June 17, 2020

Assol Kubeisinova
Technical Advisor, NWB
P.O. Box 119
Gjoa Haven, NU X0B 1J0

RE: Issued for Construction Drawings Submission - Mine Site Landfarm
Mary River Project - Type 'A' Water Licence 2AM-MRY1325 - Amend. No. 1

On behalf of Baffinland Iron Mines Corporation (Baffinland), please find attached transmission of the following drawings and documents in accordance with Part D, Item 2 of the Type 'A' Water Licence 2AM-MRY1325 (the Licence):

- Design Brief
  - Mary River Project – Mine Site Landfarm – Design Brief and IFC Drawings
- Drawings
  - 0010 – Mine Site Landfarm Specifications
  - 0100 – Mine Site Landfarm Plan and Setting Out Details
  - 0200 – Mine Site Landfarm Sections
  - 0201 – Mine Site Landfarm Details

Construction of the Mine Site Landfarm was identified in the 2020 Work Plan as Item No. 2019-18, and reclamation securities for a facility footprint of 9,000 m^2 were allocated. For confirmation, the attached design has a total effective footprint of 8,813 m^2, confirming that adequate reclamation securities have been posted.

The construction of a landfarm at the Mine Site was previously approved by the NWB in the approval of Modification No. 10 for the Mary River Project (Motion No. 2018-13-P4-03). Note that while the location of the landfarm has shifted from the layout approved in Modification No. 10, the landfarm is still located at the landfill facility at the Mary River Mine Site. Detailed design identified that the grades in the original location identified in the Modification No. 10 submission would not be appropriate. Baffinland does not believe this change in location constitutes a modification to the licence.

Baffinland will prepare a Construction Summary Report within ninety (90) days following completion of this work, in accordance with Part D, Item 17 of the Licence.

We trust that this information meets the requirements under Part D of the Licence.

Regards,

Christopher Murray
Environmental & Regulatory Compliance Manager

Attachments:
Attachment 1: Design Brief & For-Construction Drawings

Cc:
Karén Kharatyan (Nunavut Water Board)
Chris Spencer, Jared Ottenhof (Qikiqtani Inuit Association)
Bridget Campbell, Godwin Okonkwo (Crown-Indigenous Relations and Northern Affairs Canada)
Solomon Amuno, Cory Barker (Nunavut Impact Review Board)
Megan-Lord Hoyle, Lou Kamermans, Timothy Ray Sewell, Connor Devereaux, Aaron MacDonell (Baffinland)

Attachment No. 1

Design Brief & For Construction Drawings

Knight Piésold CONSULTING

June 16, 2020

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North Bay, Ontario
Canada, P1B 8G5
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E northbay@knightpiesold.com
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Mr. Shawn Parry
Manager - Road Maintenance Mary River Mine Site
Baffinland Iron Mines Corporation
#300-2275 Upper Middle Road East
Oakville, Ontario
Canada, L6H 0C3

Dear Shawn,

RE: Mary River Project - Mine Site Landfarm - Design Brief and IFC Drawings

1.0 INTRODUCTION

Knight Piésold Ltd. (KP) is pleased to provide Baffinland Iron Mines Corporation (Baffinland) with this design brief and accompanying Issued for Construction (IFC) drawing package for construction of a landfarm at the Mine Site of the Mary River Project. The Mine Site Landfarm is an approved component of the Project identified in Part A, Item 1 of Type A Water Licence 2AM-MRY-1325 (Nunavut Water Board [NWB], 2015).

Design details are summarized below.

2.0 DESIGN AND OPERATING SUMMARY

The main design and operating criteria used as a basis for the Mine Site Landfarm are summarized on Table 1. The design and operating criteria have been developed in consultation with Baffinland, also considering the operation, maintenance, and monitoring manual for the existing landfarm at Milne Port (Baffinland, 2015).

The Landfarm design is focused on foundation preparation, berm construction and basin lining to establish the required contaminated soil and snow/ice storage capacity. Additional infrastructure required for the Landfarm development that are not addressed in this report include:

- Access roads to the Landfarm and access into each Landfarm cell
- Drainage details around the perimeter of the Landfarm
- Water removal details from the Landfarm

The Mine Site Landfarm will be used to store and treat soils and ice/snow contaminated with hydrocarbons in four separate lined cells. Three contiguous cells (Cells 1, 2 and 3) will be used to treat hydrocarbon contaminated soils, and a separate fourth cell (Cell 4) will contain hydrocarbon contaminated ice/snow, as shown in plan on Drawing 0100. Each of the three cells designated for soil remediation has been sized to contain the average annual quantity of contaminated soil that Baffinland has generated at the Project in recent years. It is recommended that contaminated soil remain within a cell until remediated. The transfer of soil between cells should be avoided as unnecessary handling of soil presents a risk of damage to the underlying liner. Contaminated soil from year 1 of landfarm operation can be placed in Cell 1, soil generated in the following year can be placed in Cell 2, and so on. This approach will allow soil to be remediated for up to three years. Other then this multi-cell arrangement, the existing landfarm manual (Baffinland, 2015) adequately describes how to operate the Mine Site Landfarm.

Ice and snow placed in Cell 4 during the winter can be treated in-situ using Baffinland's mobile Oily Water Treatment System (OWTS), or can be removed by a vacuum truck for treatment elsewhere, once the ice and snow have melted in the spring.

3.0 LANDFARM DESIGN AND CONSTRUCTION

3.1 GENERAL

Due to the granular nature of the existing foundation soils and the presence of permafrost, it was determined that the slope stability of the perimeter berms and bearing capacity of the foundation soils would be adequate for the Landfarm (KP, 2008). It is expected that differential settlement of the foundation soils will be negligible (KP, 2008). The Landfarm berms will be assessed as part of Baffinland's biannual geotechnical inspections, and any identified stability issues will need to be addressed based on recommendations contained in the corresponding geotechnical inspection reports submitted to the NWB annually in accordance with Part D, Item 18 and Part I, Item 12 of the Type A Water Licence (NWB, 2015).

Landfarm design and construction details for site grading/foundation preparation, containment berms and the geosynthetic lining system; along with the estimated landfarm capacity, are provided in the following sections. IFC Drawings and technical specifications for construction are included with this letter. The location and layout of the Landfarm is provided on Drawing 100. The design is consistent with the existing Milne Port Landfarm (Tetra Tech EBA, 2014) and guidance established by the Government of the Northwest Territories, prepared by Ferguson Simek Clark [FSC], 2003).

3.2 STORAGE CAPACITY

Each cell in the Landfarm has been sized to contain the following:

- 300 mm thickness of contaminated soil or ice/snow
- Average annual base snow depth (105 mm water equivalent; Tetra Tech EBA, 2014)
- Average annual snow drift accumulation (assumed to have a slope of 6H:1V extending from each berm and assumed to have a density 325 kg/m3; Tetra Tech EBA, 2014)
- Runoff generated from the Annual 1 in 100-year precipitation value (260 mm; Tetra Tech EBA, 2014)
- 300 mm freeboard depth

The storage capacity for each Landfarm cell is summarized in Table 2, based on the Drawings.

In terms of storage capacity of contaminated materials, each of Cells 1, 2 and 3 has been sized to contain at least 600 m^3 of contaminated soil on an annual basis, and Cell 4 has been sized to contain up to 700 m^3 of contaminated snow/ice (Table 1). Actual soil and snow/ice capacities of each cell are shown in Column 6 of Table 2.

Table 2 Landfarm Storage Capacity Summary

Cell	Effective Footprint Area[1] (m^2)	Average Annual Base Snow SWE[2] (m^3)	Average Annual Snow Drift SWE (m^3)	Annual 1 in 100-year Precipitation (m^3)	Soil or Snow/Ice Storage Capacity[3] (m^3)	Total[4] (m^3)
1	2,487	410	415	1,015	720	2,560
2	2,212	400	465	990	650	2,505
3	2,431	445	675	1,105	730	2,955
4	1,683	330	925	820	700	2,775

NOTES:

1. SOIL PLACEMENT AREA INCLUDES A 2 m OFFSET FROM THE TOE OF THE BERM, AS SPECIFIED BY BAFFINLAND (2015).
2. SWE = SNOW WATER EQUIVALENT.
3. EFFECTIVE STORAGE VOLUME BASED ON 300 mm SOIL THICKNESS AND THE 2 m OFFSET (SEE NOTE 1).
4. TOTAL STORAGE CAPACITY INCLUSIVE OF SOIL OR SNOW/ICE PLACED FOR TREATMENT, AS WELL AS SNOW AND PRECIPITATION ALLOWANCES.

3.3 FILL MATERIALS

Baffinland has indicated that the following fill materials will be used to construct the earthworks portion of the Landfarm (Drawing 0010):

- 4 inch (100 mm) minus material (till), locally borrowed, to be used as the subgrade layer
- Medium sand, locally borrowed and processed, to be used as the bedding layer (both below and above the geosynthetic lining system)

In general, all fill materials used for construction shall meet the following requirements:

- Be free of any potentially acid generating (PAG) or metal leaching (ML) concerns
- Consist of hard, durable material, free of clay, loam, and other deleterious materials or organic matter, and shall contain no ice

3.4 LAYOUT AND SUBGRADE PREPARATION

The Landfarm layout will be established by constructing the subgrade, followed by bedding layer and berm construction (Drawings 100 and 200). The subgrade layer will be placed directly on the existing ground to establish the required grades, ranging from 1.6 to 5%. Cuts should not be used to establish these grades. The bedding layer will be placed on the subgrade to provide a suitable foundation for the geosynthetic lining system. Perimeter and internal berms will then be constructed to form the limits of the four cells (Drawing 100). All berms will have 2H:1V slopes and have a crest width of 2 m, prior to placement of the bedding layer over the geosynthetic lining system.

3.5 GEOSYNTHETICS AND BEDDING INSTALLATION

All four cells of the Landfarm will be lined with 60 mil HDPE geomembrane sandwiched between two layers of 12 oz/yd^2 non-woven geotextile. The geosynthetic lining system will extend up the interior slope of each berm and will be anchored at the crest of each berm, as indicated on the Drawing 201. Each anchor trench and berm crest will then be covered with bedding material to protect the liner.

Construction equipment shall not travel directly over the geosynthetic lining system. Heavy equipment, such as haul trucks, shall not travel on the surface of the bedding layer. Bedding material is to be dumped at the edge of each cell and spread and levelled with small, low ground pressure equipment. Specifications for maximum equipment pressure vs. bedding thickness are shown on Drawing 0010.

3.6 QUALITY ASSURANCE/QUALITY CONTROL

The construction Quality Assurance/Quality Control program shall include the following key components to meet the intent of the design and the technical specifications, as shown on the Drawings:

- Survey control and periodic topographic surveys to establish lines and grades and provide support for the preparation Record drawings
- Foundation approvals prior to the placement of subgrade material
- Monitoring of construction activities, including the timely completion of field tests on fill materials
- Timely collection and laboratory testing of fill materials
- Approval of subgrades prior to the installation of geosynthetics
- Appropriate delivery, handling and storage of geosynthetics
- Timely field seam inspection and testing of geosynthetics
- Provision of as built documentation for geosynthetics

The Owner's Representative appointed to oversee the Landfarm construction shall contact KP immediately if there are any uncertainties related to the drawings or technical specifications.

3.7 MATERIAL AND QUANTITY ESTIMATES

The material and quantity estimates for the Landfarm are provided in Table 3. The quantities were measured based on the IFC designs and dimensions shown on the Drawings and are "neat line" estimates.

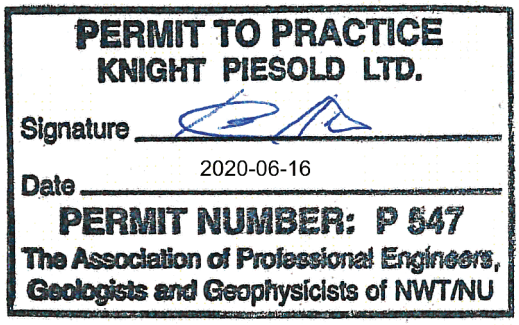
4.0 CLOSURE AND RECLAMATION

Final closure of the Mary River Landfarm facility will meet the objectives and criteria outlined in the Interim Closure and Reclamation Plan (Baffinland, 2018a). For closure planning, the total lined area is approximately 16,276 m^2 and the unlined area (the outside portions of the berms) totals 4,900 m^2.

5.0 CLOSING

We trust that the information contained in this design brief is satisfactory at this time. Please do not hesitate to contact us if there are any questions or uncertainties related to the IFC design and construction package.

Yours truly,
Knight Piésold Ltd.



Prepared: _____
Wilson Muir, P.Eng.
Senior Engineer

Reviewed: _____
Kevin Hawton, P.Eng.
Specialist Engineer | Associate

Approval that this document adheres to the Knight Piésold Quality System: _____

Attachments:

Table 1 Rev 0	Design Criteria
Table 3 Rev 0	Schedule of Estimated Materials and Quantities
Drawing 001 Rev 0	Drawing List
Drawing 010 Rev 0	Specifications
Drawing 100 Rev 0	Plan and Setting Out Details
Drawing 200 Rev 0	Sections
Drawing 201 Rev 0	Details

Copy To: Connor Devereaux, Baffinland Iron Mines Corporation

/rc

References:

Baffinland Iron Mines Corporation (Baffinland), 2015. *Landfarm Operation Maintenance and Monitoring Manual*. March 18. Ref. No. BAF-PH1-320-T07-0005, Rev 0.

Baffinland Iron Mines Corporation (Baffinland), 2016. *2016 Qikiqtani Inuit Association (QIA) and Nunavut Water Board (NWB) - Annual Report for Operations*. March 31.

Baffinland Iron Mines Corporation (Baffinland), 2017. *2017 Qikiqtani Inuit Association (QIA) and Nunavut Water Board (NWB) - Annual Report for Operations*. March 31.

Baffinland Iron Mines Corporation (Baffinland), 2018a. *Interim Closure and Reclamation Plan.* October 30. Doc. No. BAF-PH1-830-P16-0012, Rev. 5.

Baffinland Iron Mines Corporation (Baffinland), 2018b. *2018 Qikiqtani Inuit Association (QIA) and Nunavut Water Board (NWB) Annual Report for Operations*. March 31.

Ferguson Simek Clark (FSC), 2003. *Guidelines for the Planning, Design, Operations and Maintenance of Modified Solid Waste Sites in the Northwest Territories*. Prepared for Municipal and Community Affairs, Government of the Northwest Territories. Yellowknife, Northwest Territories. FSC Project No: 2001-1330.

Knight Piésold Ltd. (KP), 2008. *Mary River Project Bulk Sampling Program Landfill Design and Operations*. March 31. North Bay, Ontario. Ref. No. NB102-00181/10-6, Rev 1.

Knight Piésold Ltd. (KP), 2012. *Baseline Hydrology Report*. January 4. North Bay, Ontario. Ref. No. NB102-181/30-7, Rev 1.

Ministry of the Environment, 2003. *Stormwater Management Planning and Design Manual*. March. ISBN 0-7794-2969-9. PIBS 4329e.

Nunavut Water Board (NWB), 2015. July 30. *Water Licence No: 2AM-MRY1325 - Amendment No.1*.

Ontario Ministry of Transportation, 1994. *MTO Drainage Management Manual*. October.

Tetra Tech EBA Inc. (Tetra Tech EBA), 2014. Letter to: Jim Millard, Baffinland Iron Mines Corporation. Re: *Design Brief for Milne Inlet Landfarm and Contaminated Snow Containment Facility Milne Inlet, NU*. April 4. Edmonton, Alberta. Ref. No. E14103075-01.

TABLE 1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

MINE SITE LANDFARM - DESIGN BRIEF AND IFC DRAWINGS
DESIGN CRITERIA

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Item No.	Item	Design Criteria	Reference
1.0	**GENERAL**		
1.1	Language and Units	• Documents to be written in English	Baffinland
		• Metric units, unless otherwise noted	Baffinland
		• Costs in CAD dollars	Baffinland
		• Coordinate System: UTM (NAD83), Zone 17	Baffinland
1.2	Codes, Standards and Guidelines	• Guidelines for the Planning, Design, Operations and Maintenance of Modified Solid Waste Sites in the Northwest Territories	Ferguson Simek Clark (FSC), 2003
		• Stormwater Management Planning and Design Manual	Ontario Ministry of the Environment, 2003
		• Landfarm Operation Maintenance and Monitoring Manual (Milne Port)	Baffinland, 2015
		• Drainage Management Manual	Ontario Ministry of Transportation, 1994
1.3	Site Elevation	• El. 160 to 220 m above mean sea level in the vicinity of the Landfarm	KP
1.4	Meteorological Parameters	• Average Maximum Daily Summer Temperature: 6.0 °C (July)	KP, 2012 (NB102-181/30-7)
		• Average Minimum Daily Winter Temperature: -34.1 °C (February)	KP, 2012 (NB102-181/30-7)
		• Average Annual Base Snow Accumulation: 105 mm (snow water equivalent)	Tetra Tech EBA, 2014
		• Average Snow Drift Accumulation: Assume 6H:1V slopes upstream of the Perimeter Landfarm Berms and a snow density of 325 kg/m^3	Tetra Tech EBA, 2014
		• Annual 1 in 100 year Precipitation Value: 260 mm	Tetra Tech EBA, 2014
2.0	**STORMWATER MANAGEMENT**		
2.1	Runoff Management System	• Divert runoff from upstream of the Landfarm to the environment via berm/culverts, to be completed by Baffinland	KP
2.2	Storm Water Containment System	• Safely and temporarily contain water volume in each Landfarm cell from the following sources, combined: o Average Annual Base Snow Depth o Average Annual Snow Drift Accumulation o Annual 1 in 100 year Precipitation Value	Tetra Tech EBA, 2014
		• Freeboard: 0.3 m	Tetra Tech EBA, 2014
3.0	**LANDFARM**		
3.1	Function	• Secure storage and treatment of hydrocarbon contaminated soils, as well as hydrocarbon contaminated snow and ice, from the Mine Site area during operations	KP, Baffinland
3.2	Foundation	• Founded on competent soil (permafrost) or exposed bedrock	KP
3.3	Landfarm Characteristics	• Four cells to manage contaminated soil, ice and snow as follows: o Cells 1, 2 and 3: Treatment of contaminated soils. Contaminated soils to be placed, remediated and removed in such a fashion that contaminated soil is always placed in an empty cell. Contaminated soil is not to be placed in a cell where remediation is ongoing. Cell 1 to receive contaminated soil in Year 1 of operations and remove remediated soil in Year 2 of operations. Cell 2 to receive contaminated soil in Year 2 of operations and remove remediated soil in Year 3 of operations. This sequencing to continue throughout mine life. o Cell 4: Containment of contaminated ice and snow. Once melted, water to be pumped to water treatment plant.	KP, Baffinland
		• Each cell is graded to allow water to drain to low point or sump. Water to be pumped to water treatment plant.	KP, Baffinland
3.4	Landfarm Geometry	• Maximum Crest Elevation (Soil Cells): El. 188.8 m	KP
		• Minimum Toe Elevation (Soil Cells): El. 180.7 m	KP
		• Maximum Perimeter Berm Height: 4.6 m	KP
		• Berm Crest Width: 2 m at elevation of HDPE geomembrane	KP
		• Perimeter Berm Slopes: 2H:1V	KP
3.5	Geosynthetic Lining System	• Geosynthetic Lining System includes: o Bedding layer below the Geosynthetic Lining System to prevent puncture o 60 mil HDPE geomembrane (textured both sides) to prevent seepage from the Landfarm o Non-woven geotextile above and below the geomembrane to act as cushion layers o Bedding layer above the Geosynthetic Lining System to protect the system during soil/snow/ice placement, remediation and removal o Marker layer (fluorescent tape) within the bedding layer to help prevent liner tear during operations inside the Landfarm	KP, Baffinland
3.6	Placement and Removal Estimates	• Potential Annual Volume of Contaminated Soil Placed: 600 m^3	KP, estimate. Based on Baffinland, 2017
		• Potential Annual Volume of Contaminated Snow/Ice Placed: 700 m^3 (snow water equivalent)	KP, estimate. Based on Baffinland, 2016
		• Potential Annual Volume of Contaminated Soil Removed: 600 m^3 (following 1 year of bioremediation)	KP, estimate. Based on Baffinland, 2017
		• Potential Annual Volume of Contaminated Snow/Ice Removed: 700 m^3 (snow water equivalent; following spring freshet)	KP, estimate. Based on Baffinland, 2016
4.0	**INSTRUMENTATION AND MONITORING**		
4.1	General	• Operation, Maintenance and Surveillance (OMS) on Landfarm to follow existing Baffinland waste management guidelines	Baffinland, 2018b

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	16JUN'20	ISSUED WITH LETTER NB20-00494	CWM	KEH

Knight Piésold CONSULTING

TABLE 3

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

MINE SITE LANDFARM - DESIGN BRIEF AND IFC DRAWINGS
SCHEDULE OF ESTIMATED MATERIALS AND QUANTITIES

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Item No.	Description	Unit	Estimated Quantity
1.0	**MOBILIZATION AND DEMOBILIZATION**		
1.1	Mobilization	Lump Sum	1
1.2	Demobilization	Lump Sum	1
1.3	Sediment Control and Stormwater Best Management Practices (BMP's)	Lump Sum	1
2.0	**EARTHWORKS**		
2.1	Process and Stockpile - Liner Bedding	m^3	7,000
2.2	Clearing, Stripping and Grubbing - Cell Foundations	m^2	20,300
2.3	Haul, Place and Compact - Subgrade Material	m^3	22,800
2.4	Load, Haul, Place and Compact - Liner Bedding	m^3	7,000
2.5	Excavate, Backfill and Compact - Anchor Trenches for Geosynthetic Lining System	m	1,000
3.0	**GEOSYNTHETICS**		
3.1	Supply and Install - 12 oz/yd^2 Non-woven Geotextile	m^2	34,100
3.2	Supply and Install - 60 mil Textured (both sides) HDPE Geomembrane	m^2	17,100
4	**GEOTECHNICAL INSTRUMENTATION**		
4.1	Supply and Install - Groundwater Monitoring Well	ea.	2
4.2	Supply and Install - Vibrating Wire Piezometers and Readout Box	Lump Sum	1
4.3	Supply and Install - Slope Inclinometer, Readout Box and Monitoring Panel	Lump Sum	1

I:\1\02\00181\56\A\Correspondence\NB20-00494 - Landfarm Design Brief - Revised\Tables\[Table 3 M and Q - CAP review_yrc.xlsx]Table 3 - M and Q

NOTES:

1. QUANTITIES BASED ON NEAT LINE ESTIMATES.
2. QUANTITIES FOR ACCESS ROAD CONSTRUCTION AND ACCESS INTO LANDFARM CELLS TO BE ESTIMATED BY BAFFINLAND.
3. WATER REMOVAL EQUIPMENT TO BE ESTIMATED AND PROVIDED BY BAFFINLAND.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	16JUN'20	ISSUED WITH LETTER NB20-00494	YC	CWM

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT
MINE SITE LANDFARM

DRAWING NO.	REVISION	TITLE
0001	0	MINE SITE LANDFARM - DRAWING LIST
0010	0	MINE SITE LANDFARM - SPECIFICATIONS
0100	0	MINE SITE LANDFARM - PLAN AND SETTING OUT DETAILS
0200	0	MINE SITE LANDFARM - SECTIONS
0201	0	MINE SITE LANDFARM - DETAILS

ISSUED FOR CONSTRUCTION

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
REVISIONS						

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	01NOV'19	ISSUED FOR CONSTRUCTION	CWM	YRC	KEH	KEH
REVISIONS						

REGISTERED PROFESSIONAL ENGINEER
K.E. HAWTON
LICENSEE
Nov 1/19
NWT/NU

Knight Piésold CONSULTING

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

MINE SITE LANDFARM
DRAWING LIST

PA NO.	DRAWING NO.	REVISION
NB102-181/56	0001	0

GEOSYNTHETICS:

CO-ORDINATION BETWEEN OWNER, ENGINEER AND CONTRACTOR

1. AFTER THE CONTRACTOR HAS COMPLETED PREPARING THE SUBGRADE SURFACE WHICH WILL LIE DIRECTLY BELOW THE GEOSYNTHETICS, THE CONTRACTOR, ENGINEER AND OWNER WILL VERIFY ACCEPTANCE BY SIGNING A FORM WHICH DESCRIBES THE EXTENT OF THE AREA. AT THAT TIME, THE CONTRACTOR ASSUMES RESPONSIBILITY OF PROTECTING THE APPROVED SURFACE, UNTIL IT IS COVERED WITH GEOSYNTHETICS.
2. ANY DAMAGE BY MECHANICAL MEANS CAUSED BY THE CONTRACTOR TO APPROVED SUBGRADE AREAS SHALL BE REPAIRED TO THE SATISFACTION OF THE ENGINEER AT THE EXPENSE OF THE CONTRACTOR. ANY DAMAGE CAUSED BY WEATHER TO APPROVED SUBGRADE AREAS SHALL BE REPAIRED TO THE SATISFACTION OF THE ENGINEER AT THE EXPENSE OF THE OWNER. ANY DAMAGE CAUSED BY WEATHER TO APPROVED SUBGRADE AREAS RESULTING FROM WIND EROSION OR POOR SURFACE RUNOFF CONTROL (E.G. ALLOWING SURFACE RUNOFF ONTO APPROVED AREAS) AS A RESULT OF OPERATIONS OF THE CONTRACTOR SHALL BE REPAIRED TO THE SATISFACTION OF THE ENGINEER AT THE EXPENSE OF THE CONTRACTOR.
3. AFTER INSTALLATION OF THE GEOSYNTHETICS AND FINAL QUALITY CONTROL MEASURES ARE COMPLETED BY THE CONTRACTOR, AREAS RECEIVING COVER MATERIAL SHALL BE CLEARLY IDENTIFIED AND THE ENGINEER SHALL BE NOTIFIED FOR GEOSYNTHETICS INSPECTION. UPON SIGNED ACCEPTANCE BY THE ENGINEER THAT THE GEOSYNTHETICS HAVE BEEN INSTALLED IN ACCORDANCE WITH THE SPECIFICATIONS, IT WILL BE AVAILABLE TO THE CONTRACTOR FOR PLACING THE COVER MATERIAL, WHERE APPLICABLE. AT THAT TIME THE CONTRACTOR WILL ASSUME RESPONSIBILITY FOR MAINTAINING THE CONDITION OF THE PORTION OF THE GEOSYNTHETICS UNTIL IT IS ADEQUATELY COVERED.
4. ANY DAMAGE TO PREVIOUSLY ACCEPTED GEOSYNTHETICS AS A RESULT OF THE CONTRACTOR'S OPERATION WILL BE REPAIRED TO THE SATISFACTION OF THE ENGINEER AT THE CONTRACTOR'S EXPENSE.
5. IN THE EVENT OF CONTRADICTION OR CONFLICT BETWEEN PARTIES MENTIONED ABOVE, QUESTIONS WILL BE TAKEN TO THE ENGINEER AND OWNER FOR FINAL DECISION.

SUBGRADE PREPARATION

1. SUBGRADE PREPARATION SHALL BE CARRIED OUT IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS AND INSTALLATION GUIDELINES.
2. SUBGRADE PREPARATION OVER ROCK SURFACES SHALL REQUIRE THE REMOVAL OF ANY PROTRUDING OBJECT SUCH THAT A SMOOTH GEOMEMBRANE SURFACE IS PROVIDED. NO OVERHANGS, PROTRUSIONS, OR LEDGES OF MORE THAN 0.1 m IN HEIGHT SHALL BE ACCEPTED.
3. PLACEMENT AND COMPACTION OF BEDDING OVER EXPOSED BEDROCK SURFACES SHALL BE CONDUCTED USING PLACEMENT AND COMPACTION METHODS TO SUIT THE SPECIFIC FIELD CONDITIONS. WHERE COMPACTION WITH A STANDARD VIBRATORY ROLLER IS NOT POSSIBLE, ALTERNATIVE COMPACTION EQUIPMENT MAY BE ACCEPTED. THE PLACEMENT AND COMPACTION METHODS MUST BE SUBMITTED TO THE ENGINEER FOR APPROVAL PRIOR TO THEIR IMPLEMENTATION.

DELIVERY, HANDLING AND STORAGE

1. DELIVERY, HANDLING AND STORAGE OF GEOSYNTHETICS MATERIAL SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S PRINTED INSTRUCTIONS.

GEOSYNTHETICS INSTALLATION

1. THE GEOMEMBRANE SHALL BE 60 mil HDPE TEXTURED ON BOTH SIDES, OR APPROVED EQUIVALENT. THE GEOTEXTILE SHALL BE 12 oz/yd², OR APPROVED EQUIVALENT AND SHALL BE INSTALLED IN INTIMATE CONTACT WITH THE GEOMEMBRANE.
2. THE GEOTEXTILE AND GEOMEMBRANE SHALL BE HANDLED IN SUCH A MANNER AS TO ENSURE THAT IT IS NOT DAMAGED IN ANY WAY. THE MATERIALS SHALL BE STORED INDOORS AT TEMPERATURES ABOVE 0 DEGREES CELSIUS PRIOR TO PLACEMENT. SHOULD THE CONTRACTOR DAMAGE THE GEOTEXTILE TO THE EXTENT THAT IT IS NO LONGER USABLE AS DETERMINED BY THESE SPECIFICATIONS OR BY THE ENGINEER, THE CONTRACTOR SHALL REPLACE THE GEOTEXTILE AT THEIR EXPENSE.
3. THE SUBGRADE UNDERLYING THE GEOTEXTILE SHALL BE APPROVED BY THE ENGINEER AND SHALL BE SMOOTH AND FREE OF RUTS OR PROTRUSIONS WHICH COULD DAMAGE THE GEOTEXTILE. THE GEOTEXTILE AND GEOMEMBRANE SHALL BE LAID FLAT AND SMOOTH SO THAT IT IS IN DIRECT CONTACT WITH THE SUBGRADE. THE GEOTEXTILE SHALL BE FREE OF TENSILE STRESSES, FOLDS AND WRINKLES SO THAT THE OVERLYING MATERIALS WILL NOT EXCESSIVELY STRETCH OR TEAR THE FABRIC. ON SLOPES STEEPER THAN 10H:1V, THE GEOTEXTILE SHALL BE LAID WITH THE MACHINE DIRECTION OF THE FABRIC PARALLEL TO THE SLOPE DIRECTION. ANCHORING OF THE TERMINAL ENDS OF THE GEOTEXTILE SHALL BE ACCOMPLISHED THROUGH THE USE OF ANCHOR TRENCHES, ANCHOR BERMS OR APRONS AT THE CREST AND TOE OF THE SLOPE. THE GEOTEXTILE SHALL BE PLACED DIRECTLY ON THE PREPARED SUBGRADE WITH SEAMS UPWARD AND SHALL EXTEND FOR A MINIMUM OF 0.9 m PAST THE DESIGNED SLOPE TOE.
4. UNLESS OTHERWISE NOTED INSTALLATION OF GEOSYNTHETICS SHALL BE IN ACCORDANCE WITH THE FOLLOWING:
   - INTERNATIONAL ASSOCIATION OF GEOSYNTHETICS INSTALLERS - "GUIDELINES FOR INSTALLATION OF FACTORY FABRICATED HEAVY WEIGHT >0.64 mm (25 mil) THICKNESS FABRIC - SUPPORTED GEOMEMBRANES" (MARCH 2014)
   - APPLICABLE GEOSYNTHETICS RESEARCH INSTITUTE STANDARDS, AND THE MANUFACTURER'S "QUALITY CONTROL MANUAL" (JANUARY 2017)
   - GUIDELINES FOR INSTALLATION OF "FACTORY FABRIC SUPPORTED GEOMEMBRANES" (MARCH 2014)
5. THE CONTRACTOR SHALL PROVIDE A WRITTEN GUARANTEE COVERING MATERIALS AND ALL WORKMANSHIP AS WELL AS DEGRADATION DUE TO ULTRAVIOLET LIGHT FOR EXPOSED AREAS. THE MATERIAL SHALL BE WARRANTED AGAINST MANUFACTURER'S DEFECTS FOR A PERIOD OF 5 YEARS FROM THE DATE OF INSTALLATION. THE INSTALLATION SHALL BE WARRANTED AGAINST DEFECTS IN WORKMANSHIP FOR A PERIOD OF 2 YEARS FROM THE DATE OF INSTALLATION.
6. THE GEOSYNTHETICS SHALL BE INSTALLED ON THE AREA SHOWN ON THE DRAWINGS OR AS DIRECTED BY THE ENGINEER.
7. PRIOR TO DEPLOYMENT OF THE GEOSYNTHETICS, THE CONTRACTOR, WITH THE OWNER AND ENGINEER SHALL INSPECT, CERTIFY, AND ACCEPT ALL SURFACES ON WHICH THE GEOTEXTILE AND GEOMEMBRANE IS TO BE PLACED TO ENSURE CONFORMANCE WITH THE DESIGN AND SPECIFICATIONS. SURFACES NOT IN COMPLIANCE WITH THE SPECIFICATIONS SHALL BE RECTIFIED BY THE CONTRACTOR. ACCEPTANCE OF THE ANCHOR TRENCHES FOR PLACEMENT OF THE GEOMEMBRANE SHALL BE INCLUDED IN THE SURFACE PREPARATION ACCEPTANCE.
8. THE CONTRACTOR SHALL PROVIDE THE ENGINEER WITH A FINAL PANEL LAYOUT DRAWING, AND HARDCOPY FORMATS, AT LEAST ONE WEEK PRIOR TO PLACING THE GEOMEMBRANE. NO HORIZONTAL SEAMS ON A SLOPE WILL BE ACCEPTED. NO GEOSYNTHETICS SHALL BE INSTALLED WITHOUT PRIOR APPROVAL BY THE ENGINEER OF THE PROPOSED LAYOUT.
9. THE GEOSYNTHETICS WILL BE PLACED USING METHODS AND PROCEDURES THAT ENSURE A MINIMUM OF HANDLING. THE INSTALLER SHALL PROVIDE ADEQUATE TEMPORARY ANCHORING DEVICES TO PREVENT DAMAGE DUE TO WINDS.
10. THE GEOSYNTHETICS SHALL BE INSTALLED IN A RELAXED CONDITION AND SHALL BE FREE OF TENSION OR STRESS UPON COMPLETION OF THE INSTALLATION. ALL NECESSARY PRECAUTIONS, INCLUDING PROVISIONS FOR INSTALLING EXTRA MATERIAL, SHALL BE TAKEN TO AVOID TRAMPOLINING OF ANY GEOMEMBRANE WHICH MAY REMAIN EXPOSED.
11. SEAMS SHALL BE MADE BY LAPPING THE UPSLOPE MATERIAL OVER THE DOWNSLOPE MATERIAL WITH SUFFICIENT OVERLAP. A MINIMUM OF 1 m IS REQUIRED FROM THE TOE OF THE SLOPE TO ANY HORIZONTAL SEAM ON FLAT AREAS.
12. EXTREME CARE SHALL BE TAKEN BY THE CONTRACTOR IN THE PREPARATION OF THE AREAS TO BE WELDED. THE AREAS TO BE WELDED SHALL BE CLEANED AND PREPARED ACCORDING TO THE APPROVED PROCEDURES, AND ALL SHEETING SHALL BE WELDED TOGETHER BY THERMAL METHODS.
13. THE WELDING EQUIPMENT USED SHALL BE CAPABLE OF CONTINUOUSLY MONITORING AND CONTROLLING THE TEMPERATURES IN THE ZONE OF CONTACT WHERE THE MACHINE IS ACTUALLY FUSING THE GEOMEMBRANE MATERIAL, TO ENSURE CHANGES IN WEATHER CONDITIONS WILL NOT AFFECT THE INTEGRITY OF THE WELD.
14. NO "FISH MOUTHS" SHALL BE ALLOWED WITHIN THE SEAM AREA. WHERE "FISH MOUTHS" OCCUR, THE MATERIAL SHALL BE CUT, OVERLAPPED, AND EXTRUSION WELDED. ALL WELDS ON COMPLETION OF THE WORK SHALL BE TIGHTLY BONDED. ANY GEOMEMBRANE AREA SHOWING DISTRESS DUE TO EXCESSIVE SCUFFING OR PUNCTURE DURING INSTALLATION BE REPLACED OR REPAIRED AT THE CONTRACTOR'S EXPENSE.
15. THE CONTRACTOR SHALL TAKE INTO ACCOUNT THAT RAPID WEATHER CHANGES ARE VERY POSSIBLE, RESULTING IN DELAYS IN CONSTRUCTION OF FIELD SEAMS. JOINTING OF PANELS AND REPAIRS WILL ONLY BE PERMITTED UNDER WEATHER CONDITIONS ALLOWING SUCH WORK WITHIN THE WARRANTY LIMITS IMPOSED BY THE GEOMEMBRANE MANUFACTURER.

FIELD SEAM INSPECTION AND TESTING

1. A MAXIMUM EFFORT SHALL BE MADE TO INSTALL A PERFECT LINER SYSTEM. THIS MEANS THAT ALL SEAMS COMPLETED IN THE FIELD, PATCHES AND EXTRUSIONS SHALL BE INSPECTED, TESTED AND RECORDED.
2. A QUALITY CONTROL TECHNICIAN SHALL INSPECT EACH SEAM, MARKING HIS/HER INITIALS AND THE DATE INSPECTED AT THE END OF EACH PANEL. ANY AREA SHOWING A DEFECT SHALL BE MARKED AND REPAIRED IN ACCORDANCE WITH APPLICABLE GEOMEMBRANE REPAIR PROCEDURES.
3. ALL FIELD SAMPLING AND TESTING SHALL BE DONE BY THE CONTRACTOR AS APPROVED BY THE ENGINEER.
4. THE FIELD INSTALLATION TESTING PROGRAM SHALL CONSIST OF PERIODIC VISUAL OBSERVATIONS, CONTINUITY, AND STRENGTH TESTS. THESE INSPECTIONS AND TESTS ARE TO BE MADE ROUTINELY AND ARE REQUIRED REGARDLESS OF OTHER TYPES OF TESTING THAT MAY BE COMPLETED. THE INSTALLER SHALL PERFORM QUALITY CONTROL TESTING ACCORDING TO THE TYPES AND FREQUENCY INDICATED BELOW.
   - VISUAL OBSERVATIONS ARE TO BE MADE ROUTINELY AND SHALL INCLUDE THE FOLLOWING:
     - VISUALLY CHECK FIELD SEAMS FOR SQUEEZE OUT, FOOT PRINT, MELT AND OVERLAP
     - CHECK MACHINES FOR CLEANNESS, TEMPERATURE AND RELATED ITEMS.
     - ANY AREA OF THE SEAM OR PANEL SHOWING A DEFECT SHALL BE MARKED AND REPAIRED IN ACCORDANCE WITH THE APPLICABLE REPAIR PROCEDURES.
   - CONTINUITY TESTING IS REQUIRED FOR ALL FIELD SEAMS AND REPAIRED AREAS. INTER-SEAM PRESSURE OR "AIR TESTING" AND TESTING USING VACUUM BOX ARE CONSIDERED ACCEPTABLE METHODS FOR CONTINUITY TESTING. THE TEST PROCEDURE FOR INTER-SEAM PRESSURE OR AIR TESTING IS AS FOLLOWS:
     - SEAL BOTH ENDS OF THE SEAM TO BE TESTED BY APPLYING HEAT TO THE END OF THE SEAM UNTIL FLOW TEMPERATURE IS ACHIEVED. CLAMP OFF THE ENDS AND LET COOL.
     - INSERT A PRESSURE GAUGE/NEEDLE ASSEMBLY INTO THE END OF THE SEAM AND SEAL.
     - THE SEAM SHALL BE PRESSURIZED TO AN INITIAL START PRESSURE, MINIMUM 28 psi AND MAXIMUM 30 psi.
     - THE INITIAL START PRESSURE IS READ AFTER A 2-MINUTE RELAXING PERIOD, WHICH ALLOWS THE AIR TO REACH AMBIENT GEOMEMBRANE TEMPERATURE; THE ENDING PRESSURE IS READ AFTER 5 MINUTES.
     - THE ALLOWABLE PRESSURE DROP IS 3 psi LESS THAN THE INITIAL START PRESSURE.
     - THE RESULTS OF THE AIR TEST SHALL BE MARKED AT THE TEST LOCATION AND SHALL BE RECORDED BY THE CONTRACTOR. IF THE TEST FAILS, THE LOCATION OF THE LEAK SHALL BE FOUND AND REPAIRED AND RETESTED OR THE ENTIRE SEAM SHALL BE REPAIRED AND RETESTED.
   - THE TEST PROCEDURE FOR VACUUM BOX TESTING IS AS FOLLOWS:
     - MIX A SOLUTION OF LIQUID DETERGENT AND WATER AND APPLY AN AMPLE AMOUNT TO THE AREA TO BE TESTED. IF A SEAM CONTAINS EXCESS OVERLAP OR LOOSE EDGES IT IS TO BE TRIMMED BEFORE TESTING.
     - PLACE A TRANSLUCENT VACUUM BOX OVER THE AREA AND APPLY A SLIGHT AMOUNT OF DOWNWARD PRESSURE TO THE BOX TO THE SEAL TO THE GEOMEMBRANE.
     - APPLY A VACUUM (3 psi TO 5 psi) TO THE AREA. ANY LEAKS WILL BECOME VISIBLE BY LARGE BUBBLES AND SHALL BE REPAIRED.
5. STRENGTH TESTS ON SEAMS SHALL BE CARRIED OUT ON SAMPLE COUPONS CUT FROM THE INSTALLED GEOMEMBRANE IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS AND THE INTERNATIONAL ASSOCIATION OF GEOSYNTHETICS INSTALLERS "GUIDELINES FOR INSTALLATION OF FACTORY FABRICATED HEAVYWEIGHT > 0.64 mm (25 mil) THICKNESS FABRIC - SUPPORTED GEOMEMBRANES" (MARCH, 2014), APPLICABLE GEOSYNTHETICS RESEARCH INSTITUTE STANDARDS AND THE MANUFACTURER'S QUALITY CONTROL MANUAL.

AS-BUILT DOCUMENTATION

1. THE CONTRACTOR SHALL PROVIDE THE OWNER AND ENGINEER WITH COPIES OF ALL THE FABRICATION AND INSTALLATION TEST LOGS AND CONFORMANCE DATA INCLUDING:
   - GEOSYNTHETIC CERTIFICATION
   - DAILY PANEL PLACEMENT LOGS
   - AS-BUILT PANEL LAYOUT DRAWINGS
   - SEAM CONTROL LOGS
   - CONSTRUCTION REPAIR REPORT
2. IN ADDITION, THE CONTRACTOR SHALL SUBMIT AS-BUILT DRAWINGS SHOWING THE INSTALLED GEOMEMBRANE PANEL LAYOUT WITH EACH PANEL OR PORTION OF PANEL IDENTIFIED BY THE MANUFACTURER'S IDENTIFICATION NUMBER. THE EXTENT OF THE INSTALLED GEOSYNTHETICS AND LOCATIONS OF ALL TESTS SHALL BE IDENTIFIED ALONG WITH LOCATIONS OF ANY REPAIRS. THE AS-BUILT DRAWINGS SHALL BE MADE AVAILABLE ELECTRONICALLY TO THE OWNER AND ENGINEER IN A TIMELY FASHION AFTER THE WORK IS COMPLETE.

FILL MATERIALS:

MATERIAL PLACEMENT AND COMPACTION REQUIREMENTS

ZONE AND MATERIAL TYPE	PLACING AND COMPACTION REQUIREMENTS
BEDDING MATERIAL	MATERIAL SHALL CONSIST OF 25 mm MINUS CLEAN SAND AND GRAVEL FREE OF CLAY, LOAM, ORGANICS, AND OTHER DELETERIOUS MATERIAL. LOWER LAYER - FLOOR: MATERIAL SHALL BE PLACED, SPREAD AND MOISTURE CONDITIONED IN MAXIMUM 300 mm LAYER TO 98% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY ASTM D698 (STANDARD PROCTOR) FROM A VIBRATORY COMPACTOR OR PLATE COMPACTORS. LOWER LAYER - SIDE SLOPES AND UPPER LAYER: MATERIAL SHALL BE PLACED, SPREAD AND MOISTURE CONDITIONED IN MAXIMUM 300 mm LAYER AFTER COMPACTION. NOMINAL COMPACTION.
SUBGRADE MATERIAL	MATERIAL SHALL CONSIST OF CLEAN, WELL GRADED, 100 mm MINUS PROCESSED ROCKFILL OR BORROWED GRANULAR MATERIAL AND SHALL BE FREE OF CLAY, LOAM, ORGANICS, AND OTHER DELETERIOUS MATERIALS. PLACED AND SPREAD IN MAXIMUM 300 mm LAYERS AFTER A MINIMUM OF 8 PASSES FROM A VIBRATORY COMPACTOR.

FILL PLACEMENT

1. STANDARDS:
   a. ASTM D698 [07E1], STANDARD TEST METHODS FOR LABORATORY COMPACTION CHARACTERISTICS OF SOIL USING STANDARD EFFORT (12,400 ft·lb/ft³) (600 kN·m/m³).
   b. ASTM D422 TEST METHOD FOR PARTICLE-SIZE ANALYSIS OF SOILS.
   c. ASTM D2216 TEST METHOD FOR LABORATORY DETERMINATION OF WATER (MOISTURE) CONTENT OF SOIL AND ROCK.
   d. ASTM D1556 TEST METHOD FOR DENSITY OF SOIL IN PLACE BY THE SAND-CONE METHOD.
   e. ASTM D2922 TEST METHODS FOR DENSITY OF SOIL AND SOIL-AGGREGATE IN PLACE BY NUCLEAR METHODS (SHALLOW DEPTHS).
2. ALL WORK SHALL CONFORM TO THE LINES AND GRADES SHOWN ON THE DRAWINGS.
3. THE CONTRACTOR SHALL PREPARE THE FOUNDATIONS AND EXCAVATED SLOPES AND CONSTRUCT THE VARIOUS EMBANKMENT FILL ZONES TO THE LINES AND GRADES AS SHOWN ON THE IFC DRAWINGS, WITHIN THE TOLERANCES SPECIFIED IN THE TABLE BELOW:

DESCRIPTION	MAXIMUM PERMISSIBLE DEVIATION	
	LINE	GRADE
FILL SLOPES	± 300 mm	+ 100 mm - 0 mm
BERM CREST	± 300 mm	+ 100 mm - 0 mm
BEDDING MATERIAL	± 300 mm	+ 100 mm - 0 mm

4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DRAINAGE, EROSION PROTECTION AND PREVENTION OF WATER POLLUTION DURING THE WORK. THIS INCLUDES THE CONSTRUCTION OF ALL CONSTRUCTION DEWATERING STRUCTURES REQUIRED BY THE OWNER'S REPRESENTATIVE.
5. NO FILL MATERIALS SHALL BE PLACED UNTIL ALL FOUNDATION PREPARATION AND TREATMENT IN THE FILL AREA HAS BEEN COMPLETED AND APPROVED IN WRITING BY THE OWNER'S REPRESENTATIVE.
6. ALL SNOW, DEBRIS, VEGETATION, OR ANY OTHER MATERIAL NOT CONFORMING TO THE FILL SPECIFICATIONS SHALL BE REMOVED PRIOR TO THE PLACEMENT OF FILL OR ADDITIONAL FILL.
7. THE TESTING REQUIREMENTS ARE SPECIFIED IN THE TABLE BELOW:

TEST	STANDARD	MINIMUM TESTING FREQUENCY
COMPACTION	ASTM D698	1 PER 200 m²
IN SITU DENSITY	ASTM D1556/D2922	1 PER 100 m²
MOISTURE CONTENT/GRAIN SIZE	ASTM D2216/D422	1 PER 200 m²

8. DAMAGE TO THE GEOSYNTHETIC LINING SYSTEM SHALL BE AVOIDED DURING PLACEMENT OF THE BEDDING MATERIAL ABOVE THE GEOSYNTHETIC LINING SYSTEM. HAULING EQUIPMENT SHALL NOT TRAVEL ON SURFACES WHERE THE GEOSYNTHETIC LINING SYSTEM IS PRESENT. THE MAXIMUM EQUIPMENT SIZES WHILE WORKING ABOVE THE GEOSYNTHETIC LINING SYSTEM ARE SPECIFIED IN THE TABLE BELOW:

BACKFILL THICKNESS OVER LINER	ALLOWABLE GROUND PRESSURE
NO BACKFILL	FOOT TRAFFIC OR ATV ONLY
150 mm OR LESS	HAND PLACEMENT
200 mm TO 300 mm	28.7 kPa TO 29.0 kPa (D3 TO D4 CAT TRACK LOADERS B LOW GROUND PRESSURE)
300 mm TO 600 mm	29.0 kPa TO 59.9 kPa (D4 TO D6 STYLE CAT OR EQUIVALENT)
600 mm TO 900 mm	72.8 kPa TO 109 kPa (D7 TO D9 CAT OR EQUIVALENT)

NOTES:

1. THE DRAWING SHALL BE READ IN CONJUNCTION WITH THE ACCOMPANYING CONTRACT DOCUMENTS AND APPLICABLE TECHNICAL SPECIFICATIONS.
2. BEDDING TO BE USED FOR ANCHOR TRENCH BACKFILL AND BEDDING MATERIAL BELOW AND ABOVE GEOSYNTHETIC LINING SYSTEM.
3. SUBGRADE MATERIAL TO BE USED FOR THE CELL BERMS AND BASE.
4. FILL MATERIALS USED FOR CONSTRUCTION SHALL NOT BE POTENTIALLY ACID GENERATING (PAG) OR METAL LEACHING (ML). THROUGHOUT CONSTRUCTION, ADEQUATE INSPECTION AND PERIODIC TESTING SHOULD BE CARRIED OUT TO DEMONSTRATE THE SUITABILITY OF THE FILL MATERIALS.
5. UNLESS OTHERWISE NOTED ALL MATERIALS SHALL CONSIST OF HARD, DURABLE FILL MATERIAL, FREE OF CLAY, LOAM, TREE STUMPS, ROOTS AND OTHER DELETERIOUS MATERIALS OR ORGANIC MATTER, AND CONTAIN NO MASSIVE ICE.

ISSUED FOR CONSTRUCTION

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
REVISIONS						

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	01NOV'19	ISSUED FOR CONSTRUCTION	CWM	YRC	KEH	KEH
REVISIONS						

REGISTERED PROFESSIONAL ENGINEER
K.E. HAWTON
LICENSEE
NOV 1/19
NWT/NU

Knight Piésold CONSULTING

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

MINE SITE LANDFARM SPECIFICATIONS

PIA NO.	DRAWING NO.	REVISION
NB102-181/56	0010	0

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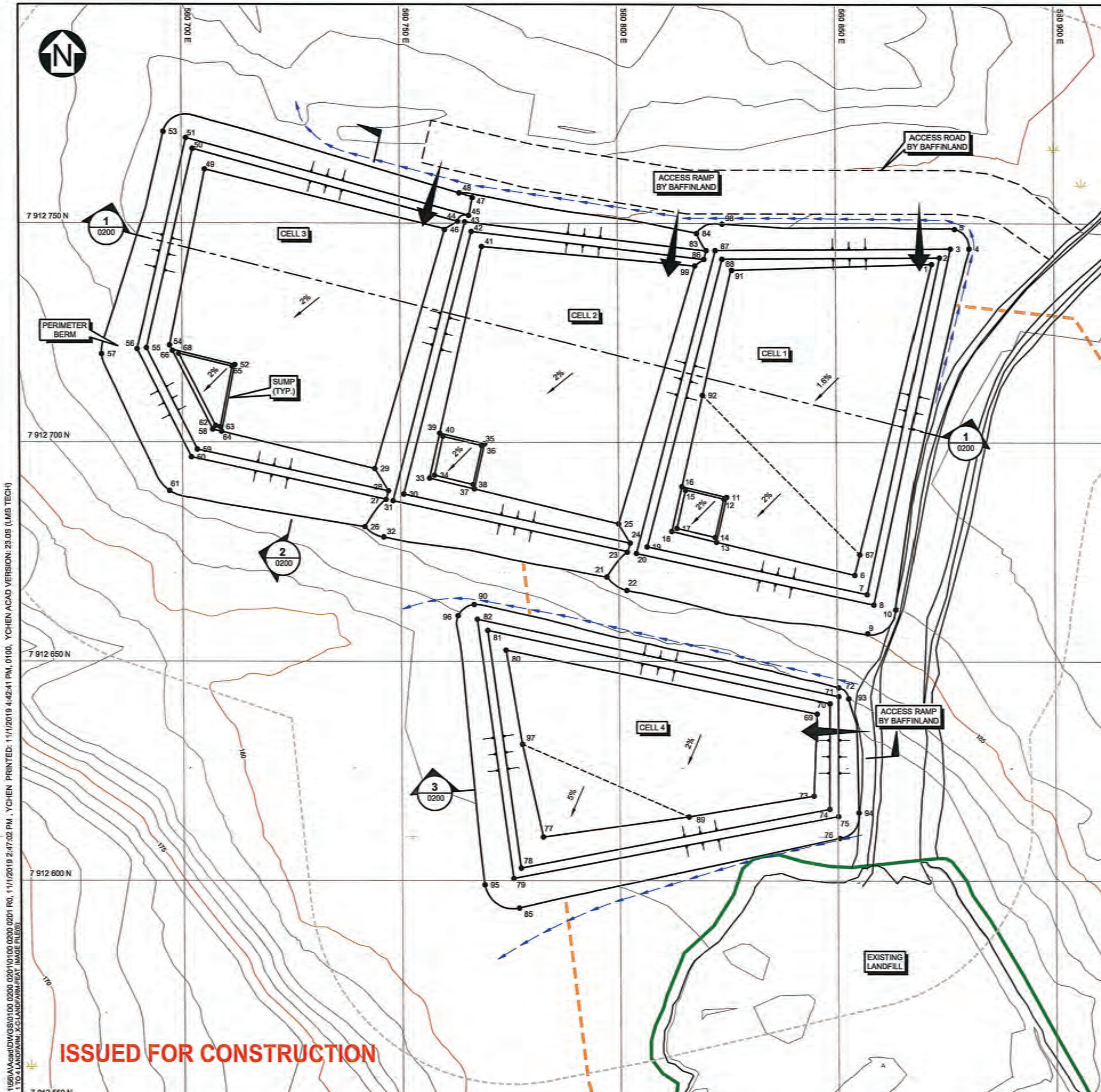


MINE SITE LANDFARM
TABLE OF SETTING OUT POINTS

POINT NO.	NORTHING	EASTING	ELEVATION (m)
1	7,912,740.71	560,871.91	187.76
2	7,912,742.20	560,873.74	188.50
3	7,912,744.21	560,876.24	188.50
4	7,912,744.24	560,880.52	186.37
5	7,912,748.72	560,877.22	186.22
6	7,912,669.76	560,854.04	186.65
7	7,912,665.36	560,856.87	188.50
8	7,912,662.99	560,858.40	188.50
9	7,912,656.43	560,856.96	185.14
10	7,912,661.88	560,863.43	185.92
11	7,912,687.50	560,824.78	186.48
12	7,912,687.12	560,824.18	185.97
13	7,912,677.27	560,822.42	186.30
14	7,912,678.32	560,822.15	185.81
15	7,912,689.10	560,815.38	185.87
16	7,912,689.92	560,814.57	186.37
17	7,912,680.41	560,813.38	185.72
18	7,912,679.69	560,812.21	186.21
19	7,912,676.19	560,806.50	188.50
20	7,912,674.68	560,804.02	188.50
21	7,912,669.30	560,797.17	184.15
22	7,912,666.22	560,801.77	184.13
23	7,912,674.98	560,801.89	187.42
24	7,912,677.04	560,802.58	187.50
25	7,912,681.43	560,799.95	185.67
26	7,912,680.75	560,741.72	183.12
27	7,912,686.98	560,746.62	186.68
28	7,912,688.95	560,747.17	186.70
29	7,912,694.02	560,744.06	184.55
30	7,912,688.19	560,750.70	187.50
31	7,912,686.68	560,748.23	187.50
32	7,912,678.40	560,746.06	183.24
33	7,912,691.85	560,756.65	185.08

MINE SITE LANDFARM
TABLE OF SETTING OUT POINTS

POINT NO.	NORTHING	EASTING	ELEVATION (m)
34	7,912,692.52	560,757.74	184.65
35	7,912,699.63	560,769.21	185.41
36	7,912,699.25	560,768.60	184.90
37	7,912,689.39	560,766.86	185.25
38	7,912,690.39	560,766.58	184.76
39	7,912,702.08	560,759.01	185.28
40	7,912,701.39	560,759.73	184.79
41	7,912,744.68	560,768.78	185.97
42	7,912,748.11	560,766.44	187.50
43	7,912,750.30	560,764.95	187.49
44	7,912,750.43	560,763.33	186.70
45	7,912,751.80	560,765.85	186.70
46	7,912,748.55	560,760.32	185.49
47	7,912,755.87	560,766.70	184.60
48	7,912,756.93	560,763.72	184.13
49	7,912,762.28	560,705.29	184.80
50	7,912,766.99	560,702.49	186.70
51	7,912,769.46	560,701.02	186.70
52	7,912,717.67	560,712.05	184.35
53	7,912,770.87	560,695.83	184.01
54	7,912,722.14	560,697.14	184.17
55	7,912,721.52	560,691.79	186.70
56	7,912,721.27	560,689.68	186.70
57	7,912,720.12	560,681.51	182.60
58	7,912,702.96	560,706.93	184.08
59	7,912,698.37	560,703.37	186.70
60	7,912,696.61	560,702.02	186.70
61	7,912,688.95	560,696.99	182.13
62	7,912,703.80	560,707.58	183.60
63	7,912,703.54	560,708.66	183.62
64	7,912,702.47	560,708.96	184.11
65	7,912,717.29	560,711.45	183.83
66	7,912,720.89	560,697.78	184.16

MINE SITE LANDFARM
TABLE OF SETTING OUT POINTS

POINT NO.	NORTHING	EASTING	ELEVATION (m)
67	7,912,674.44	560,855.24	186.73
68	7,912,720.24	560,699.19	183.68
69	7,912,638.09	560,845.29	182.63
70	7,912,640.43	560,848.26	184.10
71	7,912,642.08	560,850.24	184.10
72	7,912,644.09	560,850.23	183.06
73	7,912,619.36	560,844.48	182.28
74	7,912,616.35	560,848.09	184.10
75	7,912,614.69	560,850.09	184.10
76	7,912,609.74	560,850.38	181.64
77	7,912,609.99	560,782.32	181.09
78	7,912,602.90	560,777.22	184.10
79	7,912,600.54	560,775.53	184.10
80	7,912,652.58	560,773.96	182.33
81	7,912,657.08	560,769.77	184.10
82	7,912,659.63	560,767.40	184.10
83	7,912,743.80	560,820.38	187.51
84	7,912,747.71	560,818.22	185.65
85	7,912,593.77	560,776.74	180.66
86	7,912,741.80	560,819.85	187.51
87	7,912,743.81	560,822.45	188.50
88	7,912,741.82	560,823.99	188.50
89	7,912,614.57	560,815.86	181.97
90	7,912,663.00	560,766.67	182.35
91	7,912,739.30	560,826.17	187.22
92	7,912,710.75	560,819.37	186.73
93	7,912,641.57	560,852.55	182.95
94	7,912,615.55	560,854.77	181.76
95	7,912,599.07	560,768.85	180.68
96	7,912,660.45	560,763.03	181.89
97	7,912,631.12	560,777.65	181.97
98	7,912,749.84	560,824.06	185.50
99	7,912,740.28	560,817.73	186.68

LEGEND:

- MARSH
- CURRENT LIMIT OF EXISTING LANDFILL
- ROAD
- ACCESS ROAD BY BAFFINLAND
- GRADE BREAK
- POTENTIAL DISTURBANCE AREA (APPROXIMATE)
- 2012 FEIS/TYPE A WATER LICENCE LANDFILL AND LANDFARM LIMIT
- APPROXIMATE RUNOFF DIRECTION
- 0.5% DIRECTION OF SURFACE GRADING
- SETTING OUT POINT
- ACCESS RAMP BY BAFFINLAND

NOTES:

1. COORDINATE GRID IS UTM (NAD83) ZONE 17.
2. TOPOGRAPHY AND LANDFILL SURVEY BASED ON INFORMATION PROVIDED BY EAGLE MAPPING AND BAFFINLAND (2008 AND 2018).
3. CONTOURS ARE IN METRES. CONTOUR INTERVAL IS 1 m.
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. LOCATIONS AND DETAILS OF CONSTRUCTION ITEMS MAY BE MODIFIED TO SUIT ACTUAL SITE CONDITIONS.
6. ALL INFRASTRUCTURE SHOWN IS PROPOSED UNLESS NOTED OTHERWISE.
7. THE DRAWING SHALL BE READ IN CONJUNCTION WITH THE CONTRACT DOCUMENTS AND APPLICABLE TECHNICAL SPECIFICATIONS.
8. FOUNDATION PREPARATION: PROVIDED THE AMOUNT OF ORGANICS AND UNSUITABLE MATERIAL ON THE GROUND IS NEGLIGIBLE, DISTURBANCE TO THE ORIGINAL GROUND (EXCAVATION, SCARIFYING, ETC.) SHOULD BE MINIMIZED SO AS NOT TO IMPACT CURRENT PERMAFROST CONDITIONS. ALTERNATIVE METHODS OF FOUNDATION PREPARATION MAY BE NECESSARY FOR SOME AREAS, AT THE DISCRETION OF THE OWNER'S REPRESENTATIVE. ALL FOUNDATIONS MUST BE MAINTAINED CLEAR OF SNOW, PONDED WATER AND ICE.
9. SETTING OUT POINTS CORRESPOND TO THE TOP OF THE LINER (INSIDE THE CELLS) OR THE TOP OF THE SUBGRADE (FOR THE DOWNSTREAM CREST OR TOE OF THE CELLS).

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

REGISTERED PROFESSIONAL ENGINEER
K.E. HAWTON
LICENSEE
Nov 1/19

Knight Piésold CONSULTING

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

MINE SITE LANDFARM
PLAN AND SETTING OUT DETAILS

P/A NO.	DRAWING NO.	REVISION
NB102-181/56	0100	0

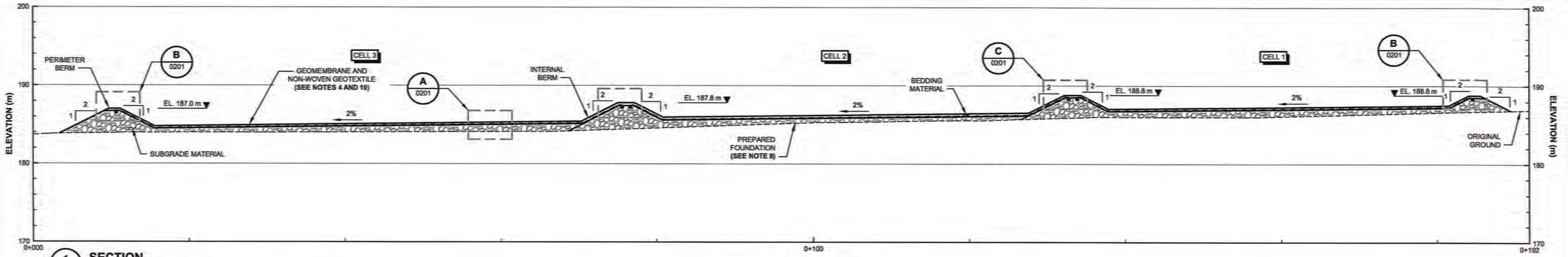
REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
0200	MINE SITE LANDFARM - SECTIONS
0201	MINE SITE LANDFARM - DETAILS

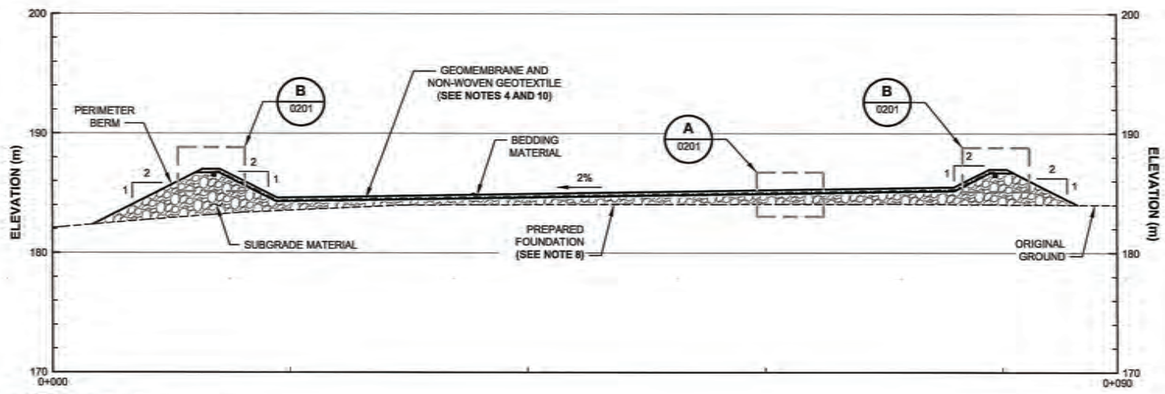
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	01NOV'19	ISSUED FOR CONSTRUCTION	CWM	YRC		

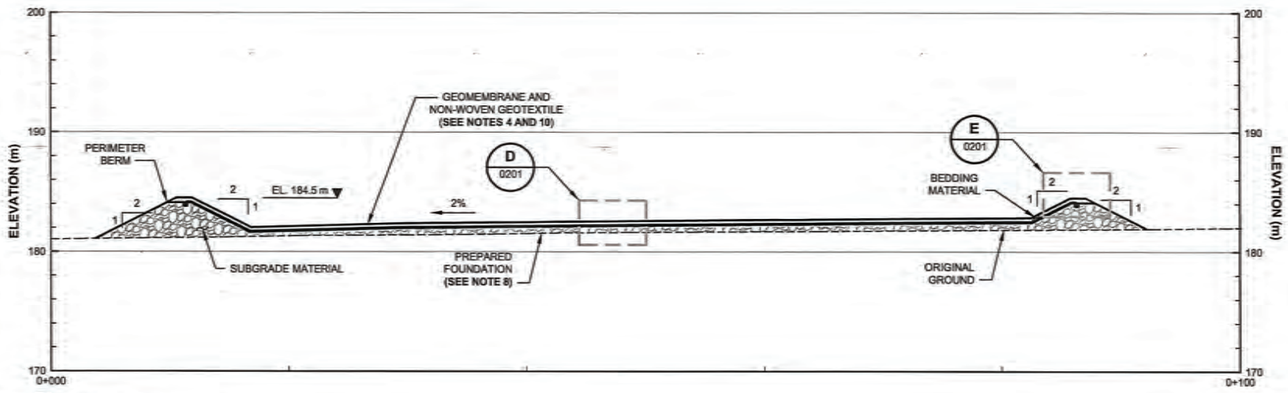
SAVED: I:\1\02\00181\56\A\Acad\DWGS\0100 0200 0201\0100 0200 0201 R0, 11/1/2019 2:47:02 PM , YCHEN PRINTED: 11/1/2019 4:42:41 PM, 0100, YCHEN ACAD VERSION: 23.0S (LMS TECH)



1 0100 **SECTION**
THROUGH SOIL CELLS
SCALE A



2 0100 **SECTION**
TYPICAL SOIL CELL
SCALE A



3 0100 **SECTION**
TYPICAL ICE/SNOW CELL
SCALE A

LEGEND:

- SUBGRADE MATERIAL
- BEDDING MATERIAL
- NON-WOVEN GEOTEXTILE
- HDPE LINER
- GEOMEMBRANE WITH NON-WOVEN GEOTEXTILE ABOVE AND BELOW
- ORIGINAL GROUND
- PREPARED FOUNDATION

NOTES:

1. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
2. LOCATION AND DETAILS OF CONSTRUCTION ITEMS MAY BE MODIFIED TO SUIT SITE CONDITIONS.
3. FOR MATERIAL AND GEOSYNTHETIC SPECIFICATIONS **SEE DRG 0010.**
4. GEOMEMBRANE TO BE 60 mil HDPE GEOMEMBRANE, TEXTURED BOTH SIDES, OR APPROVED EQUIVALENT AND TO BE INSTALLED AS PER THE MANUFACTURER'S SPECIFICATIONS.
5. ANCHOR TRENCH TO BE EXCAVATED TO THE APPROXIMATE LIMITS SHOWN (0.3 m x 0.3 m IN SECTION). FOLLOWING GEOTEXTILE AND GEOMEMBRANE INSTALLATION, TRENCH TO BE BACKFILLED WITH COMPACTED SUBGRADE MATERIAL.
6. DOWNSTREAM SLOPE OF BERMS TO BE TRIMMED AND NOMINALLY COMPACTED. UPSTREAM SLOPE OF BERM TO BE PREPARED FOR GEOSYNTHETICS INSTALLATION AS PER THE TECHNICAL SPECIFICATIONS.
7. EXCAVATION SLOPES ARE THE CONTRACTOR'S RESPONSIBILITY.
8. FOUNDATION PREPARATION: PROVIDED THE AMOUNT OF ORGANICS AND UNSUITABLE MATERIAL ON THE GROUND IS NEGLIGIBLE, DISTURBANCE TO THE ORIGINAL GROUND (EXCAVATION, SCARIFYING, ETC.) SHOULD BE MINIMIZED SO AS NOT TO IMPACT CURRENT PERMAFROST CONDITIONS. ALTERNATIVE METHODS OF FOUNDATION PREPARATION MAY BE NECESSARY FOR SOME AREAS, AT THE DISCRETION OF THE OWNER'S REPRESENTATIVE. ALL FOUNDATIONS MUST BE MAINTAINED CLEAR OF SNOW, PONDED WATER AND ICE.
9. THE DRAWING SHALL BE READ IN CONJUNCTION WITH THE CONTRACT DOCUMENTS AND APPLICABLE TECHNICAL SPECIFICATIONS.
10. NON-WOVEN GEOTEXTILE TO BE 12 oz/yd^2. NON-WOVEN GEOTEXTILE TO BE INSTALLED AS PER MANUFACTURER'S SPECIFICATIONS.
11. FINAL SLOPES SHALL BE TRIMMED TO THE LINES AND TOLERANCES INDICATED ON THE DRAWINGS AND IN THE TECHNICAL SPECIFICATIONS.

ISSUED FOR CONSTRUCTION

SCALE A 5 2.5 0 5 10 15 20 25 m

DRG. NO.	DESCRIPTION
0010	MINE SITE LANDFARM - SPECIFICATIONS
0100	MINE SITE LANDFARM - PLAN AND SETTING OUT DETAILS
0201	MINE SITE LANDFARM - DETAILS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	01NOV'19	ISSUED FOR CONSTRUCTION	CWM	YRC		

REVISIONS

REGISTERED PROFESSIONAL ENGINEER
K.E. HAWTON
LICENSEE
NWT/NU

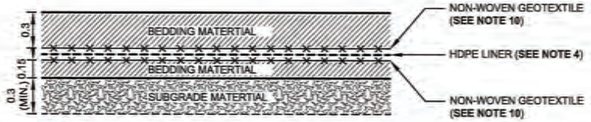
Knight Piésold CONSULTING

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

MINE SITE LANDFARM SECTIONS

PROJECT NO.	DRAWING NO.	REVISION
NB102-181/56	0200	0

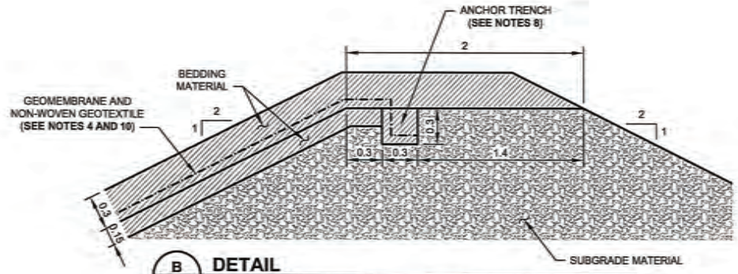


A 0200 DETAIL
TYPICAL SOIL CELL LINER SYSTEM
SCALE A

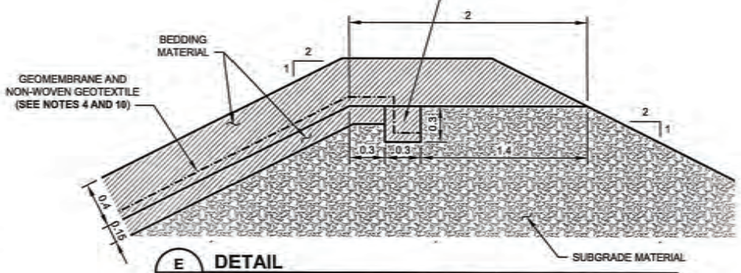
D 0200 DETAIL
TYPICAL ICE/SNOW CELL LINER SYSTEM
SCALE A

LEGEND:

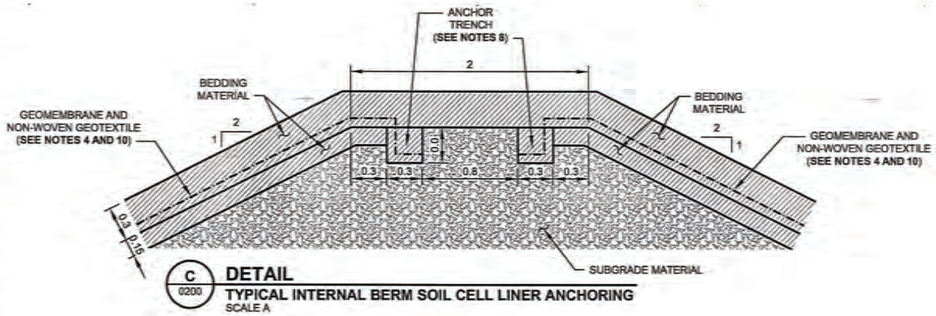
- SUBGRADE MATERIAL
- BEDDING MATERIAL
- NON-WOVEN GEOTEXTILE
- HDPE LINER
- GEOMEMBRANE WITH NON-WOVEN GEOTEXTILE ABOVE AND BELOW
- ORIGINAL GROUND
- PREPARED FOUNDATION



B 0200 DETAIL
TYPICAL PERIMETER BERM SOIL CELL LINER ANCHORING
SCALE A



E 0200 DETAIL
TYPICAL PERIMETER BERM ICE/SNOW CELL LINER ANCHORING
SCALE A



C 0200 DETAIL
TYPICAL INTERNAL BERM SOIL CELL LINER ANCHORING
SCALE A

NOTES:

1. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
2. LOCATION AND DETAILS OF CONSTRUCTION ITEMS MAY BE MODIFIED TO SUIT SITE CONDITIONS.
3. FOR MATERIAL AND GEOSYNTHETIC SPECIFICATIONS **SEE DRG 0010**.
4. GEOMEMBRANE TO BE 60 mil HDPE GEOMEMBRANE, TEXTURED BOTH SIDES, OR APPROVED EQUIVALENT AND TO BE INSTALLED AS PER THE MANUFACTURER'S SPECIFICATIONS.
5. ANCHOR TRENCH TO BE EXCAVATED TO THE APPROXIMATE LIMITS SHOWN (0.3 m x 0.3 m IN SECTION). FOLLOWING GEOTEXTILE AND GEOMEMBRANE INSTALLATION, TRENCH TO BE BACKFILLED WITH COMPACTED SUBGRADE MATERIAL.
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9. THE DRAWING SHALL BE READ IN CONJUNCTION WITH THE CONTRACT DOCUMENTS AND APPLICABLE TECHNICAL SPECIFICATIONS.
10. NON-WOVEN GEOTEXTILE TO BE 12 oz/yd^2. NON-WOVEN GEOTEXTILE TO BE INSTALLED AS PER MANUFACTURER'S SPECIFICATIONS.
11. FINAL SLOPES SHALL BE TRIMMED TO THE LINES AND TOLERANCES INDICATED ON THE DRAWINGS AND IN THE TECHNICAL SPECIFICATIONS.

ISSUED FOR CONSTRUCTION

SCALE A 0.5 0.25 0 0.5 1.0 1.5 2.0 2.5 m

DRG. NO.	DESCRIPTION
0010	MINE SITE LANDFARM - SPECIFICATIONS
0200	MINE SITE LANDFARM - SECTIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	01NOV'19	ISSUED FOR CONSTRUCTION	CWM	YRC		

REVISIONS

REGISTERED PROFESSIONAL ENGINEER
K.E. HAWTON
LICENSEE
Nov 1/19
NWT/NU

Knight Piésold CONSULTING

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

MINE SITE LANDFARM DETAILS

P/A NO.	DRAWING NO.	REVISION
NB102-181/56	0201	0

SAVED: I:\1\02\001\156\AAcad\DWG\9\100 0200 0201\100 0200 0201 R0, 11/1/2019 2:47:02 PM , YCHEN PRINTED: 11/1/2019 4:43:33 PM, 0201 , YCHEN ACAD VERSION: 23.0S (LMS TECH)
XREF FILE(S): 01 - GRILL 1 TO 4 LANDFARM, X-G-LANDFARM-PAT IMAGE FILE(S):