		1684, 1685, 1686, 1687, 1688	1618	New bridge, note some tilting and movement of bin wall foundations at both ends of the bridge. This may be imparting additional compression loads on the bridge.
74	16.5L&R		Linear pits both sides with water	Moderate	Not apparent	Moderate	Develop pit drainage	B			Long, linear pits both sides. Left side has larger pond. No thaw features apparent. Assess drainage options. Flatten embankment side slopes where water is at the toe of slope.	B		1588	Little change, although there is now more ponding on right side. Should flatten embankment slopes as noted in 2009. Limited settlement of road surface above ice wedges can be seen and may be indicative of the start of thaw of the ice wedges.
75	15.0R		Some water	Low	Not apparent	Stable	Dress surfaces	C			Long pit, some water, no active subsidence, dress surfaces.	C		1589	No change
76	14.2L		Dry	Low	Not apparent	Stable	Dress surfaces	C			Dry, well-drained pit floor. Stockpile of sandy gravel present. Dress surfaces.	C			No change
77	13.4L		Pond	Low	Not apparent	Moderate	Pothole pit	C			Some refilling may be required in pothole pit beside road.	C			No change
78	13.2L		One pond to north	Low	Not apparent	Moderate	Large area to dress	C		623	Shallow pit on top of rise. Pond in north end that can be drained to the north. Grade and dress surfaces.	C		1617	Pond size is increasing and water is getting deeper, may start to impact road stability. Drain pond as noted in 2009.
79	12.8L&R		Wet bottom	Low	Segregated ice	Unstable	Large surface area	B		624	Pit in silty sand, abundant ground ice. Active thaw in pit floor. Surface will need to be regraded to cover exposed icy sediments. Several visits may be necessary to stabilize the new active layer.	B		1590	No change
	10.0													1591	Realignment of road, no issues at this time
80	9.6L		Water-filled wedge cracks	Low	Wedge ice	Unstable	Active sinkholes in wedge cracks	B	732, 733, 734	636	Extensive melt out of ice wedges resulting in water-filled troughs. Need to drain and fill sinkholes. Material should be imported as the entire pit is underlain by wedge ice and further removal of active layer material will exacerbate reclamation.	A		1592, 1616	Water continues to pond and thaw settlement continues, need to undertake reclamation as suggested in 2009
81	9.4R		Extensive pond	Moderate	Wedge ice	Unstable	Wedge cracks flooded in pit bottom	B		636	Flat bottom pit with no drainage. Develop drainage and fill wedge cracks evident below water level. Dress and grade surfaces.	B			No change
82	9.4L`		Dry	Low	Segregated ice	Unstable	Sinkholes	C		635	Side hill cut into bank beside road. Backfill and regrade with rip-rap quality material. Allow future drainage from cover.	C			No change
82A	8.7													1615	New borrow pit, relatively stable and well drained, some limited settlement but currently is well away from the road.
	8.5													1593	Photo of stable road
82B	8.2											C	1683	1614	New borrow pit, relatively stable and well drained, some limited settlement but currently is well away from the road.

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Site WP No. 2009	Km Post	General Location Comments	Pit Water 2009	Erosion Potential	Ground Ice Features	Active Layer Stability	Reclamation Focus	Priority	Ground Photos	Aerial Oblique Photos	2009 Comments	Priority	Ground Photos	Aerial Oblique Photos	2014 Comments
83	7.8L&R		Left pit flooded, right pit wet	Moderate	Wedge ice	Unstable	Road shoulder unstable, develop drainage	**B**		634	Deep pits (about 3 m) no drainage. Ice wedge cracks and sinkholes. Backfill sinkholes and regrade steep slopes. Rebuild and flatten road side slopes. Regrade base and improve drainage.	**A**	1681, 1682	1594	Extensive settlement continues near the edge of the road embankment, threatening road stability. The recommendations from 2009 should be carried out as soon as possible to reduce the chance of failure of the road.
83A	7.2											**A+**	1679, 1680	1595	Realignment with pits on both sides of the embankment, extensive thaw settlement and potential road instability. The pits on both sides of the road should be immediately regraded and material added at the toe on both sides to lessen thaw settlement and improve embankment stability.
84	6.6R		Flooded	Moderate	Wedge ice	Moderate	Develop drainage	**C**		627	Broad flooded pit. Develop drainage. Grade and dress pond edges and road side slopes.	**C**		1596, 1612, 1613	No change
	4.7													1597	Photo of stable road with some realignment and an increased embankment thickness
	4.2													1598	Small sinkhole and transverse crack forming on road surface, raise embankment to provide more thermal cover if possible.
85	3.8R	Milne Inlet permitted pit	Dry	Low	Minor wedge ice	Stable	Silty sand susceptible to dusting	**B**		630	This is the main permitted pit for development at Milne Inlet. The site is a dry and naturally well-drained river terrace. The material is fine grained (silty) and may be susceptible to generating dust. Small dune-like features evident on surface. If the site is retained for future use, a pit plan should be prepared. In order to control dust, it may be necessary to provide ridges of coarse material at closure that will trap wind-blown sand.	**B**		1599	With the creation of the Milne inlet quarry there is likely no need to consider further material withdrawal from this pit and it could be reclaimed in the manner suggested in 2009
86	3.1R&L	Milne Inlet permitted pit	Minor pond on left, right is dry	Low	Not apparent	Stable	Regrade to protect from dusting	**B**			Small pits, silty sand poor construction material. Grade and work cover to provide a coarser cap.	**B**			No change
87	2.9R	Within permit	Localized ponding	Low	Not apparent	Stable	Regrade to protect from dusting	**B**		631	Large exposed pit; silty sand may need a coarser cover to protect from dusting.	**B**			No change