16 July 2018

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

RE: Modification Request No. 9
Milne Port Ore Stockpile Water Management Upgrades
Mary River Project, Water Licence 2AM-MRY1325 - Amendment No. 1

1 – INTRODUCTION

Baffinland Iron Mines Corporation (Baffinland) is pleased to submit this request for approval for a planned modification to the Mary River Project (the Project), in accordance with Part G of Type A Water Licence 2AM-MRY1325 - Amendment No. 1 (Type A Water Licence). As part of this modification request, consistent with guidance from the Nunavut Impact Review Board (NIRB), Baffinland has completed a self-assessment to demonstrate that the change proposed does not constitute a significant modification to the Project as originally approved under Project Certificate No. 005 (as Amended) and that the potential ecosystemic and socio-economic effects associated with the modification are insignificant.

On January 10, 2018, Baffinland submitted Rev. 1 of its 2018 Work Plan to the Nunavut Water Board (NWB) and the Qikiqtani Inuit Association (QIA) (Baffinland 2018a). The Work Plan included scope of work items that are considered approved under the Project Certificate, but require a Type "A" Water Licence modification (Category 2). This Modification Request No. 9 is for additional activities related to 2018 Work Plan Item No. 4, the expansion of the ore stockpile pad at Milne Port, which will require expansion of the existing Pond No. 1. Additionally, in reviewing the current water management infrastructure at the Milne Port Ore Stockpile Pad, it was determined that Pond No. 2 is undersized for the current footprint of the ore stockpile pad. Capacity of the Pond No. 2 will be expanded beyond what is required for the current footprint, but will aid in the overall management of surface water at the ore stockpile under its current and future design. The upgrades are summarized as follows:

- **Milne Port Ore Stockpile Water Management Upgrades –** addition of two new lined compartments (No. 1a and No. 2a) to the existing water management ponds (No. 1 & 2) and increasing the capacity of the existing eastern pond (No. 2) by raising the downstream embankment and existing emergency spillway level, at the ore stockpile pad at Milne Port.

The above item and associated existing ponds are shown on Figure A.1 in Baffinland (2018a), presented as Attachment 1.

2 – SELF-ASSESSMENT OF PROPOSED MODIFICATION

Baffinland has undertaken a self-assessment of the proposed modification in accordance with the *Process for Seeking Approval for Modifications to Previously-Approved Projects* (NIRB 2018). This self-assessment consists of four main components:

- Comparison of the modification with the scope of the Approved Project
- An assessment of significance applying the factors set out in Section 90 of the Nunavut Project Planning and Assessment Act (NuPPAA)
- Identification of other new or modified permits, licences or approvals necessary to complete the proposed modification
- Determination as to whether or not reconsideration of the existing Project Certificate is appropriate, considering Nunavut Agreement Section 12.8.2 and NuPPAA Section 112.

2.1 COMPARISON OF MODIFICATIONS TO APPROVED PROJECT

Baffinland undertook a comparison of the proposed modification with the scope of the Approved Project, as described in the Final Environmental Impact Statement (FEIS) and the FEIS Addendum (Baffinland 2012 and 2013) for the Early Revenue Phase (ERP) of the Project. In completing this review, Baffinland considered the following question:

Was the modification activity assessed previously, or does it represent a reasonably expected modification or optimization of that which was assessed in the FEIS or FEIS Addendum?

This modification request has been assessed previously. The results of this review are presented in Table 1.

Table 1 Comparison of Proposed Modification to the Scope of the Approved Project

Item No.	Activity/Infrastructure	Comparison to the Scope of the Approved Project	FEIS Reference
N/A	Milne Port Ore Stockpile Water Management Upgrades	An optimization consistent with the scope of the Approved Project and its assessment by NIRB.	FEIS Addendum Vol 3, Section 2.3

2.2 SIGNIFICANCE ASSESSMENT

A screening level assessment of potential changes to the assessment of the Approved Project effects was completed for each of the valued ecosystem components (VECs) and valued socio-economic components (VSECs) identified in the FEIS. This assessment is presented in Table 2.

Baffinland

Table 2 Comparison of Effects of Requested Modification to Approved Project

Theme	FEIS VEC	FEIS Key Indicator	Change in Effect and Significance	Description of Change in Potential Effects	Additional Mitigation Measures
Atmospheric Environment	Climate change	Greenhouse gases (GHGs)	Change; not significant	One-time minor increase in annual GHG emissions of ERP that is immeasurable in the context of the Life-of-Mine (LOM) GHG estimate of the Approved Project.	No additional mitigation required
		Climate change	Change; not significant	Immeasurable minor increase.	No additional mitigation required
	Air quality	Particulate matter, SO_2, NO_X	Change; not significant	Site characteristics and effects pathways are unchanged. Short-term localized increases in particulate matter and gaseous emissions associated with additional earthworks, entirely mitigated once modification is complete.	No additional mitigation required; implement existing Air Quality and Noise Abatement Management Plan.
	Noise and vibration	Atmospheric noise levels, marine noise levels, vibration	Change; not significant	Short-term localized noise increase associated with additional earthworks, entirely mitigated once modification is complete.	No additional mitigation required; implement existing Air Quality and Noise Abatement Management Plan.
Terrestrial Environment	Landforms, soil and permafrost	Sensitive landforms	No change	There are no sensitive landforms identified within the existing PDA where the modification will be undertaken.	No additional mitigation required; implement existing Environmental Protection Plan (EPP).
	Vegetation	Plant abundance and diversity Plants important to Inuit Plant health	No change	Assessment of the Approved Project assumed complete loss of vegetation within the PDAs. Since modification will occur within the existing PDA, no change to vegetation will occur relative to the Approved Project.	No additional mitigation required; implement existing EPP.
	Terrestrial wildlife and habitat	Caribou	No change	Assessment of the Approved Project assumed complete loss of terrestrial habitat within the PDA. Since modification will occur within the existing PDA, no change to terrestrial wildlife habitat will occur relative to the Approved Project.	No additional mitigation required; implement existing Terrestrial Environment Mitigation and Monitoring Plan (TEMMP).
	Migratory birds and habitat	Peregrine Falcon, Snow Goose, Eider, Red-throated Loon, shorebirds, songbirds, species at risk	No change	Assessment of the Approved Project assumed complete loss of habitat within the PDA. The footprint of the modification will be surveyed for bird nests prior to work if being undertaken during the nesting season, in accordance with the TEMMP and EPP.	No additional mitigation required; implement existing TEMMP and EPP.
Freshwater Aquatic Environment	Surface water include freshwater quality and quantity	Water quantity Water and sediment quality	Change; not significant	Additional earthworks represent no potential increase in sedimentation effects to local freshwater watercourses. Location is adjacent the shoreline of Milne Inlet.	No additional mitigation required; water management measures will be installed consistent with Baffinland's Civil Design Criteria and with applicable management plans: Surface Water and Aquatic Ecosystems Management Plan, Freshwater, Sewage and Wastewater Management Plan, and EPP.
	Freshwater fish, fish habitat and other aquatic organisms	Arctic char	Change; not significant	Proposed modification is situated immediately upstream of Milne Inlet. The potential for changes to water quality affecting fish could result from potential sedimentation during earthworks.	No additional mitigation required; implement existing Surface Water and Aquatic Ecosystems Management Plan, Freshwater, Sewage and Wastewater Management Plan, and EPP.

Theme	FEIS VEC	FEIS Key Indicator	Change in Effect and Significance	Description of Change in Potential Effects	Additional Mitigation Measures
Marine Environment	Sea ice	Area of shore fast ice in Steensby Inlet	No change	Not applicable to the requested modification.	No additional mitigation required.
	Water and sediment quality	Water and sediment quality parameters with established guidelines	No change	Additional earthworks represent a minor potential increase in sedimentation effects to the shoreline of Milne Inlet.	No additional mitigation required; implement existing Surface Water and Aquatic Ecosystems Management Plan, Freshwater, Sewage and Wastewater Management Plan, and EPP.
Human Environment	Land and resources use	Wildlife harvesting by Inuit Travel and camps	No change	The scale of the modification is minor and entirely confined to the existing PDA and Commercial Lease boundaries. Changes to how Baffinland manages visitors and hunters will not be necessary.	No additional mitigation required.
	Cultural resources	Archaeological sites	No change	Effects to archaeology are not expected, as modification is located in an area previously surveyed (and mitigated, if necessary).	No additional mitigation required; implement existing Cultural Heritage Protection Plan and EPP.
	Other Valued Socio-economic Components (VSECs): - Population demographics - Education and training - Human health and wellbeing - Community infrastructure and public services - Governance and leadership - Livelihood and employment - Economic development and self-reliance - Contracting and business opportunities - Benefits, taxes and royalties		No change	Any additional employment and contracting will be undertaken in accordance with the provisions of the Inuit Impact and Benefit Agreement (IIBA) with the Qikiqtani Inuit Association (QIA).	No additional mitigation required.

The modification request was evaluated against the significance criteria presented in Section 90 of the *Nunavut Project Planning and Assessment Act* (*NuPPAA*):

(a) The size of the geographic area, including the size of wildlife habitats, likely to be affected by the impacts

(b) The ecosystemic sensitivity of that area

(c) The historical, cultural and archaeological significance of that area

(d) The size of the human and animal populations likely to be affected by the impacts

(e) The nature, magnitude and complexity of the impacts

(f) The probability of the impacts occurring

(g) The frequency and duration of the impacts

(h) The reversibility or irreversibility of the impacts

An assessment of the requested modification in relation to Section 90 of the *NuPPAA* is presented in Table 3.

Table 3 Significant Modification Self-Assessment Using *NuPPAA* S.90 Significance Criteria

NuPPAA Section 90 Significance Criteria	Evaluation of Modification Request No. 7
(a) the size of the geographic area, including the size of wildlife habitats, likely to be affected by the impacts	Proposed modification is located within the Commercial Lease Boundaries; the geographic extent of the Project remains unchanged.
(b) the ecosystemic sensitivity of that area	Proposed modification confined to the existing project boundaries; no new environmental sensitivities have been identified.
(c) the historical, cultural and archaeological significance of that area	Proposed modification confined to the existing project boundaries; no new features of historical, cultural or archaeological significance will be affected.
(d) the size of the human and the animal populations likely to be affected by the impacts	No change.
(e) the nature, magnitude and complexity of the impacts	Proposed modification has effects that are consistent with the Approved Project.
(f) the probability of the impacts occurring	Proposed modification has effects that are consistent with the Approved Project.
(g) the frequency and duration of the impacts	Proposed modification has effects that are similar in frequency and duration to effects assessed for the Approved Project.
(h) the reversibility or irreversibility of the impacts	The proposed modification has effects that range from fully reversible to irreversible, consistent with the Approved Project.
(i) the cumulative impacts that could result from the impacts of the project combined with those of any other project that has been carried out, is being carried out or is likely to be carried out	Marginal potential increases in the effects to air quality, noise, water quality and consequently fish and fish habitat are confined to the local study areas, and do not overlap with other past, present or reasonably foreseeable activities that would constitute new cumulative effects.
(j) any other factor that the Board considers relevant to the assessment of the significance of impacts	This criterion is not applicable to a proponent self-assessment.

The activities are confined within the boundaries of Baffinland's Commercial Lease and therefore do not represent a change to the previously assessed geographic extent of the Project. These activities will not be located in an area of particular ecosystem sensitivity and the areas of disturbance do not impact areas of historical, cultural or archeological significance. Human and wildlife are not likely to be adversely affected. The activities will not significantly change air emissions, impede water flow, impact aquatic life, hinder wildlife access or increase noise levels, and the activities will not directly interact with fish or fish habitat. Most of the effects are reversible as reclamation will be carried out once the activity is complete. Additional cumulative effects are not expected given that there are no new residual effects predicted from the requested modification.

2.3 OTHER REQUIRED APPROVALS

In addition to requiring NWB approval as a modification under the Type A Water Licence, the proposed modification requires approval from the QIA as land owner, as part of the annual work plan approval process. Additionally, adequate reclamation security is required for the proposed works, for which Baffinland has engaged QIA though the 2018 Work Plan Addendum to complete a review of the appropriate marginal increase.

2.4 RECONSIDERATION OF THE PROJECT CERTIFICATE

Baffinland reviewed Section 12.8.2 of the Nunavut Agreement and Section 112 of the *NuPPAA* and has determined that reconsideration of the existing Project Certificate is not appropriate.

Section 112 of *NuPPAA* states the following:

> ***112 (1)*** *The Board may, on its own initiative or at the request of the Designated Inuit Organization, the proponent or any interested person, reconsider the terms and conditions set out in a project certificate that it has issued if*
>
> *(a) the terms and conditions are not achieving their intended purpose or are having effects that are significantly different from those anticipated at the time the certificate was issued;*
>
> *(b) the circumstances relating to the project are significantly different from those anticipated at the time the certificate was issued; or*
>
> *(c) technological developments or new information provides a more efficient method of achieving the intended purpose of the terms and conditions.*

Section 12.8.2 of the *Nunavut Agreement* presents nearly identical wording as *NuPPAA* Section 112.

The requested modification is consistent with the scope of the Approved Project, and hence Baffinland has concluded that the terms and conditions of the Project Certificate are achieving their purpose (Clause a); and that the circumstances related to the project and its effects remain unchanged from the Approved Project (Clause b). No technological developments or new information have been identified in relation to Clause c. The requested modification does not warrant changes to existing conditions or new conditions within the Project Certificate. As such, reconsideration of the Project Certificate is not appropriate.

The requested modification is described in Section 3, in accordance with Part G, Item 3 of the Type A Water Licence.

2.5 SELF-ASSESSMENT CONCLUSION

Based on the self-assessment provided in Sections 2.1 through Section 2.4, Baffinland has concluded that:

- The proposed modification is an activity that was previously assessed by Baffinland.
- The effects of the proposed modification is not significant.
- No other permits, licences or approvals (or modifications of existing approvals) are required, beyond approval of this modification request by the NWB, and approval from QIA with respect to the Interim Closure and Reclamation Plan and the associated Reclamation Security. It is expected that upon approval of the current modification request, approval by the QIA, as the land owner, will be granted.
- Reconsideration of the terms and conditions in Project Certificate No. 005 is not required.

3 – MODIFICATION REQUEST

In accordance with Part G of Baffinland's Type A Water Licence, the Licensee may carry out modifications after written notification has been provided to the Board, provided such modifications do not place the Licensee in contravention of the Licence or the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*, and such modifications are consistent with the NIRB Project Certificate.

In Section 2, Baffinland confirmed that the requested modifications are consistent with the scope of the Approved Project, and that a reconsideration of the Project Certificate is not appropriate.

Baffinland has also reviewed the proposed modification to determine if it potentially contravenes the Water Licence, thereby requiring written approval from the NWB before proceeding.

The two water management ponds affected by the proposed modification are currently identified in the Water Licence issued by the NWB (MP-05 and MP-06). This modification does not contravene the Licence. Baffinland will proceed with these works 60 days following submission of this modification request. Should the Board respond in writing before the 60 days that approval is not granted for specific works, Baffinland would not proceed with the works until written approval is granted. Baffinland will provide as-built documentation in accordance with the Type 'A' Water Licence, to be submitted 90 days following completion of construction.

3.1 MILNE PORT ORE STOCKPILE WATER MANAGEMENT UPGRADES

3.1.1 Description of Facilities and/or Works to be Constructed

The construction of the new lined compartment expansion (No. 1a) for Pond No. 1 is required to accommodate the addition of approximately 26,000 m² of footprint to the Ore Stockpile No. 1 pad at Milne Port (2018 Work Plan Item No. 4), which results in an increase to the surface water volume received by Pond No. 1. Additionally, it has been identified that Pond No. 2 is undersized based on the pad catchment area, and will therefore require an increase in capacity by raising its existing berms and adding a new lined compartment expansion (No. 2a). The resulting expanded capacity of Pond No. 2 will be greater than what is required for the current footprint, but will aid in the overall management of surface water at the ore stockpile under its current and future design. Related work includes expanding the stockpile pad, excavation of drainage ditches to convey surface water to the existing water management ponds, and two new culvert crossings installed beneath access roads in addition to the existing culvert.

3.1.2 Proposed Location of the Structure

The proposed work will occur within the existing PDA at Milne Port, as shown on Figure A.1 (Attachment 1).

3.1.3 Identification of any Potential Impacts to the Receiving Environment

The ponds and related water management facilities are consistent with the Approved Project and the potential impacts of the activity have been assessed in the FEIS and Addendum (Table 1). Sedimentation and erosion mitigation measures, as required, shall be in place before commencing construction. A temporary water management plan shall be developed and implemented prior to construction.

The proposed work and associated activities will permit the containment of a higher volume of water associated with the enlarged ore stockpile and historic runoff, and therefore reduce the potential for accidental release of sediment-laden water into Milne Inlet during and following significant precipitation events.

3.1.4 Monitoring

Periodic environmental inspections will be conducted by Baffinland's Environmental personnel in conjunction with the Contractor's Health, Safety and Environment Lead. Inspections will ensure that Contractors are complying with the conditions of the Type A Water Licence (in particular Part D, Conditions Applying to Construction and Operation) and Baffinland's management plans and procedures. Inspections will be documented by taking photos and using Baffinland's environmental inspection forms. This includes inspections and photos before and after the work, and during the course of the work to document any deficiencies. Documented deficiencies will be forwarded to the responsible Contractor for corrective action.

Baffinland will prepare a Construction Summary Report for the modification described in this request, in accordance with Part D, Item 17 of the Type A Water Licence. The Construction Summary Report will include the information specified in Schedule D of the licence.

During operation, monitoring of the final (treated) effluent quality at Pond 1 (MP-06) and Pond 2 (MP-05) will be carried out in accordance with the Type A Water Licence. No change in the monitoring parameters are warranted. Existing management plans for the Mary River Project are sufficient to address the ongoing monitoring and management of the expansions to the water management ponds once constructed.

3.1.5 Schedule for Construction

Construction is expected to begin 60 days following submission of this modification request in accordance with Part G Item 1 of the Type A Water Licence, or upon written approval from the Board in accordance with Part G Item 2. The work is expected to be completed before the end of 2018, and would proceed approximately as follows:

- Initiation of construction earthworks (60 days from submission, approximately September 14)
- Install sedimentation and erosion control, and drain water in existing ponds (2 days)
- Level existing ground level for new compartment (No. 1a) footprint to 3 m (1 week)
- Raise and extend Pond No. 2 berm (1 week)
- Place fill for new compartments (No. 1a & 2a) (1 week)
- Lay geotextile for Pond No. 2 berm raise and new compartments (2 days)
- Extend and weld new liners to key into existing water management ponds (1 week)
- Confirm key in of berms and ditching (2 days)
- Install new culverts (2 days)

Note that the above schedule is provided for reference only, and is subject to change based on weather conditions, material and contractor availability, equipment availability, and any other unforeseen circumstances.

3.1.6 Drawings of Engineered Structures

The following engineering documents in Hatch (2018; Attachment 2) provide details on the Milne Port Ore Stockpile Water Management Upgrades:

- PORT SITE STOCKYARD 1 – EXTENSION LAYOUT (Drawing No. H353004-40000-228-271-0007-0001
- PORT SITE STOCKYARD 1 – BERM (P-SWD-4) DRAINAGE PLAN (Drawing No. H353004-40000-221-272-0006-0001)
- PORT SITE STOCKYARD No.1 SETTLING POND No.2A PLAN AND PROFILE (Drawing No. H353004-40000-228-272-0008-0001)
- PORT SITE STOCKYARD No.1 SETTLING POND No.1A PLAN AND PROFILE (Drawing No. H353004-40000-228-272-0007-0001)

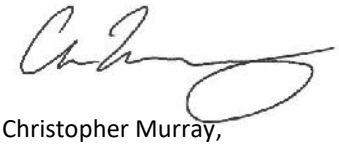
3.1.7 Proposed Sediment and Erosion Control Measures

Baffinland will employ a combination of sediment and erosion control measures (check dams, rip-rap, silt fences, etc.), as outlined in the Environmental Protection Plan (Baffinland 2016a) and Surface Water and Aquatic Ecosystems Management Plan (Baffinland 2016b) to address and manage sedimentation concerns during construction. Regular maintenance of the water management ponds will be required to ensure they continue to function as intended. Existing management plans for the Mary River Project are sufficient to address the ongoing monitoring and management of the expansions to the water management ponds.

4 – CLOSURE

We trust that this information meets the requirements under Part G under Baffinland's Type A Water Licence and look forward to the NWB's response. Please do not hesitate to contact the undersigned should you have any questions or comments.

Regards,



Christopher Murray,
Environmental & Regulatory Compliance Manager

Cc:
Karén Kharatyan (Nunavut Water Board)
Stephen Williamson Bathory, Fai Ndofor (Qikiqtani Inuit Association)
Jonathan Mesher, Ian Parsons, Karen Costello (Crown-Indigenous Relations and Northern Affairs Canada)
Solomon Amuno (Nunavut Impact Review Board)
Grant Goddard, Megan-Lord Hoyle, Timothy Ray Sewell, Andrew Vermeer (Baffinland)

ATTACHMENTS

1 Milne Port Site Plan – Modification No. 9
2 Civil Design Report (Hatch, 2018)

REFERENCES:

Baffinland Iron Mines Corporation (Baffinland). 2012. *Mary River Project - Final Environmental Impact Statement*. February 2012.

Baffinland Iron Mines Corporation (Baffinland). 2013. *Mary River Project - Addendum to the Final Environmental Impact Statement for the Early Revenue Phase*. June 2013.

Baffinland Iron Mines Corporation (Baffinland). 2016a. *Environmental Protection Plan*. Doc. No. BAF-PH1-830-P16-0008, Rev. 1, August 30, 2016.

Baffinland Iron Mines Corporation (Baffinland). 2016b. *Surface Water and Aquatic Ecosystems Management Plan*. Doc. No. BAF-PH1-830-P16-0026, Rev.4, March 17, 2016.

Baffinland Iron Mines Corporation (Baffinland). 2018a. *2018 Work Plan*. Rev. 1 dated January 10, 2018.

Baffinland Iron Mines Corporation (Baffinland). 2018b. *Mary River Project - Modification Request No. 7 – 2018 Upgrades at the Mine Site and Milne Port (Water Licence 2AM-MRY1325 - Amendment No. 1).* Letter to the Nunavut Water Board dated March 8, 2018.

Hatch. 2018. Port Stockyard Settling Ponds. Project Memo H353004-40000-228-030-0001, Rev. A, Dated June 27, 2018

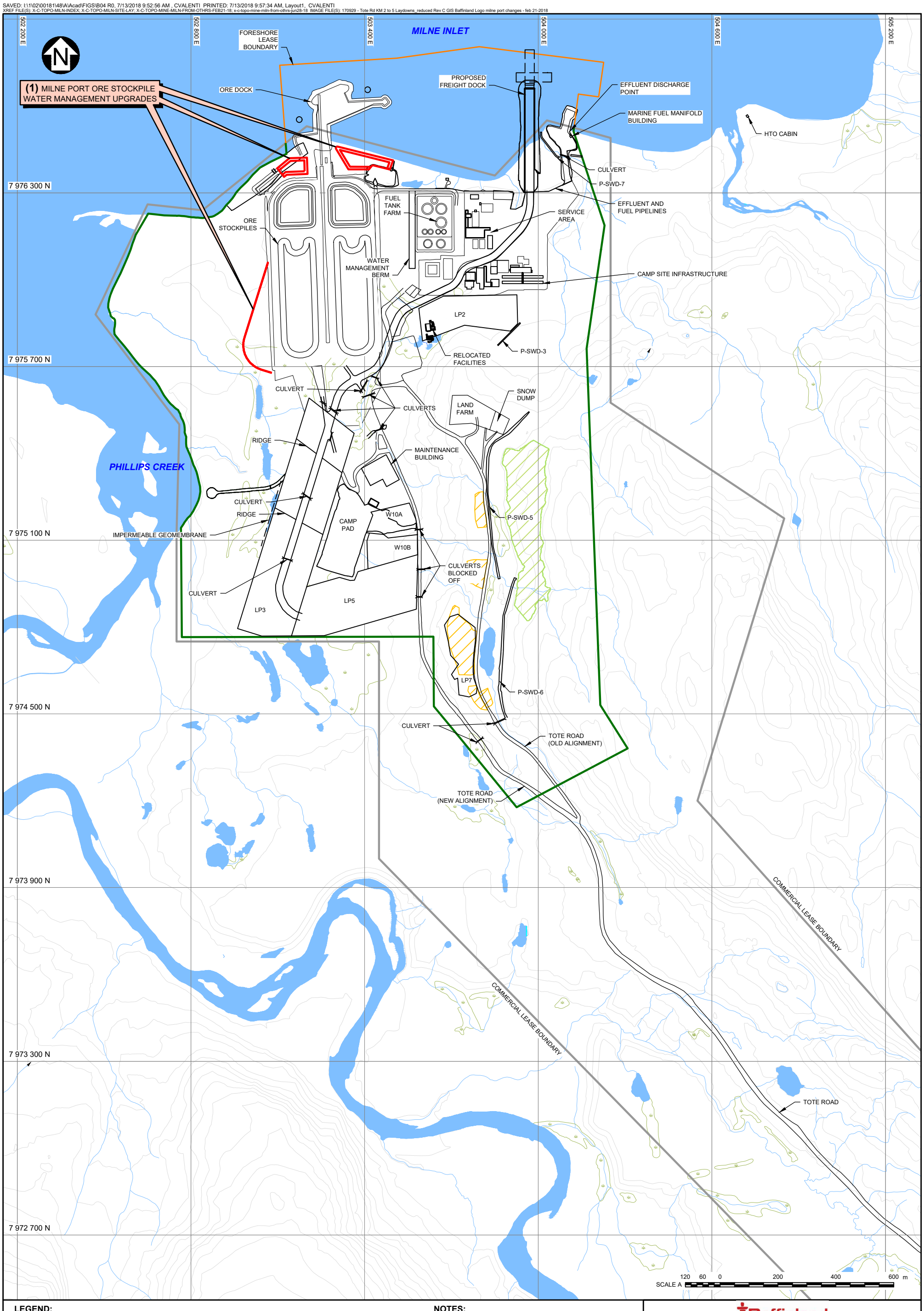
Nunavut Impact Review Board (NIRB). 2018. *Process for Seeking Approval for Modifications to Previously-Approved Projects*. Memorandum dated February 14, 2018 issued to the Nunavut Wide Distribution List.

Baffinland

Attachment 1

Milne Port Site Plan – Modification No. 9

SAVED: I:\1\02\00181\48\A\Acad\FIGS\B04 R0, 7/13/2018 9:52:56 AM , CVALENTI PRINTED: 7/13/2018 9:57:34 AM, Layout1, CVALENTI
XREF FILE(S): X-C-TOPO-MILN-INDEX; X-C-TOPO-MILN-SITE-LAY; X-C-TOPO-MINE-MILN-FROM-OTHRS-FEB21-18; x-c-topo-mine-miln-from-othrs-jun28-18 IMAGE FILE(S): 170929 - Tote Rd KM 2 to 5 Laydowns_reduced Rev C GIS Baffinland Logo milne port changes - feb 21-2018



LEGEND:

- WATER
- BORROW AREAS
- QUARRY AREA
- ROAD
- RIVER/STREAM/DRAINAGE
- QIA SURFACE COMMERCIAL LEASE IMPACT BOUNDARY
- POTENTIAL DEVELOPMENT AREA BOUNDARY
- FORESHORE LEASE BOUNDARY

NOTES:

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

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	13JUL'18	ISSUED WITH TRANSMITTAL	CM	CJV	CM

Baffinland

MARY RIVER PROJECT

MILNE PORT SITE PLAN
MODIFICATION REQUEST #9

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-181/48	NB18-00410

FIGURE A1 REV 0

Baffinland

Attachment 2

Civil Design Report

(Hatch, 2018)

Project Memo

H353004

July 13, 2018

To: Tamer Atiba

From: F Hugo

cc:

BIM
G Gaudet
S Borcsok

Hatch
A Grobbelaar
R Goosen
V Lavric
S Perry
D Stanger

Baffinland Iron Mines Corporation
Mary River Expansion Project

Port Stockyard Settling Ponds

1. Introduction

Hatch has been retained by Baffinland Iron Mines (BIM) to provide the design for the Mary River Project. Mary River is an operational iron ore mine on Baffin Island in Canada's Nunavut territory. Ore is mined from the open pit, crushed onsite and hauled to the Milne Port (approximately 100 km from the mine site).

This memo describes the basis of design for the settling ponds at the Port stockyard.

2. Background

Two settling ponds were constructed at the port for the drainage water from the existing stockyard during the Early Revenue Phase (ERP). Settling Pond #1 is on the western side of the existing ship loader and Pond #2 is situated on its eastern side. The balance of the port drainage design is described in the 2018 Water Management Plan, document H353004-40000-200-210-0001.

The existing capacity of both ponds is considered insufficient due to the new data related to the stockpile runoff, depth of Pond #2 and augmentation of the stockpile footprint. Additional storage capacity will be added by constructing new compartments and raising the spillway of Pond #2.

3. Site Conditions

The following sections provide a description of the site conditions.

3.1 Geotechnical

The closest borehole to the existing settling ponds is BH 16-M001. A sandy deposit (sand to sand and gravel) was encountered down to the termination of the borehole (at about 15 m depth). No silt layer was found in this borehole.

During construction of the existing ponds, groundwater was encountered at shallow depths, which resulted in changes being made on site. Settling Pond # 1 (western side) was raised by approximately 300mm and settling Pond # 2 (eastern side) by approximately 1,400mm. Therefore, the new ponds are designed to be constructed at the same invert levels as the existing ponds.

The slope angles of 1V:3H used in the design for ponds #1 and #2 are deemed appropriate and performed well. Therefore, the new compartments (Ponds #1A and 2A) were designed using the same parameters and with the same factor of safety.

3.2 Climate and Hydrology

The project is located in the North Baffin Region of Baffin Island. Based on regional data collected by Knight Piesold (2012), the mean rainfall at the port is about 217mm and the mean annual temperature is approximately -15°C. The monthly average temperatures are mostly above freezing between June and August.

Short-term rainfall intensity-duration-frequency curves recommended by Knight Piesold (2012) for the Mary River Project and established in the civil design criteria (Hatch 2013) are based on rainfall data from the Environment Canada Clyde River (ID 2400800) and Pond Inlet Airport (ID 2403201) climate stations. The intensity-duration-frequency values in Table 1 present rainfall statistics for durations between 5 minutes and 24 hours for return periods 2 years to 200 years.

Table 1: Milne Port intensity-Duration-Frequency Values

Duration	2 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	50 yrs	100 yrs	200 yrs
5 min	9.5	12.0	14.0	15.1	15.9	16.5	18.3	20.1	22.0
10 min	7.2	9.0	10.5	11.3	11.9	12.4	13.7	15.1	16.5
15 min	6.0	7.5	8.7	9.4	9.9	10.3	11.4	12.6	13.7
30 min	5.0	6.3	7.3	7.9	8.3	8.6	9.5	10.5	11.4
1 hr	4.0	5.2	6.1	6.6	7.0	7.3	8.1	9.0	9.9
2 hr	3.0	3.9	4.6	5.0	5.2	5.5	6.1	6.8	7.4
6 hr	2.0	2.7	3.3	3.6	3.9	4.0	4.6	5.1	5.7
12 hr	1.3	1.8	2.2	2.4	2.6	2.7	3.1	3.4	3.8
24 hr	1.0	1.4	1.7	1.9	2.0	2.1	2.4	2.7	3.0

The rainfall intensity-duration-frequency statistics as shown in the table above were confirmed by Knight Piesold in December of 2016 in a memo addressed to the project director and also attached to this memo. It is therefore accepted that the information is valid and does not need to be updated.

4. Proposed Scope of Work

The upgrade of the existing settling Pond #1 drainage system involves the following scope:

- Construction of drainage ditches and berms to convey water towards the existing settling Pond #1 (See attached drawing H353004-40000-228-271-0007-0001).
- Increase the footprint area of the existing stockyard while still ensuring adequate drainage (See attached drawing No. H353004-40000-221-272-0006-0001).
- Add an additional lined compartment (Settling Pond #1A) with an interlinking spillway to the existing pond (See attached drawing H353004-40000-228-272-0008-0001).

The upgrade of the existing settling Pond #2 involves the following scope:

- Raise the downstream embankment crest elevation.
- Raise the existing emergency spillway level.
- Excavate ditch and connect to the existing system.
- Add additional lined compartment (Settling Pond #2A) with interlinking spillway to the existing pond (refer to attached drawing H353004-40000-228-272-0007-0001).

5. Design Basis

5.1 General

The design basis is as described in the Civil Design Philosophy, H353004-00000-200-210-0001.

5.2 Dam Classification

The settling pond is not classified as dams according to the Canadian Dam Association, since it will contain less than 30 000m^3 and is less than 2.5m in height.

5.3 Emergency Spillway

The emergency spillway is designed to safely pass the 1:200 peak flow without any overtopping of the embankment. The spillway is designed as a broad crested weir as described in the Civil Design Philosophy referenced above.

5.4 Freeboard Requirements

A minimum 300mm freeboard must be maintained at full supply level.

5.5 Pond Capacity

The ponds are sized in accordance with the Civil Design Philosophy. This requires that the ponds are able to contain the 1:10 year return period 24 hour storm event which equates to 40.8mm of rainfall. A runoff coefficient of 0.9 is used over the proposed catchment area. The catchment areas consists of rockfill pad and iron ore stockpiles.

The existing capacity for Settling Pond #1 calculated (based on the as-built drawings) is 2,600 m^3. The total required capacity is 6,750 m^3. The following will be executed:

- A second compartment (Pond #1A) will be constructed and will incorporate an interlinking overflow. This will have a capacity of 4,150 m^3.

The existing capacity for Settling Pond #2 calculated (based on the as-built drawings) is 732 m^3. The total required capacity is 6,910 m^3. The following will be executed:

- The downstream crest elevation of existing Pond #2 will be lifted to elevation 8.75m.a.s.l. and the spillway will be raised to elevation 8.35m.a.s.l. This will result in the total capacity in Pond #2 of 2,577 m^3.
- A second compartment (Pond #2A) will be constructed. The crest elevation will match that of the modified Pond #2 and will incorporate an interlinking overflow. This will correspond to a capacity of 4,394 m^3.

The total storage volume for settling Ponds #2 and # 2A will be 6,971 m^3.

5.6 Runoff Conveyance

As described in Section 4, new ditches and berms shall be constructed to convey water to the existing ditches and then into the ponds. Refer to the drawings as mentioned in Section 4.

There will be a total of 3 culvert crossings to convey the runoff towards the ponds. Two new culverts will be installed beneath access roads in addition to the existing culvert. The existing 950mm diameter culvert, which crosses a road just upstream of Pond #2 was analyzed and it was concluded that it has sufficient capacity to cope with the 1:25 year return period peak flow as per the requirements set out in the Civil Design Philosophy.

6. Construction

6.1 Construction and Operating Considerations

The construction considerations related to the settling ponds include the following:

- Test pitting to be carried out along the footprint prior to any fill placement, if ground conditions permit.
- If ground water is encountered the contractor must inform the engineer and the design must be adjusted accordingly to ensure that adequate storage capacity is maintained.
- The existing ponds shall be drained as required and the condition of the existing exposed geomembrane inspected to ensure that there are no leaks, repairs to be carried out as required.
- Sedimentation and erosion mitigation measures, as required, shall be in place before commencing construction.
- A temporary water management plan shall be developed and implemented prior to construction.
- All materials shall be placed in accordance with the placement of fill specification H353004-00000-221-078-0001.
- As-built surveys shall be collected to document all construction activities.

- The operating conditions related to the settling ponds include:
- Once the required water quality has been achieved the pond must be pumped empty to avoid uncontrolled discharge.

6.2 Construction Materials

The ponds will be constructed using non-frost susceptible rockfill material consisting of:

- Type 8 - General Fill
- Type 5 - Intermediate Bedding Material
- Type 9 - Fine Bedding Material
- Type 19 - Riprap

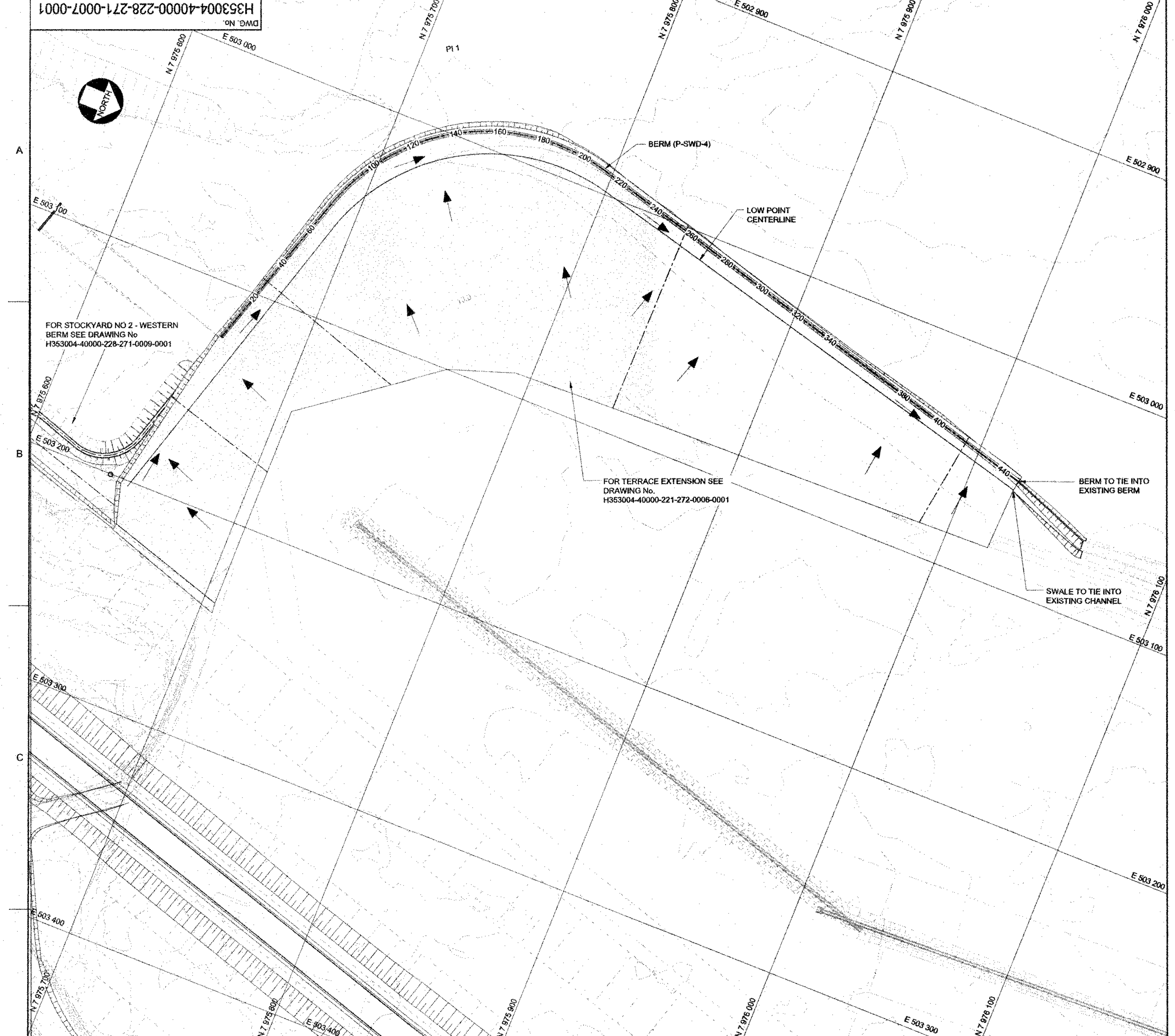
For more information about the materials mentioned above refer to H353004-00000-280-078-0001, Quarried Fill Materials Requirements.

F Hugo

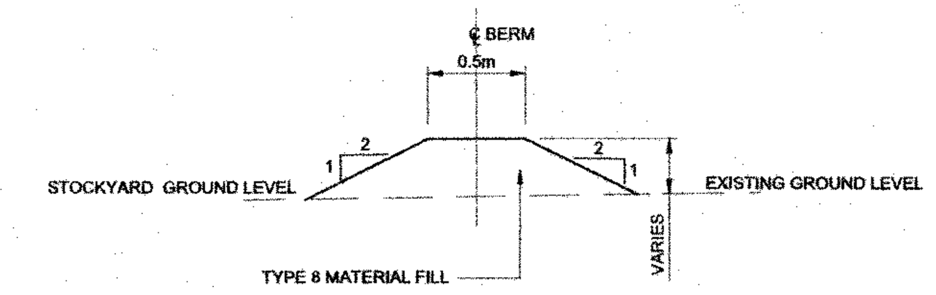
FH:kf

Attachments:

H353004-40000-228-271-0007-0001
H353004-40000-221-272-0006-0001
H353004-40000-228-272-0008-0001
H353004-40000-228-272-0007-0001
Knight Piesold Updated Design Peak Flow Assessment



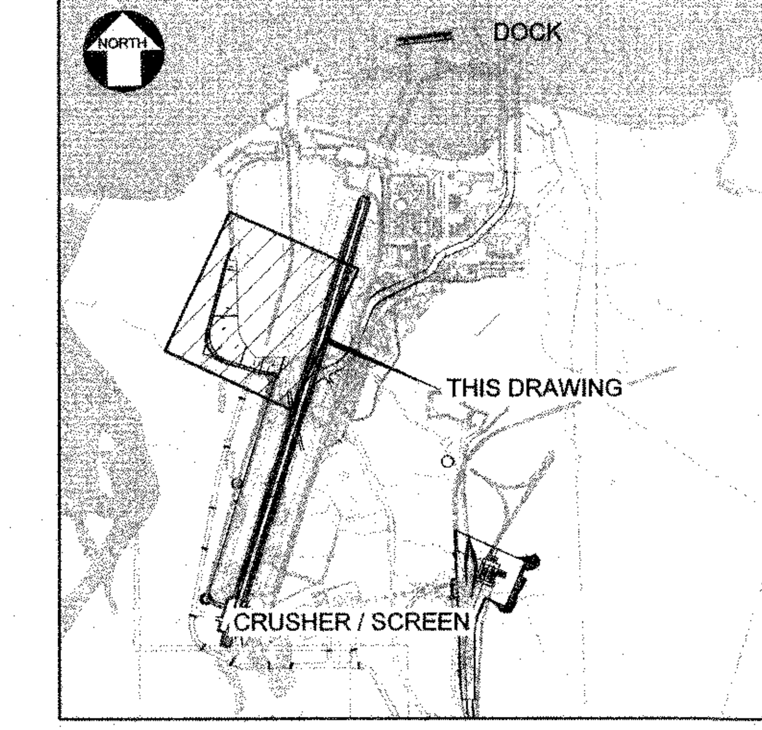
PLAN
SCALE 1:1000



TYPICAL SECTION THROUGH BERM
SCALE 1:25

SETTING OUT DATA STOCKYARD BERM

NAME	CH	E	N	DETAILS
START	0.000	503 123.987	7 975 663.514	L 78.218m
BCC1 PI1 ECC1	78.218 215.899	503 049.456 502 967.146 502 989.959	7 975 687.247 7 975 713.457 7 975 796.773	R 90.000m DA 87°39'00" TL 86.383m AL 137.681m
END	449.002	503 051.520	7 976 021.600	L 233.103m



KEY PLAN

NOTES:

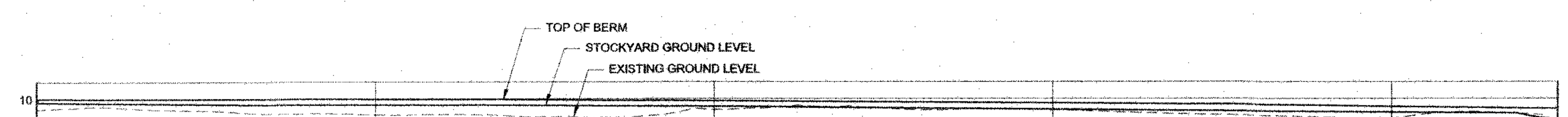
1. LIDAR SURVEY PROVIDED BY PHOTSAT (2016)
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METERS.
3. EG CONTOURS AND ELEVATIONS ARE IN METERS. CONTOUR INTERVAL IS 0.5m.
4. LAYDOWN CONTOURS AND ELEVATIONS ARE IN METERS. CONTOUR INTERVAL IS 0.25m
5. ALL DIMENSIONS ARE IN METER UNLESS NOTED OTHERWISE.
6. FOR TYPICAL LAYERWORKS FOR FINISHED GRADING, REFER TO DETAIL 1 ON DWG No. H353004-00000-221-294-0002-0001

LEGEND:

10.20	CONTOUR ELEVATION
43	SETTING OUT POINT NUMBER
EG	EXISTING GROUND
CH	CHAINAGE
EL	ELEVATION
→	ON PAD FLOW DIRECTION

SCALES:
HORIZONTAL 1:1000
VERTICAL 1:200

DATUM 5.000



CHAINAGE (m)	BERM LEVEL	STOCKYARD GROUND LEVEL	GROUND LEVELS ON CL
0	9.78	9.784	9.370
20	9.99	9.749	9.516
40	9.99	9.709	9.346
60	9.98	9.668	9.194
80	9.97	9.631	9.120
100	9.97	9.635	9.052
120	9.96	9.627	9.071
140	9.95	9.622	8.977
160	9.92	9.593	8.910
180	9.90	9.566	9.005
200	9.87	9.539	9.355
220	9.84	9.515	9.534
240	9.82	9.477	9.563
260	9.79	9.441	9.344
280	9.76	9.404	9.396
300	9.73	9.366	9.324
320	9.71	9.328	9.201
340	9.68	9.290	9.085
360	9.64	9.255	8.998
380	9.59	9.228	8.893
400	9.53	9.201	8.856
420	9.48	9.165	9.212
440	9.43	9.002	9.103
449	9.40	8.778	

PROFILE STOCKYARD BERM
FROM 0.000 TO 449.002

PERMIT TO PRACTICE
HATCH LTD.
Signature
Date 2018-07-13
PERMIT NUMBER: P 512
The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

REFERENCE DRAWINGS

DRAWING No.	DRAWING TITLE
H353004-00000-221-294-0002-0001	STANDARD DRAWING - EARTHWORKS & DRAINAGE DETAILS
H353004-40000-228-271-0009-0001	STOCKYARD NO 2 - WESTERN BERM - LAYOUT & LONGITUDINAL SECTION
H353004-40000-228-272-0006-0001	STOCKYARD 1 - TERRACE EXTENSION - LAYOUT

REG. PROFESSIONAL: REGISTERED PROFESSIONAL ENGINEER L1247 R. A. HALIM LICENSEE 2018-07-13 NWT/NU

FOR CONSTRUCTION

REVISIONS

No.	DESCRIPTION	BY	CHK'D	DATE
1	EDC STAMP REMOVED	GPM	FH	13-07-2018
0	APPROVED FOR CONSTRUCTION	GPM	FH	25/05/2018

HATCH

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	GP MEADES	NR	18/05/2018
DESIGNER	B ROOS	NR	18/05/2018
CHECKER	F HUGO		2018-07-13
DESIGN COORD.	R GOOSEN		2018-07-13
RESP. ENG.	R HALIM		2018-07-13
LEAD DISC. ENG.	A GROBBELAAR		2018-07-13
AREA LEAD	V LAVRIC		2018-07-13
ENG. MANAGER	D STANGER		2018-07-13
AREA MANAGER	T ATIBA		13-7-18

DRAWING APPROVAL STATUS: Approved for Construction

Baffinland

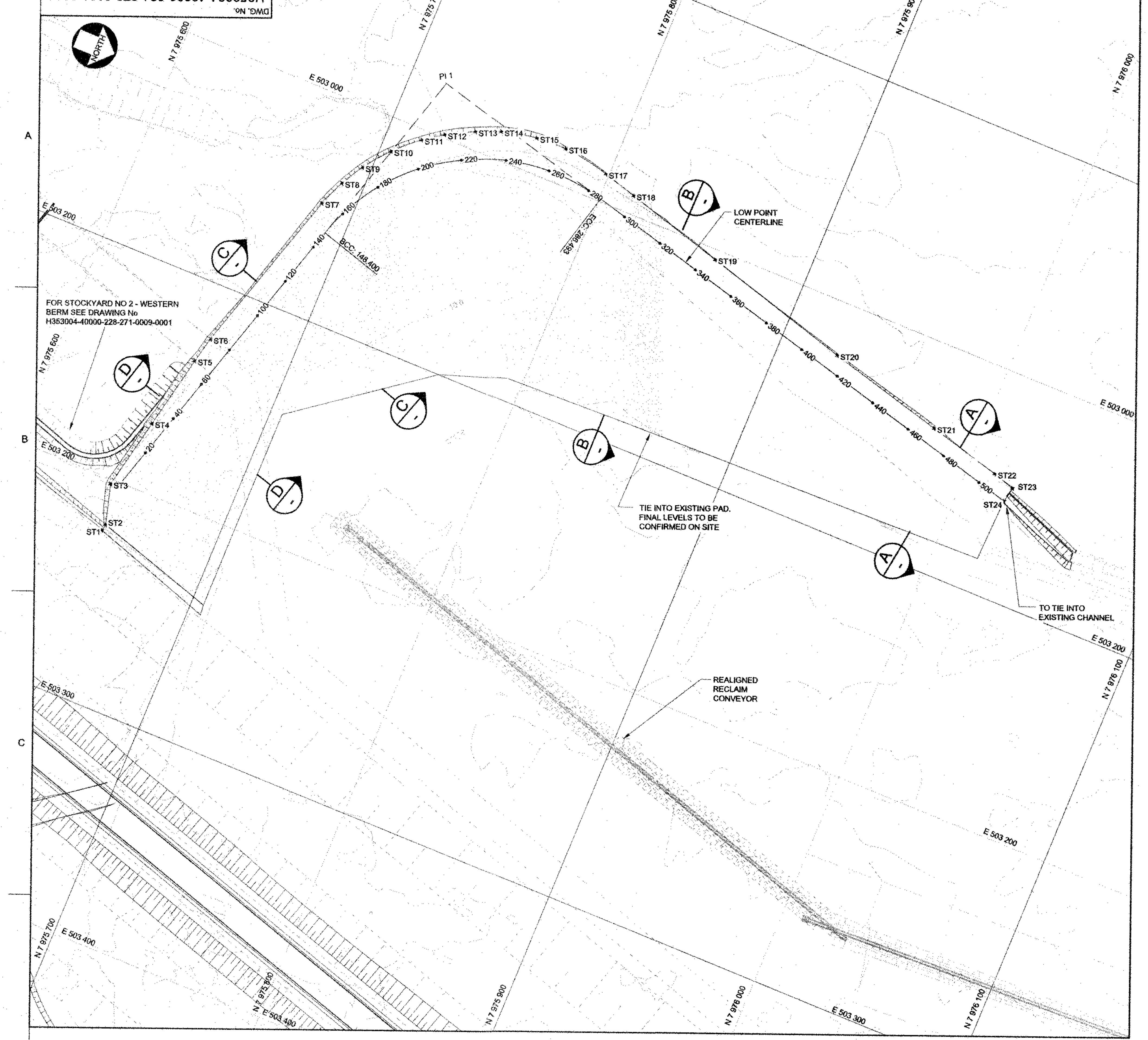
BAFFINLAND IRON MINES LP
MARY RIVER EXPANSION PROJECT

PORT SITE
STOCKYARD NO 1 - BERM (P-SWD-4)
DRAINAGE PLAN

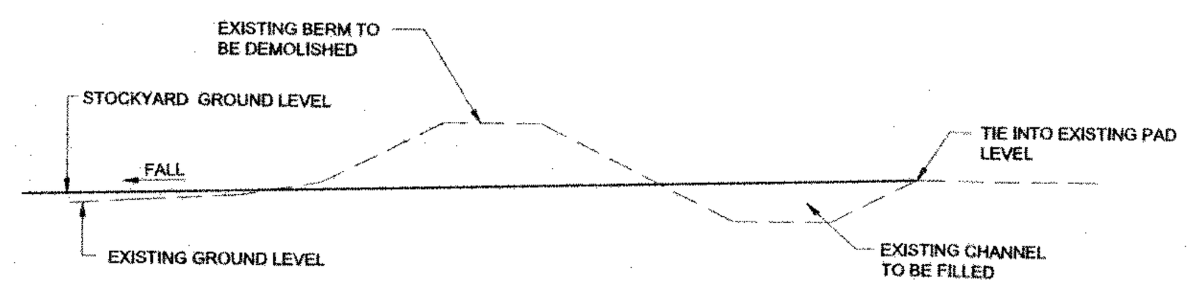
SCALE: OR AS NOTED
DWG. No. H353004-40000-228-271-0007-0001
REV 1

SHEET SIZE: E

$USERNAMES $DATES $FILES $TIMES



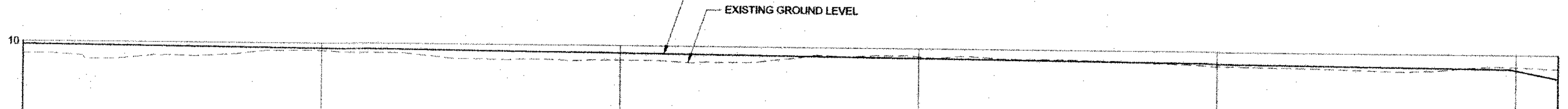
PLAN
SCALE 1:1000



TYPICAL DETAIL : TIE-IN POINT
SCALE 1:100

SCALES:
HORIZONTAL 1:1000
VERTICAL 1:200

DATUM 5.000



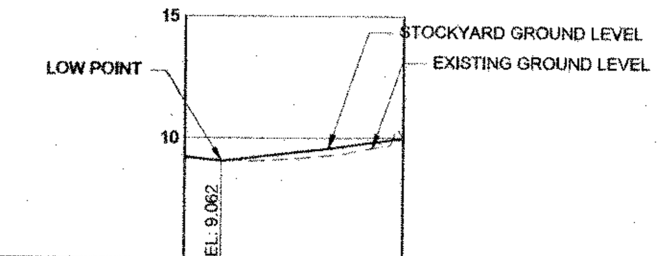
STOCKYARD GROUND LEVEL	9.800	9.770	9.741	9.711	9.681	9.652	9.622	9.592	9.563	9.534	9.503	9.474	9.443	9.412
GROUND LEVELS ON CL	9.200	9.008	9.038	9.098	9.451	9.490	9.374	9.115	8.984	8.998	9.011	8.949	8.953	9.326
CUT / FILL	0.600	0.763	0.703	0.612	0.231	0.162	0.248	0.477	0.578	0.535	0.492	0.525	0.490	0.087
CHAINAGE (m)	0	20	40	60	80	100	120	140	160	180	200	220	240	260

STOCKYARD GROUND LEVEL	9.385	9.352	9.320	9.289	9.258	9.227	9.196	9.164	9.134	9.102	9.071	8.969	8.400
GROUND LEVELS ON CL	9.441	9.458	9.479	9.350	9.317	9.177	9.028	8.993	8.938	8.826	9.039	9.181	9.065
CUT / FILL	-0.056	-0.106	-0.159	-0.061	-0.059	0.050	0.168	0.171	0.196	0.277	0.033	-0.212	-0.665
CHAINAGE (m)	280	300	320	340	360	380	400	420	440	460	480	500	514

PROFILE TERRACE LOW POINT
FROM 0.000 TO 514.116

SCALES:
HORIZONTAL 1:1000
VERTICAL 1:200

DATUM 5.000

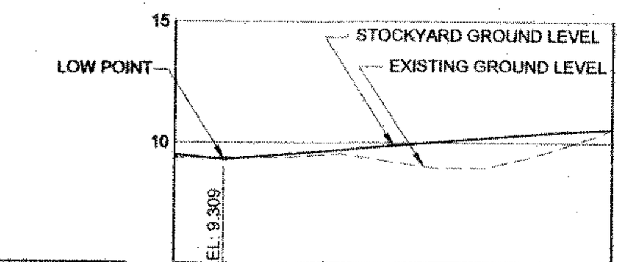


STOCKYARD GROUND LEVEL	9.157	9.362	9.855	9.979
GROUND LEVELS ON CL	9.157	9.130	9.622	9.985
CUT / FILL	0.000	0.232	0.232	-0.007
CHAINAGE (m)	0	20	40	45

PROFILE SECTION A-A

SCALES:
HORIZONTAL 1:1000
VERTICAL 1:200

DATUM 5.000

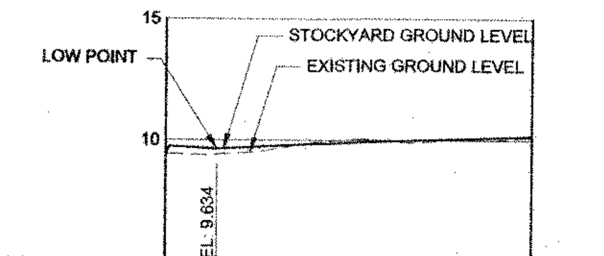


STOCKYARD GROUND LEVEL	9.352	9.472	9.806	10.140	10.465	10.568
GROUND LEVELS ON CL	9.352	9.389	9.353	8.966	9.863	10.574
CUT / FILL	0.000	0.084	0.453	1.174	0.602	-0.006
CHAINAGE (m)	0	20	40	60	80	90

PROFILE SECTION B-B

SCALES:
HORIZONTAL 1:1000
VERTICAL 1:200

DATUM 5.000

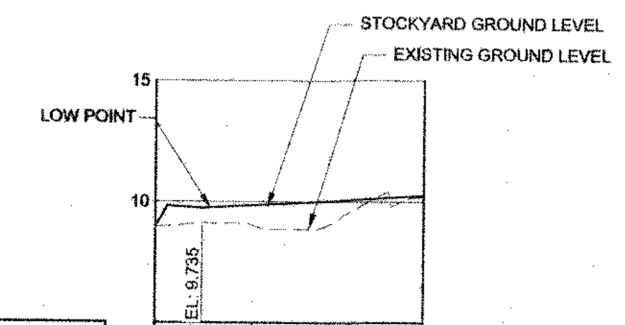


STOCKYARD GROUND LEVEL	9.460	9.739	9.917	10.057	10.164
GROUND LEVELS ON CL	9.429	9.552	10.044	10.000	10.100
CUT / FILL	0.031	0.188	-0.127	0.057	0.064
CHAINAGE (m)	0	20	40	60	75

PROFILE SECTION C-C

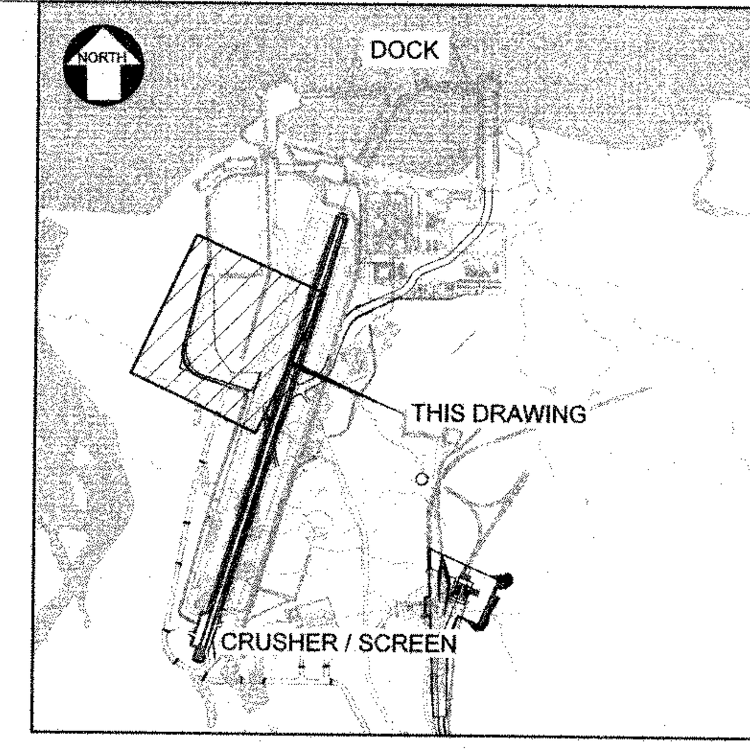
SCALES:
HORIZONTAL 1:1000
VERTICAL 1:200

DATUM 5.000



STOCKYARD GROUND LEVEL	8.980	9.849	10.078	10.258
GROUND LEVELS ON CL	8.950	9.022	9.576	10.240
CUT / FILL	0.030	0.827	0.501	0.018
CHAINAGE (m)	0	20	40	55

PROFILE SECTION D-D



KEY PLAN

NOTES:

1. LIDAR SURVEY PROVIDED BY PHOTSAT (2016)
2. COORDINATE GRID IS SHOWN IN UTM (NAD83) ZONE 17 AND IS IN METERS.
3. EG CONTOURS AND ELEVATIONS ARE IN METERS. CONTOUR INTERVAL IS 0.5m.
4. LAYDOWN CONTOURS AND ELEVATIONS ARE IN METERS. CONTOUR INTERVAL IS 0.25m
5. ALL DIMENSIONS ARE IN METER UNLESS NOTED OTHERWISE.
6. FOR TYPICAL LAYERWORKS FOR FINISHED GRADING, REFER TO DETAIL 1 ON DWG No. H353004-00000-221-294-0002-0001

LEGEND:

- 10.20 — CONTOUR ELEVATION
- 43 — SETTING OUT POINT NUMBER
- EG — EXISTING GROUND
- CH — CHAINAGE
- EL — ELEVATION

STOCKYARD No. 1

POINT	E	N	LEVEL
ST1	503 223.052	7 975 650.441	11.020
ST2	503 220.022	7 975 650.975	10.000
ST3	503 202.185	7 975 645.989	9.900
ST4	503 169.671	7 975 652.740	9.851
ST5	503 136.070	7 975 659.716	9.800
ST6	503 124.339	7 975 662.575	9.800
ST7	503 048.229	7 975 685.425	9.700
ST8	503 036.396	7 975 690.283	9.650
ST9	503 026.337	7 975 696.053	9.650
ST10	503 014.615	7 975 705.208	9.650
ST11	503 004.632	7 975 715.951	9.650
ST12	502 998.488	7 975 724.696	9.643
ST13	502 991.956	7 975 737.006	9.623
ST14	502 987.726	7 975 747.804	9.614
ST15	502 984.312	7 975 763.759	9.601
ST16	502 983.825	7 975 777.578	9.591
ST17	502 987.422	7 975 798.579	9.650
ST18	502 991.746	7 975 813.874	9.542
ST22	503 046.006	7 976 012.373	9.300
ST23	503 048.993	7 976 022.281	9.300
ST24	503 055.860	7 976 020.930	8.400

SETTING OUT DATA TERRACE LOW POINT

NAME	CH	E	N	DETAILS
START	0.000	503 202.297	7 975 649.310	L 148.400m
BCC1 PI1 ECC1	148.400 286.493	503 060.100 502 976.948 502 998.729	7 975 691.766 7 975 716.592 7 975 800.593	R 90.000m DA 87°54'40" TL 86.779m AL 138.092m
END	514.116	503 055.860	7 976 020.930	L 227.623m

PERMIT TO PRACTICE
HATCH LTD.
Signature ____
Date 2018-07-13
PERMIT NUMBER: P 512
The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

DRAWING No.	DRAWING TITLE
H353004-00000-221-294-0002-0001	STANDARD DRAWING - EARTHWORKS & DRAINAGE DETAILS
H353004-40000-228-271-0009-0001	STOCKYARD NO 2 - WESTERN BERM - LAYOUT & LONGITUDINAL SECTION
H353004-40000-228-271-0007-0001	STOCKYARD NO 1 - BERM (P-SWD-4) - PLAN/PROFILE

REFERENCE DRAWINGS

PROFESSIONAL ENGINEER R. A. HALIM L2247 LICENSEE 2018-07-13 NWT/NU

REG. PROFESSIONAL

FOR CONSTRUCTION

No.	DESCRIPTION	BY	CHK'D	DATE
1	EDC STAMP REMOVED	GPM	FH	13/07/2018
0	APPROVED FOR CONSTRUCTION	GPM	FH	25/05/2018

REVISIONS

HATCH

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	GP MEADES	NR	18/05/2018
DESIGNER	B ROOS	NR	18/05/2018
CHECKER	F HUGO		2018-07-13
DESIGN COORD.	R GOOSEN		2018-07-13
RESP. ENG.	R HALIM		2018-07-13
LEAD DISC. ENG.	A GROBBELAAR		2018-07-13
AREA LEAD	V LAVRIC		2018-07-13
ENG. MANAGER	D STANGER		2018-07-13
AREA MANAGER	T ATIBA		18-7-13

DRAWING APPROVAL STATUS: Approved for Construction

Baffinland

BAFFINLAND IRON MINES LP
MARY RIVER EXPANSION PROJECT

PORT SITE
STOCKYARD 1 - EXTENSION
LAYOUT

SCALE 1:1,000 OR AS NOTED

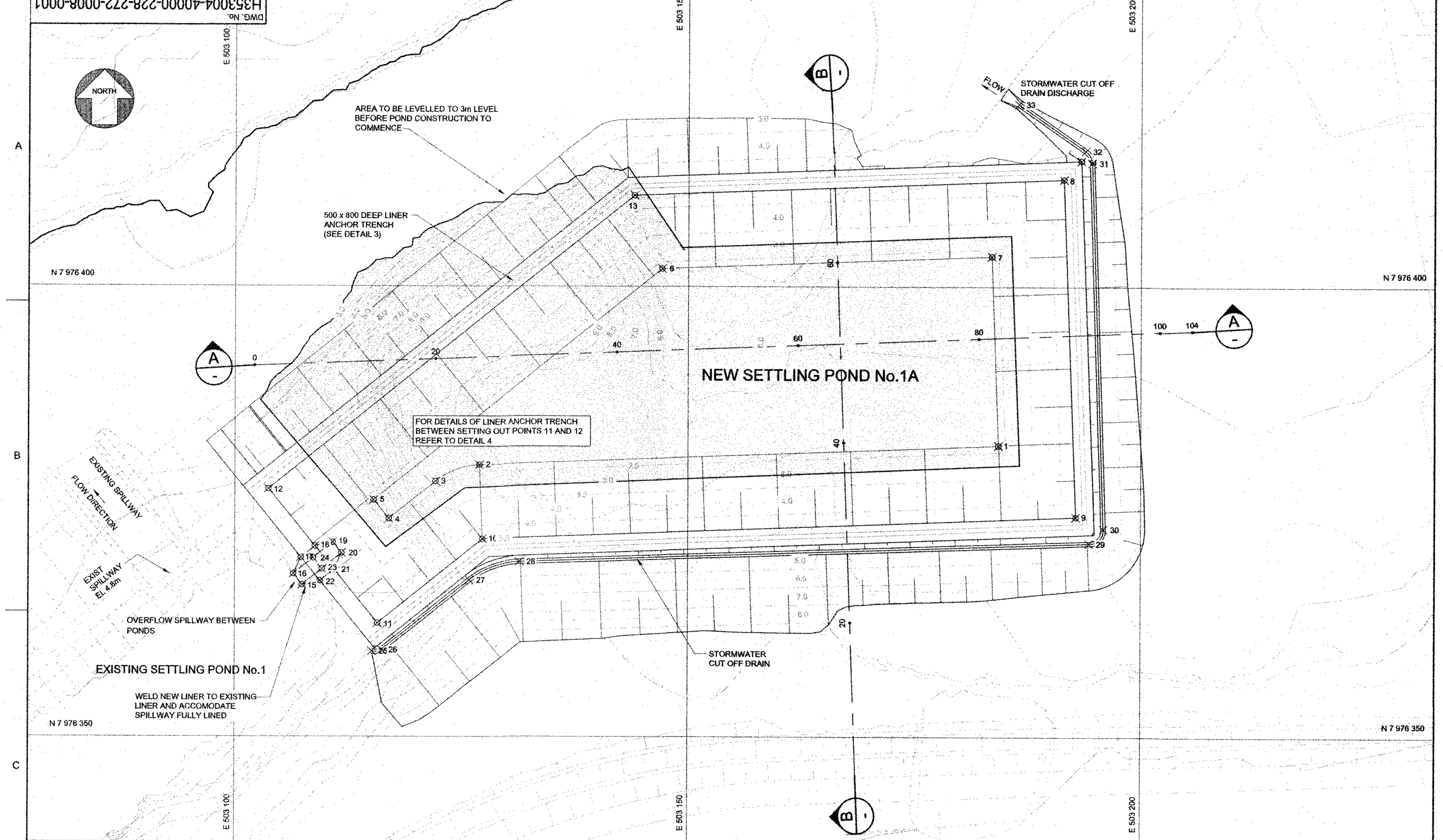
DWG. No. H353004-40000-221-272-0006-0001

REV 1

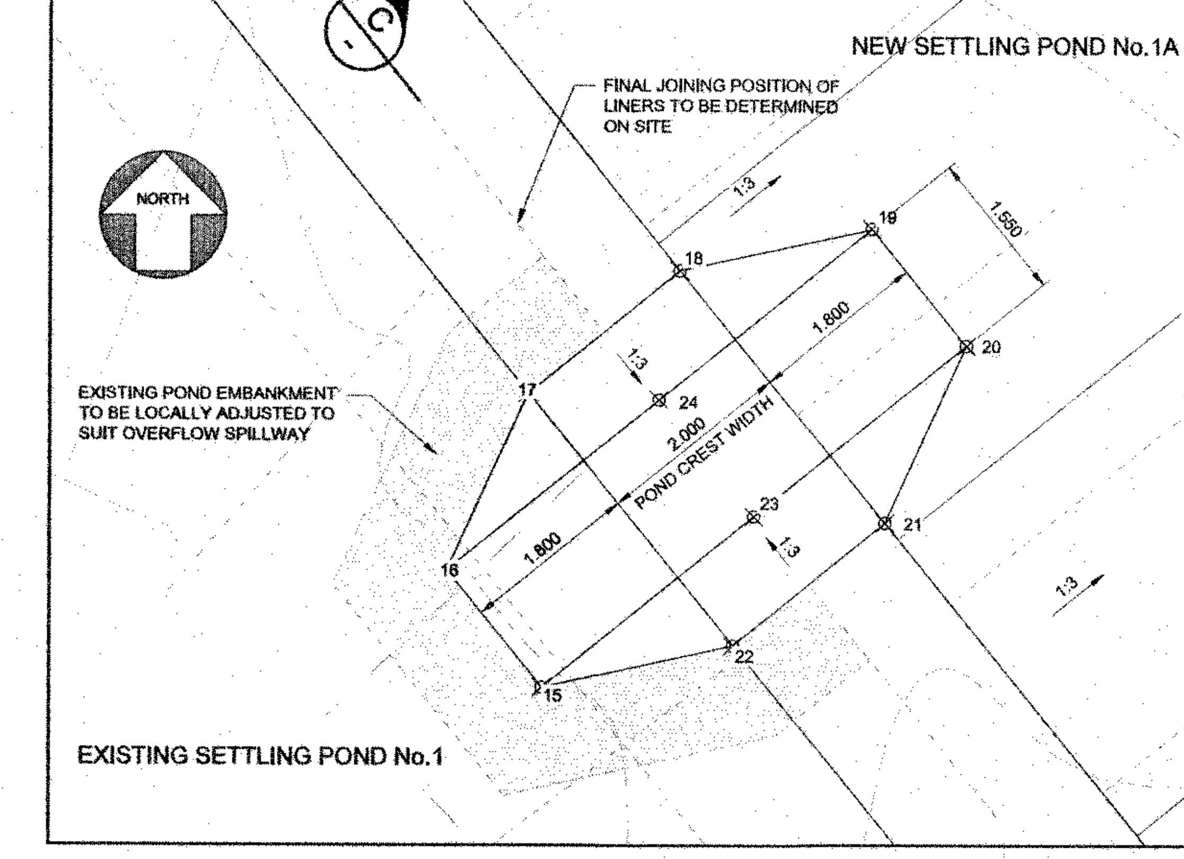
SHEET SIZE: E

$USERNAME$ $DATE$ $FILE$ $TIME$

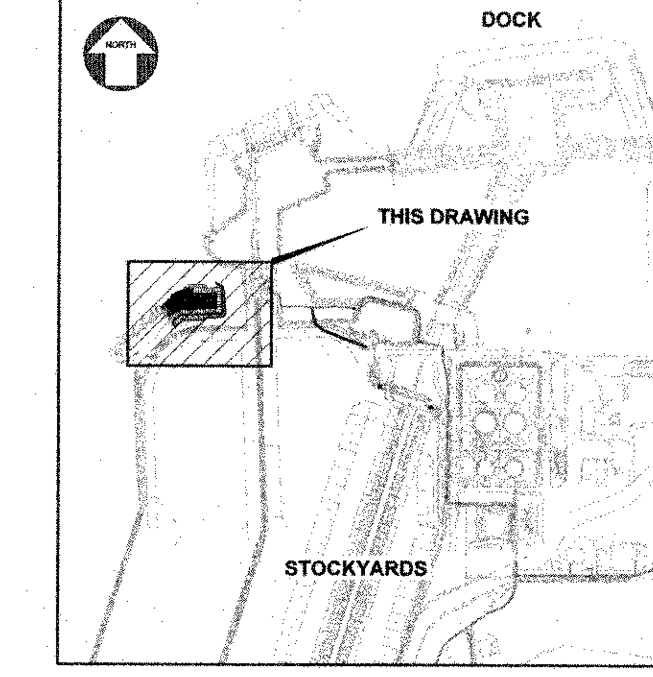
H353004-40000-228-272-0008-0001
DWG. No.



PLAN ON NEW SETTLING POND No.1A
SCALE 1:250



PLAN ON PONDS OVERFLOW SPILLWAY
SCALE 1:20



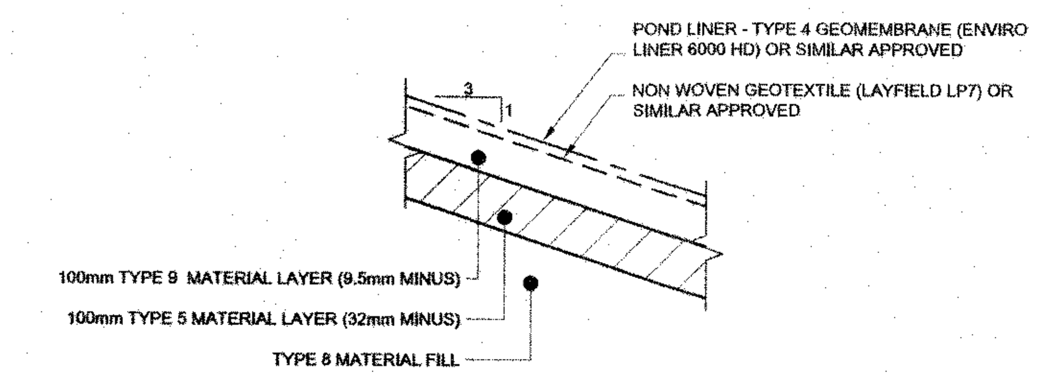
KEY PLAN

NOTES:

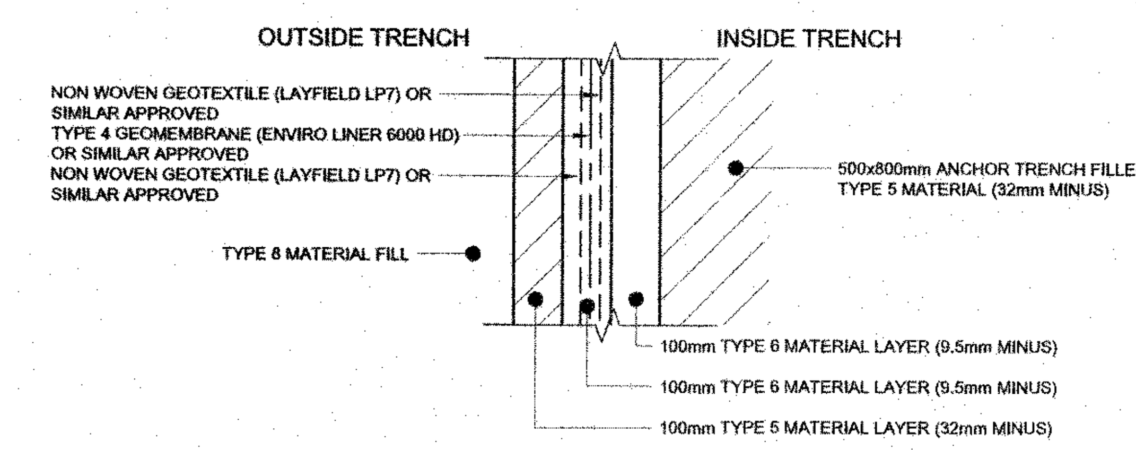
1. LIDAR SURVEY PROVIDED BY PHOTSAT (2016).
2. CO-ORDINATE GRID IS SHOWN IN UTM (NAD83), ZONE 17 AND IS IN METERS.
3. CONTOURS ARE IN METERS. THE CONTOUR INTERVAL IS 0.5m.
4. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE NOTED.
5. IT IS ASSUMED THAT ALL RUN OFF COLLECTED BY THE SETTLING POND IS NON-ACID GENERATING AND CAN BE DISCHARGED TO THE ENVIRONMENT ONCE THE REQUIREMENTS OF BIM ENVIRONMENTAL CRITERIA HAS BEEN ACHIEVED. WATER TO BE DISCHARGED TO AN APPROVED POINT, IN ACCORDANCE WITH THE CLIENT'S (BIM) ENVIRONMENTAL REQUIREMENTS.
6. THE INSTALLATION OF THE GEOMEMBRANE (ENVIRO LINER 6000HD) IS TO BE IN STRICT ACCORDANCE WITH THE SPECIALIST PROVIDERS SPECIFICATIONS.
7. INVERT LEVEL OF EXISTING POND IS TAKEN AT 4.8m. IF GROUNDWATER ENCOUNTERED DURING CONSTRUCTION, POND '1A' INVERT LEVEL MAY NEED TO BE ADJUSTED AS DIRECTED BY THE ENGINEER.

LEGEND:

CL	CREST LEVEL
IL	INVERT LEVEL
HWL	HIGH WATER LEVEL
FBL	FREE BOARD LEVEL
— - — - —	TYPE 4 GEO-MEMBRANE (ENVIRO LINER 6000 HD) OR SIMILAR APPROVED
- - - - - -	NON WOVEN GEO-TEXTILE (LAYFIELD LP7) OR SIMILAR APPROVED
— — —	EXISTING LINER

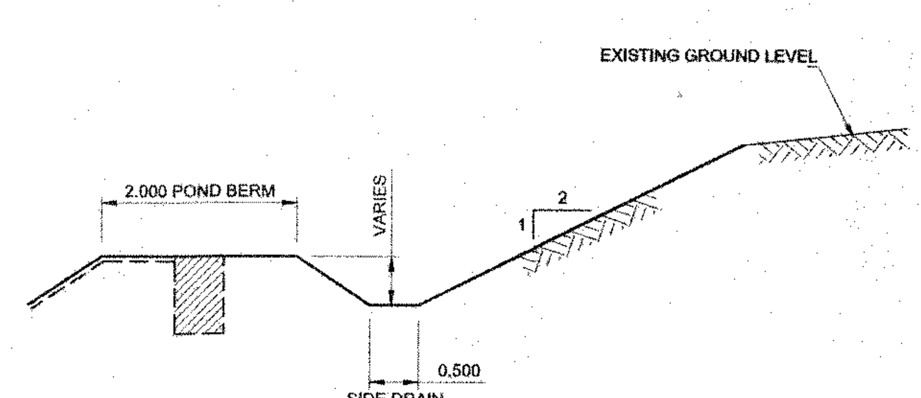


DETAIL 1 - POND LINER
SCALE 1:10

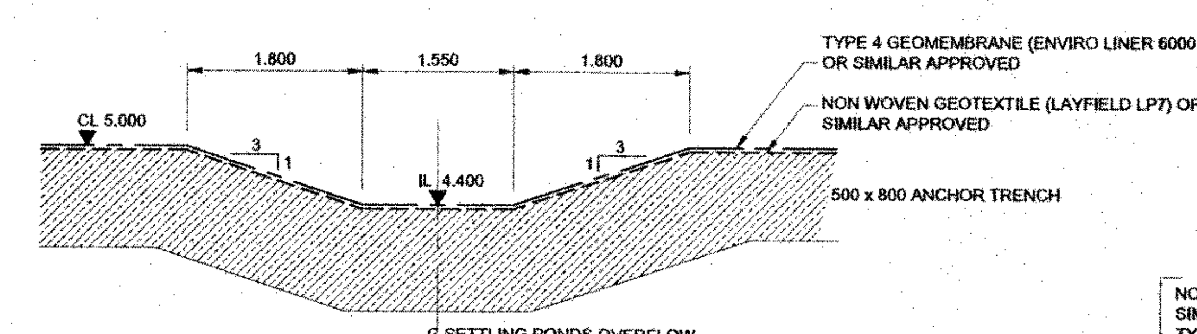


DETAIL 2 - TRENCH LINER
SCALE 1:10

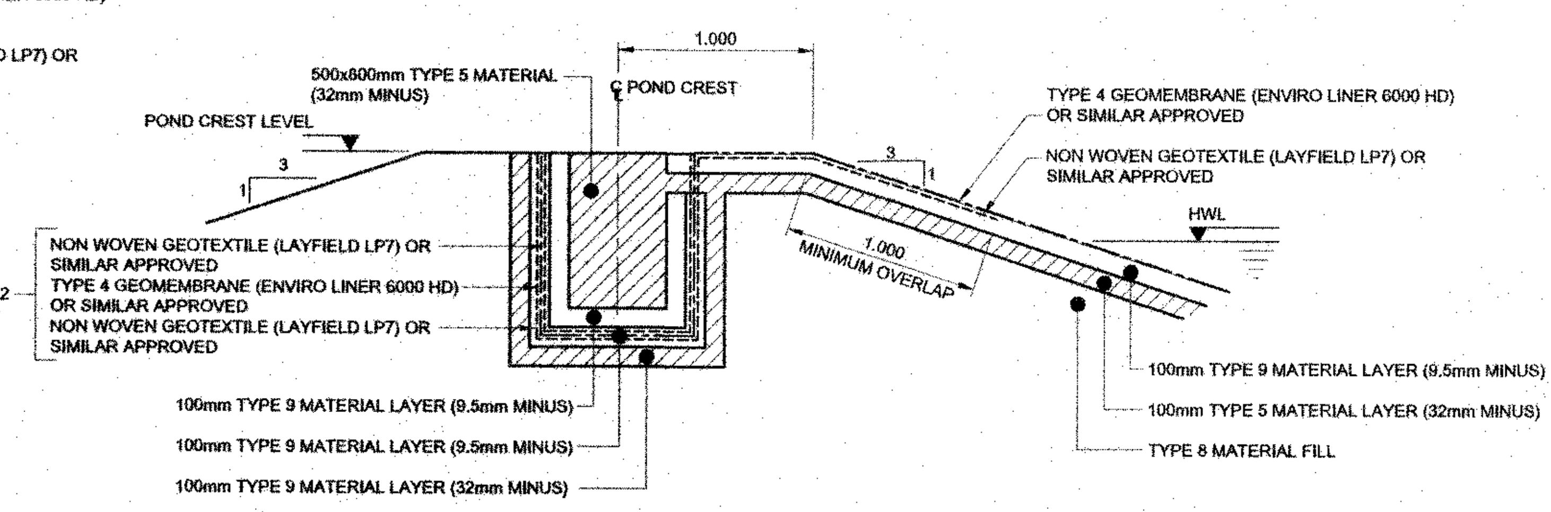
STORMWATER CUT OFF DRAIN SETTING OUT			
POINT	E	N	INVERT LEVEL
25	503115.142	7976359.482	4.834
26	503116.229	7976359.638	4.833
27	503125.889	7976367.371	4.803
28	503131.412	7976369.415	4.788
29	503194.294	7976371.534	4.636
30	503195.867	7976373.156	4.633
31	503194.562	7976413.802	4.535
32	503193.842	7976415.123	4.534
33	503186.457	7976420.295	4.512



STORMWATER CUT OFF DRAIN - TYPICAL SECTION
SCALE 1:50



SECTION C - C
SCALE 1:50

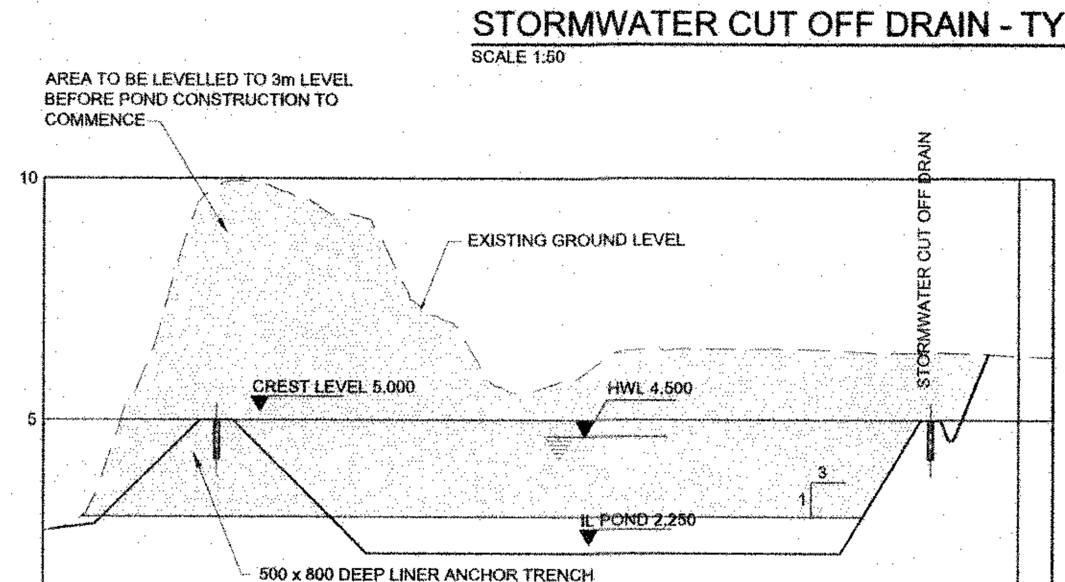


DETAIL 3 - POND LINER ANCHOR TRENCH
SCALE 1:25

SETTLING POND EXTENSION SETTING OUT			
POINT	E	N	LEVEL
1	503184.284	7976382.385	2.250
2	503127.009	7976380.177	2.250
3	503122.140	7976378.349	2.250
4	503116.996	7976374.190	2.250
5	503115.317	7976376.263	2.250
6	503147.109	7976401.967	2.250
7	503183.508	7976403.371	2.250
8	503191.448	7976411.933	5.000
9	503192.833	7976374.458	5.000
10	503127.327	7976371.933	5.000
11	503115.773	7976362.592	5.000
12	503103.709	7976377.487	5.000
13	503144.053	7976410.105	5.000
14	503193.373	7976414.009	5.000
15	503107.448	7976366.833	4.400
16	503106.472	7976368.038	4.400
17	503107.303	7976369.868	5.000
18	503108.857	7976371.127	5.000
19	503110.822	7976371.560	4.400
20	503111.797	7976370.354	4.400
21	503110.967	7976368.525	5.000
22	503109.409	7976367.263	5.000
23	503109.623	7976368.595	4.415
24	503108.648	7976369.799	4.415

SCALES:
HORIZONTAL 1:500
VERTICAL 1:100

DATUM 0.000

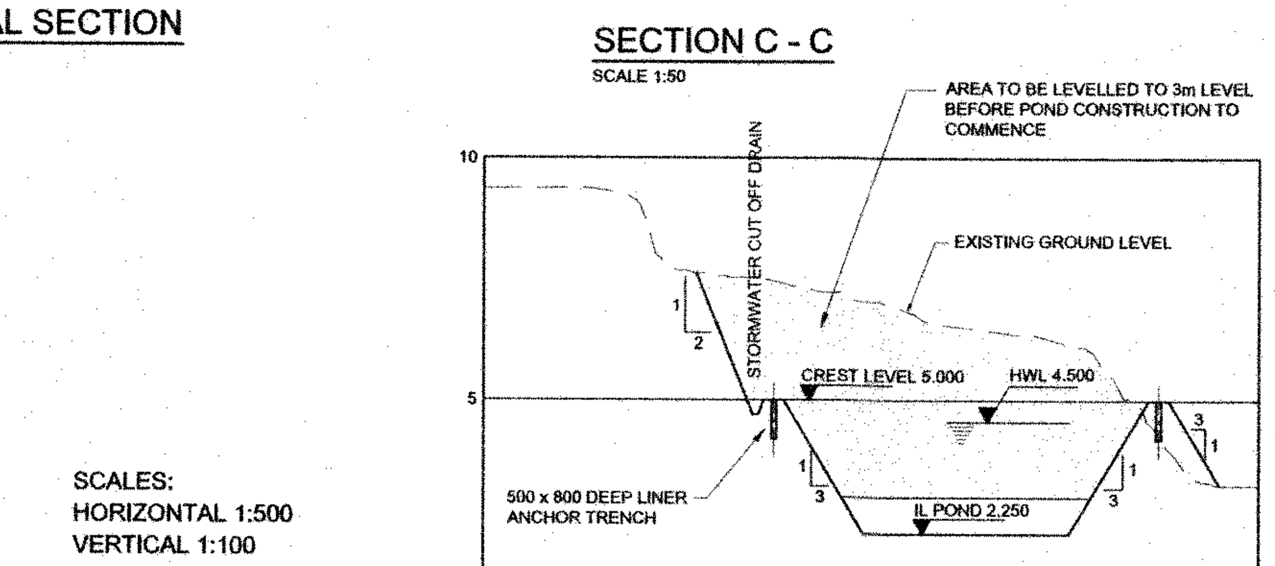


CUT / FILL		-5.063	-4.915	-4.191	-4.199		
CENTRE LINE (CL)		4.883	2.250	2.250	2.250		
GROUND LEVELS ON CL		9.946	7.165	6.441	6.449	6.324	6.303
DISTANCE (m)	0	20	40	60	80	100	104

SECTION A - A

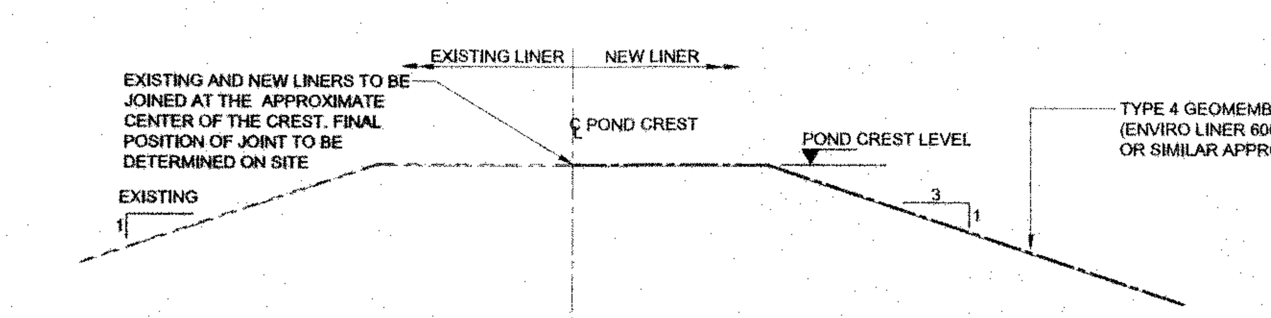
SCALES:
HORIZONTAL 1:500
VERTICAL 1:100

DATUM 0.000



CUT / FILL			-4.782	-3.897	
CENTRE LINE (CL)			2.250	2.250	
GROUND LEVELS ON CL	9.367	7.671	7.032	6.147	3.257
DISTANCE (m)	0	20	40	60	80

SECTION B - B



DETAIL 4 - POND LINER ANCHOR TRENCH BETWEEN POINTS 11 AND 12
SCALE 1:25

PERMIT TO PRACTICE
HATCH LTD.
Signature
Date 2018-07-13
PERMIT NUMBER: P 512
The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

DRAWING No.	DRAWING TITLE
H349000-2345-10-035-0001	ORE STOCKPILE SEDIMENTATION PONDS - 'AS-BUILT'
H353004-40000-220-272-0006-0001	2018 SURFACE WATER MANAGEMENT PLAN

REFERENCE DRAWINGS

REGISTERED PROFESSIONAL ENGINEER L1247 R. A. HALIM LICENSEE 2018-07-13 NWT/NU
REG. PROFESSIONAL

FOR CONSTRUCTION

No.	DESCRIPTION	BY	CHK'D	DATE
1	EDC STAMP REMOVED	GPM	FH	13/07/2018
0	APPROVED FOR CONSTRUCTION	GPM	FH	13/06/2018

REVISIONS

HATCH

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	I BARNARD	NR	13/06/2018
DESIGNER	H HERBST	NR	13/06/2018
CHECKER	F HUGO		2018-07-13
DESIGN COORD.	R GOOSEN		2018-07-13
RESP. ENG.	R HALIM		2018-07-13
LEAD DISC. ENG.	A GROBBELAAR		2018-07-13
AREA LEAD	V LAVRIC		2018-07-13
ENG. MANAGER	D STANGER		
AREA MANAGER	T ATIBA		18-7-13

DRAWING APPROVAL STATUS: Approved for Construction

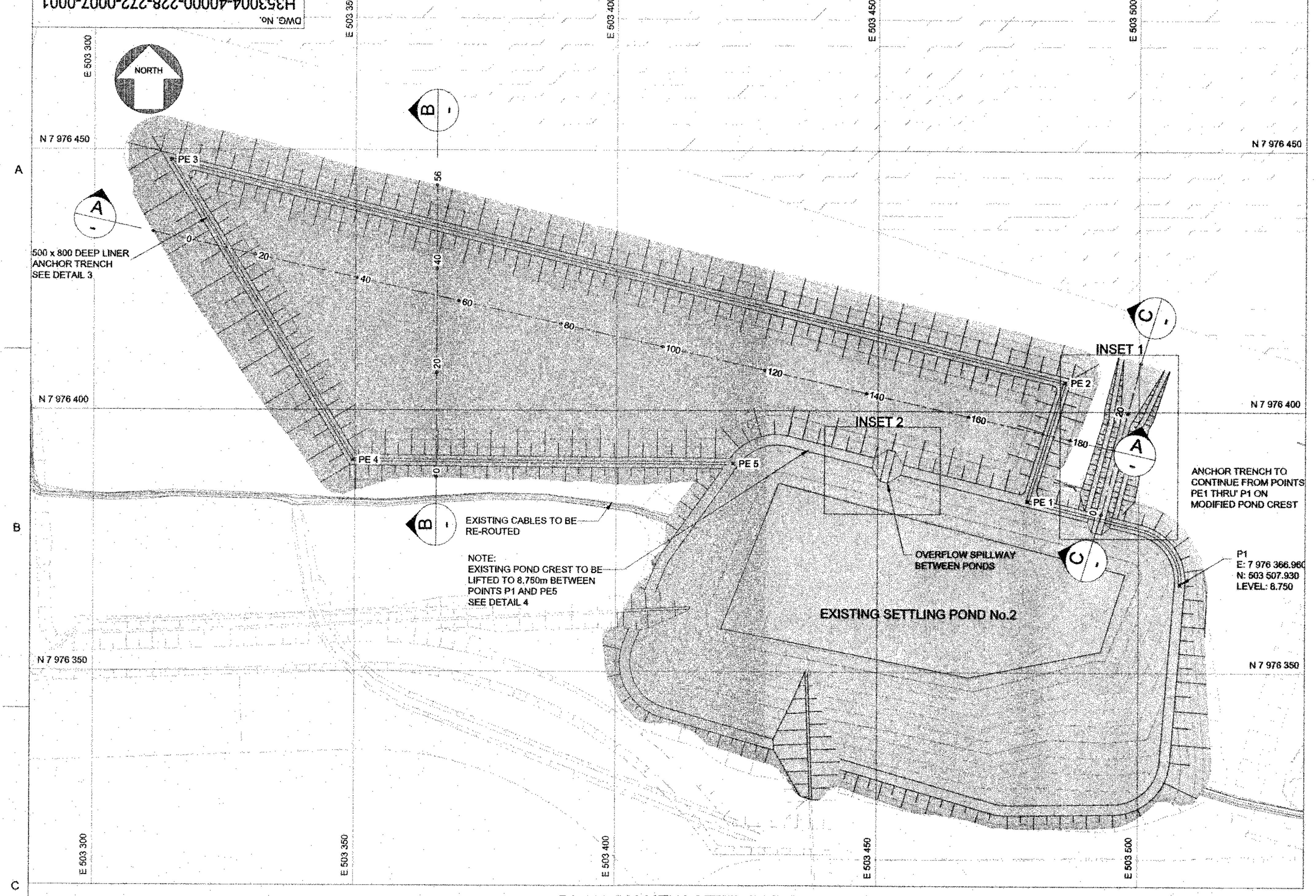
Baffinland

BAFFINLAND IRON MINES LP
MARY RIVER EXPANSION PROJECT

PORT SITE
STOCKPILE No.1 SETTLING POND No.1A
PLAN AND PROFILE

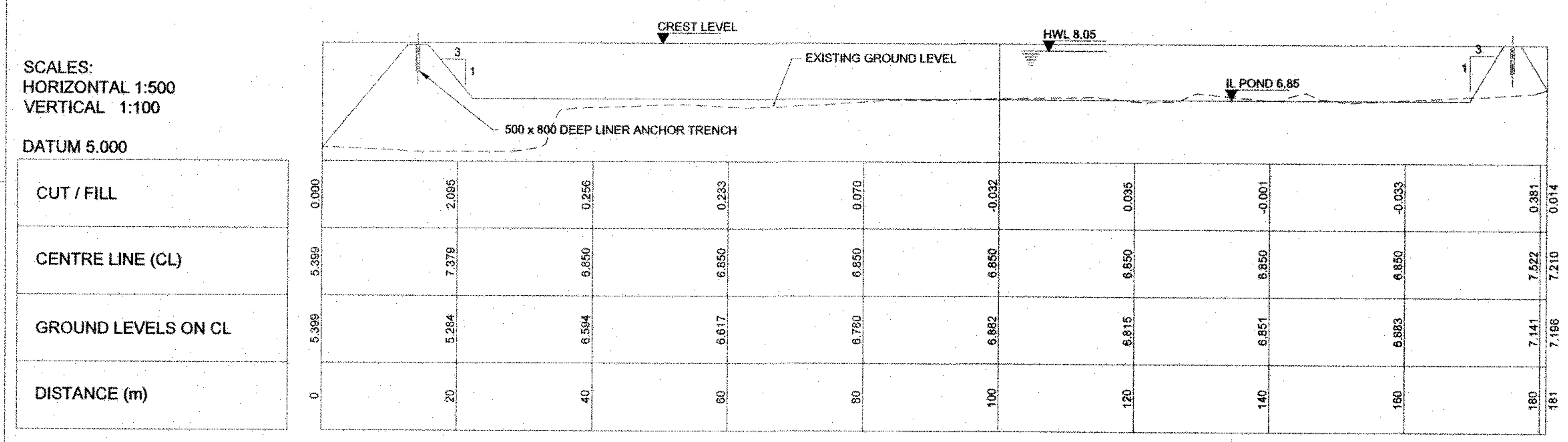
SCALE 1:250 OR AS NOTED
DWG. No. H353004-40000-228-272-0008-0001
REV 1

SHEET SIZE: E

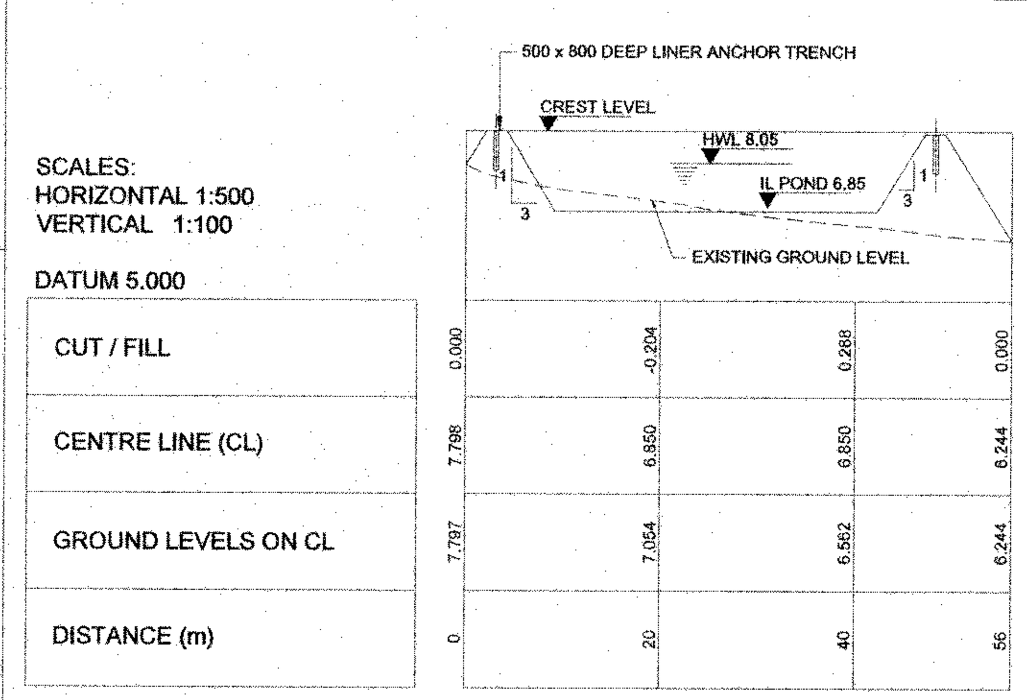


PLAN ON NEW SETTLING POND NO.2A

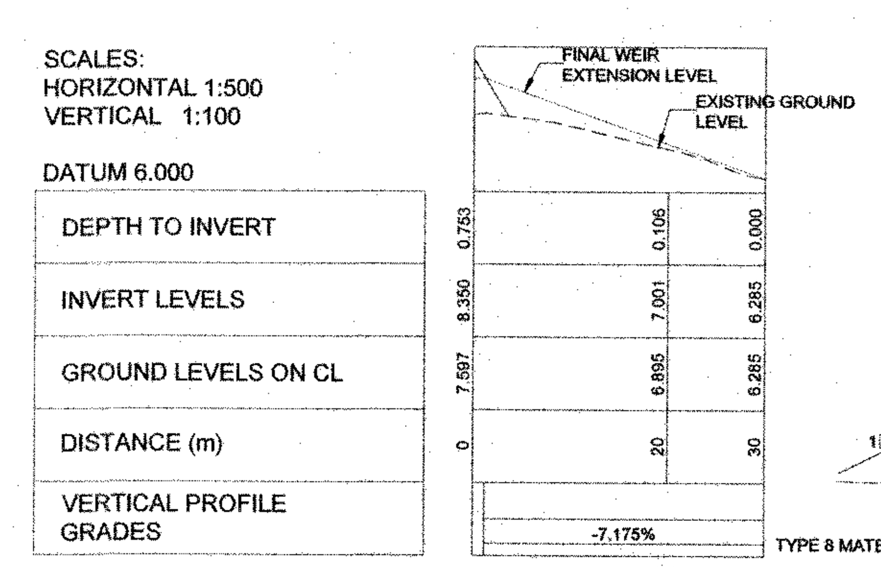
SCALE 1:500



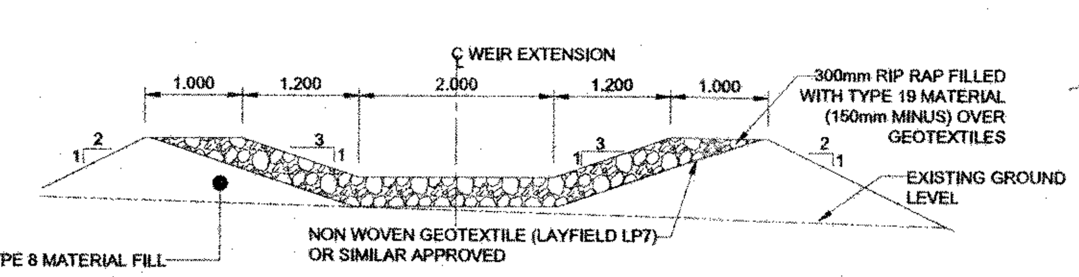
SECTION A - A



SECTION B - B

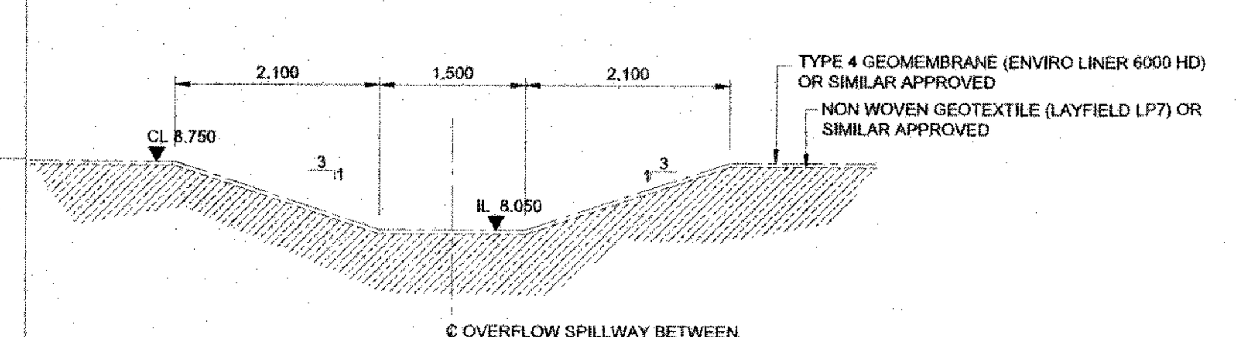


SECTION C - C



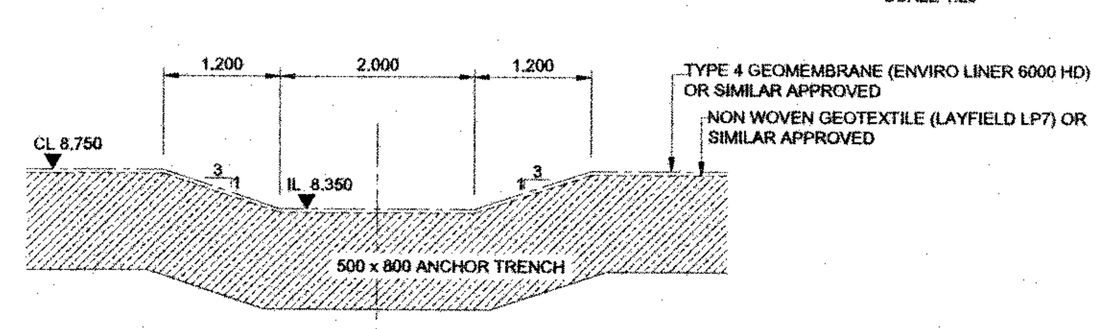
SECTION F - F

SCALE 1:20



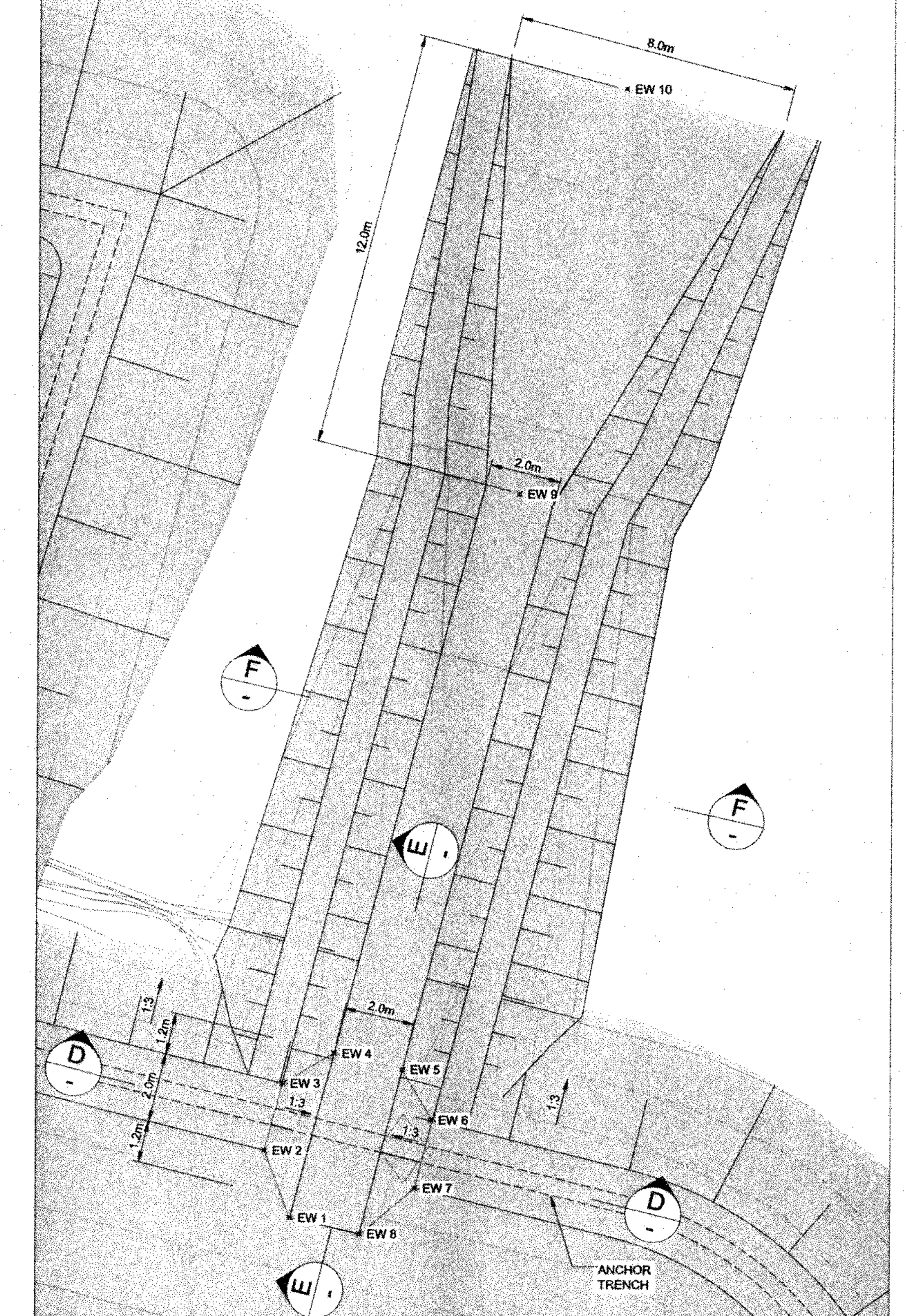
SECTION G - G

SCALE 1:20



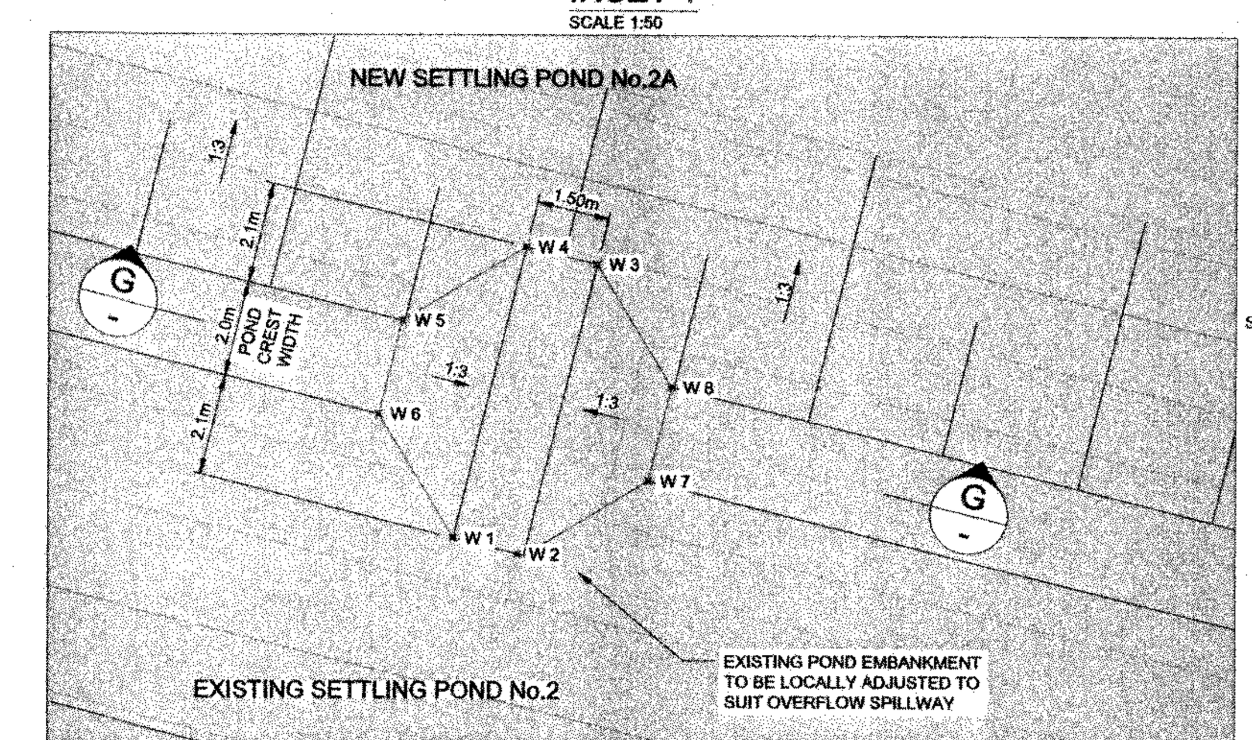
SECTION D - D

SCALE 1:20



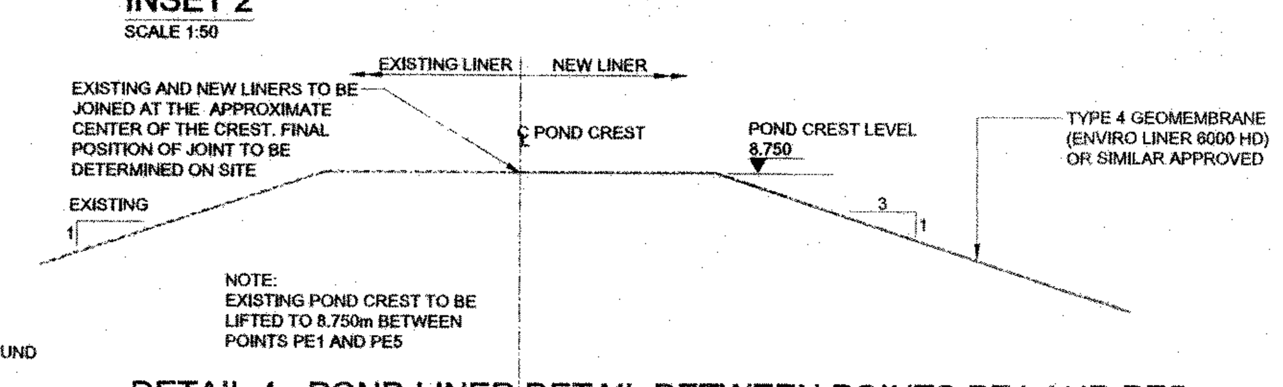
INSET 1

SCALE 1:50



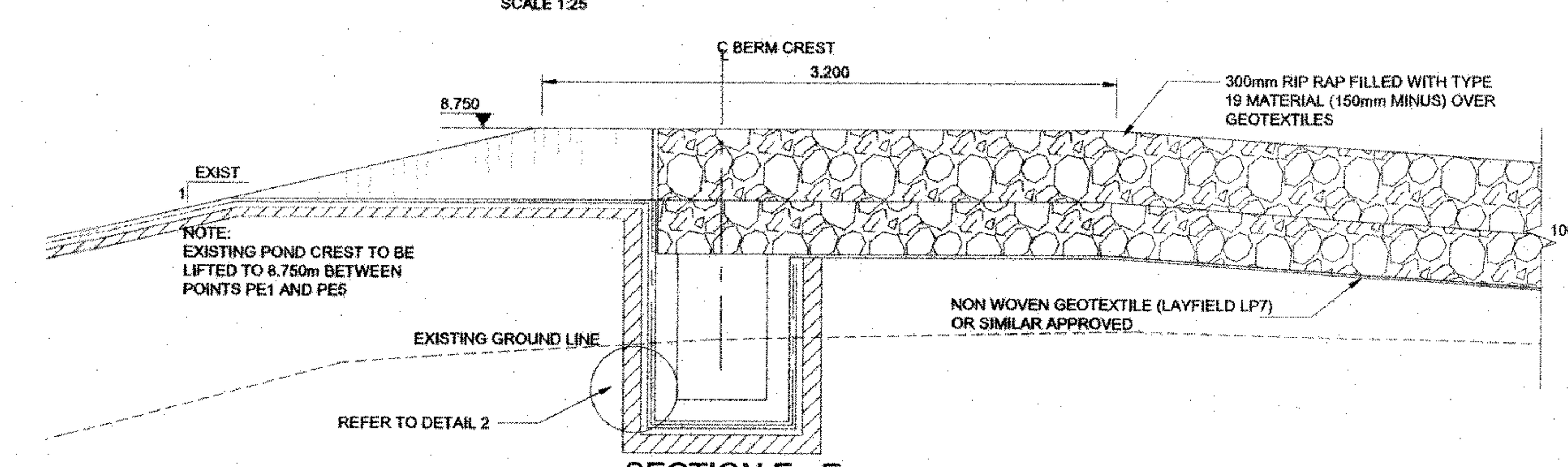
INSET 2

SCALE 1:50



DETAIL 4 - POND LINER DETAIL BETWEEN POINTS PE1 AND PE5

SCALE 1:25



SECTION E - E

SCALE 1:25

NOTES:

1. LIDAR SURVEY PROVIDED BY PHOTSAT (2016).
2. CO-ORDINATE GRID IS SHOWN IN UTM (NAD83), ZONE 17 AND IS IN METERS.
3. CONTOURS ARE IN METERS. THE CONTOUR INTERVAL IS 0.5m.
4. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE NOTED.
5. IT IS ASSUMED THAT ALL RUN OFF COLLECTED BY THE SETTLING POND IS NON-ACID GENERATING AND CAN BE DISCHARGED TO THE ENVIRONMENT ONCE THE TSS HAS BEEN ACHIEVED. WATER TO BE DISCHARGED TO AN APPROVED POINT, IN ACCORDANCE WITH THE CLIENT'S (BIM) ENVIROMENTAL REQUIREMENTS.
6. THE INSTALLATION OF THE GEOMEMBRANE (ENVIRO LINER 6000HD) IS TO BE IN STRICT ACCORDANCE WITH THE SPECIALIST PROVIDERS SPECIFICATIONS.
7. EXISTING MODIFIED POND VOLUME = 2 578m^3
   NEW SETTLING POND VOLUME = 4 393m^3
   TOTAL VOLUME = 6 971m^3

LEGEND:

CL CREST LEVEL

IL INVERT LEVEL

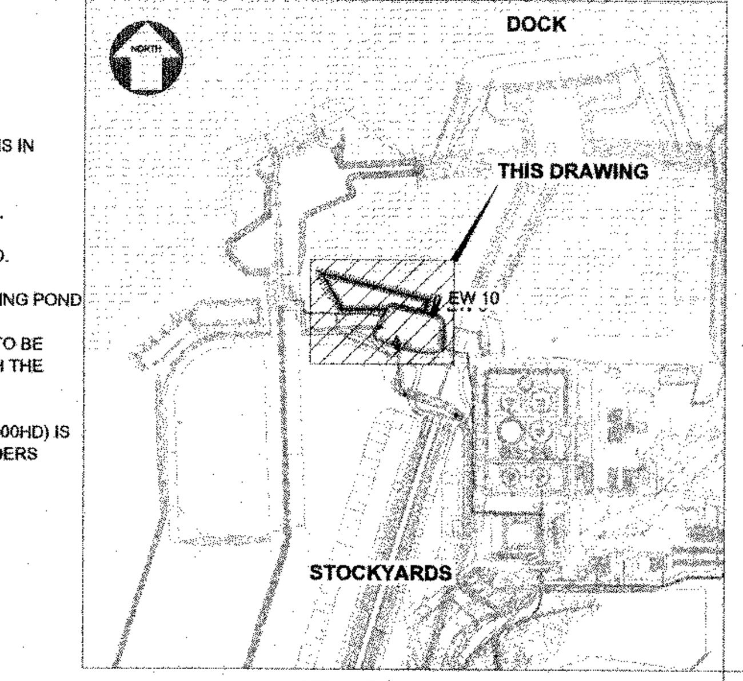
HWL HIGH WATER LEVEL

FBL FREE BOARD LEVEL

TYPE 4 GEO-MEMBRANE (ENVIRO LINER 6000 HD) OR SIMILAR APPROVED

NON WOVEN GEO-TEXTILE (LAYFIELD LP7) OR SIMILAR APPROVED

EXISTING LINER



KEY PLAN

POND EXTENSION SETTING OUT POINTS

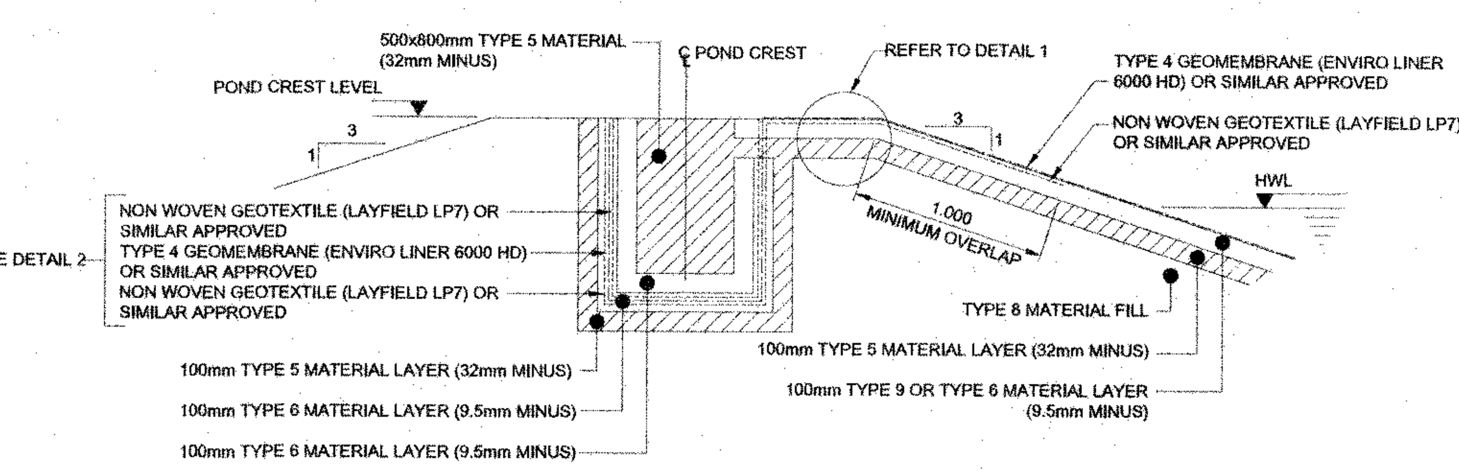
POINT	E	N	LEVEL
PE 1	503 478.748	7 976 382.804	8.750
PE 2	503 485.801	7 976 405.602	8.450
PE 3	503 314.822	7 976 447.996	8.450
PE 4	503 349.623	7 976 390.455	8.450
PE 5	503 422.312	7 976 389.878	8.750

WEIR EXTENSION POND SETTING OUT POINTS

POINT	E	N	LEVEL
W 1	503 450.445	7 976 386.628	8.050
W 2	503 451.774	7 976 386.296	8.050
W 3	503 453.391	7 976 392.279	8.050
W 4	503 451.935	7 976 392.639	8.050
W 5	503 449.397	7 976 391.109	8.750
W 6	503 448.912	7 976 389.172	8.750
W 7	503 454.454	7 976 387.805	8.750
W 8	503 454.924	7 976 389.735	8.750

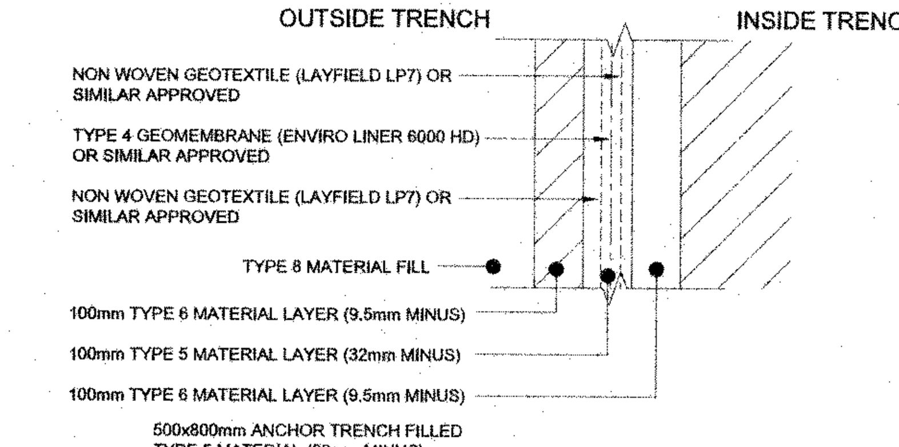
EXISTING WEIR MODIFIED SETTING OUT POINTS

POINT	E	N	LEVEL
EW 1	503 490.915	7 976 377.013	8.350
EW 2	503 490.183	7 976 378.942	8.750
EW 3	503 490.693	7 976 380.873	8.750
EW 4	503 492.163	7 976 381.740	8.350
EW 5	503 494.113	7 976 381.277	8.350
EW 6	503 494.921	7 976 379.827	8.750
EW 7	503 494.477	7 976 377.877	8.750
EW 8	503 492.899	7 976 376.560	8.350
EW 9	503 497.378	7 976 397.773	7.144
EW 10	503 500.397	7 976 409.353	6.285



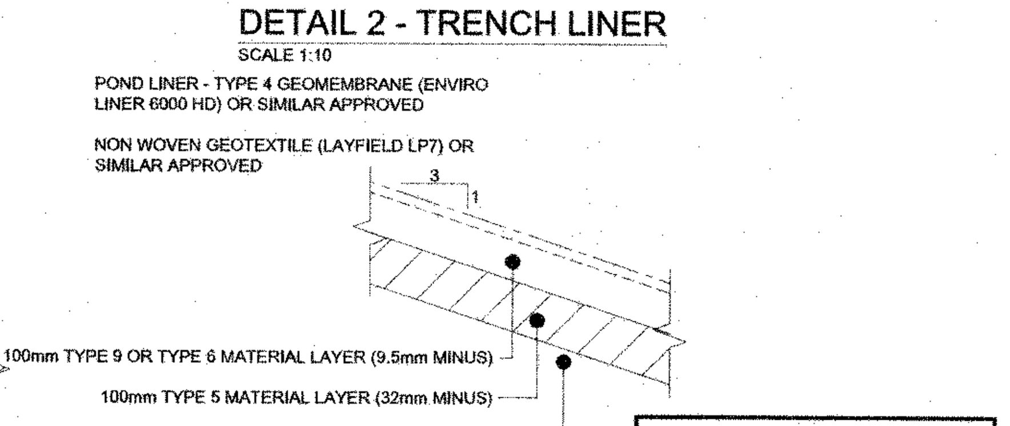
DETAIL 3 - POND LINER ANCHOR TRENCH

SCALE 1:25



DETAIL 2 - TRENCH LINER

SCALE 1:10



DETAIL 1 - POND LINER

SCALE 1:10

PERMIT TO PRACTICE
HATCH LTD.
Signature
Date 2018-07-07
PERMIT NUMBER: P 512
The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

FOR CONSTRUCTION

HATCH

Baffinland

DRAWING No.	DRAWING TITLE
H349000-2345-10-035-0001	ORE STOCKPILE SEDIMENTATION PONDS - 'AS-BUILT'
H353004-40000-220-272-0006-0001	2018 SURFACE WATER MANAGEMENT PLAN

REFERENCE DRAWINGS

REG. PROFESSIONAL (R. A. HALIM, LICENSEE L2247, 2018-07-07, NWT/NU)

No.	DESCRIPTION	BY	CHK'D	DATE
0	APPROVED FOR CONSTRUCTION	JM	FH	05/07/2018

REVISIONS

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	GP MEADES	NR	02/07/2018
DESIGNER	B ROOS	NR	02/07/2018
CHECKER	F HUGO		2018-07-05
DESIGN COORD.	R GOOSEN		2018-07-05
RESP. ENG.	R HALIM		2018-07-07
LEAD DISC. ENG.	A GROBBELAAR		2018-07-05
AREA LEAD	V LAVRIC		2018-07-09
ENG. MANAGER	D STANGER		2018-07-06
AREA MANAGER	T ATIBA		18-7-9

DRAWING APPROVAL STATUS: Approved for Construction

BAFFINLAND IRON MINES LP
MARY RIVER EXPANSION PROJECT

PORT SITE
STOCKYARD1, SETTLING POND No.2A
PLAN AND PROFILE

SCALE 1:500 OR AS NOTED

DWG. No. H353004-40000-228-272-0007-0001 REV 0

SHEET SIZE: E

December 13, 2016

File No.:NB102-00181/39-A.01
Cont. No.:VA16-01950

Mr. Matt Weaver
Project Director
Baffinland Iron Mines Corporation
#300 - 2275 Upper Middle Road East
Oakville, Ontario
Canada, L6H 0C3

Dear Matt,

Re: Updated Design Peak Flow Assessment

Baffinland Iron Mines Corporation (Baffinland) has requested that Knight Piésold Ltd. (KP) update the design peak flow analysis for the Mary River Project to incorporate recent streamflow data.

The previous peak flow analysis completed by KP (2012) was based on limited streamflow data collected by KP over the period of 2006 to 2011, along with longer term regional Water Survey of Canada data. Updated return period flow estimates incorporating streamflow data collected since 2011 will be used by Baffinland to support the design of water crossings along its north railway connecting Milne Port to the Mine Site.

BACKGROUND

A long-term hydrological record does not exist for the North Baffin Region. Stream flow has been monitored at the Mary River Project since 2006, with up to 16 seasonal stream gauges on smaller river/creek systems and four (4) year-round hydrometric stations on larger systems (Water Survey of Canada) operated at various times. Table 1 and Figure 1 present the six (6) seasonal hydrometric stations that continue to be operated by Baffinland.

Table 1 Active Hydrometric Stations

Station	Location	Catchment Area (km^2)
H1	Tributary of Phillip's Creek	250
H2	Tom River	210
H4	Camp Lake Tributary 2 (CLT-2)	8.3
H5	Camp Lake Tributary 1, branch L1 (CLT-1, L1)	5.3
H6	Mary River	240
H11	Sheardown Lake Tributary 1 (SDLT-1)	3.6

ANALYSIS

Annual peak instantaneous flow records are now available from the six active hydrometric stations listed in Table 1, for periods ranging from 6 to 10 years, as summarized in Table 2.

Table 2 Annual Peak Instantaneous Flow Records (m^3/s)

	Station					
Year	**H1**	**H2**	**H4**	**H5**	**H6**	**H11**
2006	35.1	69.9	5.3	3.2	100.3	
2007	35.0	46.7	2.0	1.4	40.2	
2008	41.6		3.1	2.8	76.8	
2009						
2010		51.3		1.7	56.6	
2011	25.0		1.5	0.7	76.5	0.10
2012	67.3	61.0	2.2	1.9	86.5	0.17
2013	18.0	77.0	1.3	2.2	77.7	0.33
2014		59.9	2.5	2.1	129.8	0.59
2015	56.6	48.6	3.6	1.4	90.1	0.27
2016	29.4	33.8	1.1	0.7	50.8	0.52
Mean	38.5	56.0	2.5	1.8	78.5	0.33
St. Dev.	16.4	13.8	1.3	0.8	25.9	0.2
CV	0.43	0.25	0.53	0.45	0.33	0.58
Skew	0.78	-0.02	1.21	0.22	0.47	0.31
Count	8	8	9	10	10	6

These datasets and their associated statistics were used to develop frequency distributions based on an Extreme Value Type I distribution, from which return period flood flow values were determined, as summarized in Table 3.

Table 3 Return Period Flow Estimates (m^3/s)

Return Period	**Station**					
	H1	**H2**	**H4**	**H5**	**H6**	**H11**
2 Year	38	56	2.5	1.8	79	0.33
5 Year	54	69	3.8	2.6	104	0.52
10 Year	66	80	4.8	3.2	123	0.66
25 Year	82	92	6.0	3.9	147	0.84
100 Year	104	111	7.8	5.0	182	1.10
200 Year	115	121	8.7	5.6	200	1.23

These flood values were then plotted against drainage area to develop upper envelope scaling relationships, which were compared to the regionally based scaling relationships generated in 2006. These plots, as shown on Figures 2 to 7, indicate that the 2006 scaling relationships provide a very good basis for estimating peak flows for drainage basins greater than approximately 100 km^2, but tend to substantially overestimate flows for smaller watersheds. However, given the limited length of the site records, and that the measured peak flow datasets involved the considerable extrapolation of their respective rating curves, it should be recognized that there is considerably uncertainty in the estimated flows, particularly for return periods greater than approximately 20 years and for smaller basins since they are not supported by regional data.

Accordingly, and given that it is prudent to err on the side of caution when determining design peak flows, it is recommended that an intermediate curve, as indicated by the solid black line on the plots, be adopted for determining design flows. These curves also provide some contingency to account for potential increases in

future peak flows that may be influenced by a possibly changing climate. The recommended scaling equations for determining return period peak design flows are summarized as follows:

$$Q_2 = 0.72 \times A^{0.86}$$

$$Q_5 = 1.10 \times A^{0.84}$$

$$Q_{10} = 1.32 \times A^{0.83}$$

$$Q_{25} = 1.70 \times A^{0.82}$$

$$Q_{100} = 2.27 \times A^{0.80}$$

$$Q_{200} = 2.53 \times A^{0.80}$$

Where, Q = peak instantaneous flow in m^3/s

A = drainage area in km^2

It should be noted that site and regional peak flow data are not available for very small watersheds, and therefore a reassessment of the rainfall-runoff approach previously recommended for very small watersheds is not possible. As a result, it is recommended that this approach, as outlined in Appendix B of the 2011 Mary River Hydrology Report, continue to be used for basins with areas less than 0.5 km^2. This approach will generally produce higher peak flow estimates than would be generated with the equations listed above.

The question has been raised as to whether the annual peak flows are primarily due to snowmelt, rainfall, or rain on snow? The dates of the annual peak flow events, as summarized in Table 4, indicate that the majority of annual peak flows are likely due to snowmelt, or snowmelt combined with rain, since the largest annual runoff events primarily occur during the freshet period in June and July. The dates for the largest events on record for each station are indicated by the yellow highlighting in Table 4, and these all occur in June and July.

Table 4 Timing of Annual Peak Flow Events (m^3/s)

Month of Maximum Annual Flow						
Station						
Year	H1	H2	H4	H5	H6	H11
2006	Sep	Sep	Jul	Jul	Sep	
2007	Jun	Jun	Jul	Jul	Jul	
2008	Jul		Jul	Jul	Aug	
2009						
2010		Jun		Jun	Jun	
2011	Jun		Jun	Jun	Jun	Jun
2012	Jun	Jun	Aug	Jun	Aug	Aug
2013	Jun	Jul	Aug	Jul	Jul	Jul
2014		Jul	Jul	Jul	Jul	Jun
2015	Jun	Jul	Jul	Jul	Jul	Jul
2016	Jun	Jun	Jun	Aug	Jun	Aug
Area (km^2)	250	210	8.3	5.3	240	3.6

It is worth noting, however, that in some years the largest flows occur in September and August due to intense rainfall, such as in 2006 when the annual peak flows occurred in September (green shading) at stations H1, H2 and H6. Furthermore, in some years very large flow events occur in the spring, summer and fall periods, as demonstrated by the hydrograph plots for 2006, as shown on Figures 8 and 9. Interestingly, in this year the

largest events in the small watersheds were due to snowmelt, while those in the large watersheds were due to rainfall.

CULVERT SIZING

Sizing culverts simply on the basis of the design flows may not be adequate because of the potential for partial culvert blockage due to ice formation over the winter, particularly in culverts situated in low lying areas with standing water. Accordingly, consideration should be given to increasing culvert sizes to account for a partial blockage due to ice.

CLOSURE

We trust this meets your current requirements. Please do not hesitate to contact the undersigned with any questions.

Prepared:

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA J. G. CATHCART

Dec 13, 2016

Jaime Cathcart, Ph.D., P.Eng.
Specialist Hydrotechnical Engineer | Associate

Reviewed:

Richard Cook, P.Geo. (Ltd.)
Senior Environmental Scientist | Associate

Approval that this document adheres to Knight Piésold Quality Systems:

Attachments:

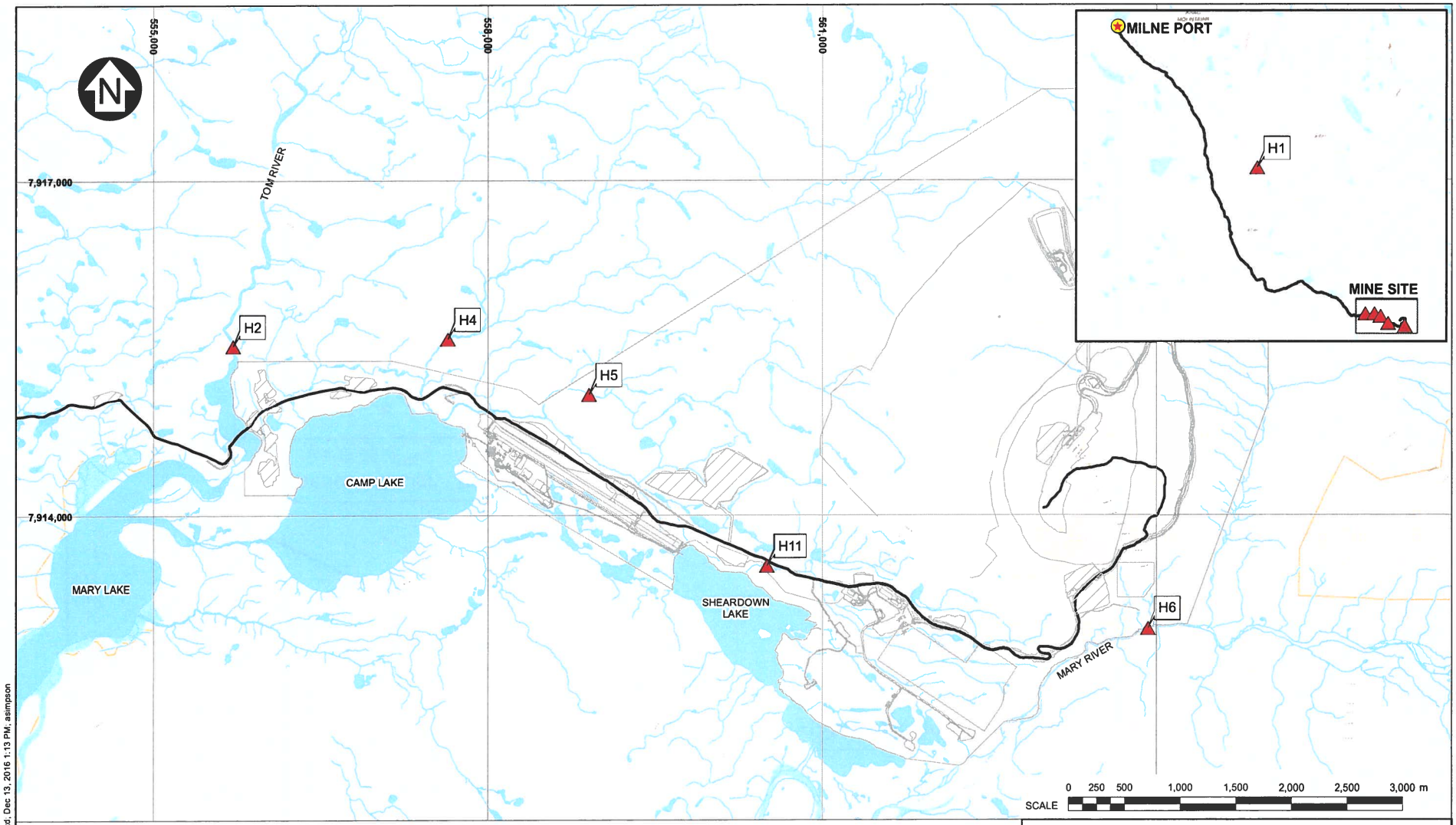
Figure 1 Rev 0	Active Hydrometric Stations
Figure 2 Rev 1	Scaling Plots for Q2 Recommended Design Flows
Figure 3 Rev 1	Scaling Plots for Q5 Recommended Design Flows
Figure 4 Rev 1	Scaling Plots for Q10 Recommended Design Flows
Figure 5 Rev 1	Scaling Plots for Q25 Recommended Design Flows
Figure 6 Rev 1	Scaling Plots for Q100 Recommended Design Flows
Figure 7 Rev 1	Scaling Plots for Q200 Recommended Design Flows
Figure 8 Rev 0	2006 Hydrographs for H1, H2 and H6
Figure 9 Rev 0	2006 Hydrographs for H4 and H5

Copy To: Wayne McPhee

REFERENCES:

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

/jc



SAVED: I:\1102\00\181139\A\GIS\Figs\A08_r0.mxd, Dec 13, 2016 1:13 PM, asimpson

LEGEND:

- ACTIVE HYDROMETRIC STATION
- MILNE INLET TOTE ROAD
- EXISTING INFRASTRUCTURE
- RIVER/STREAM/DRAINAGE
- WATER

NOTES:

1. BASE MAP: © ESRI DATA AND MAPS (ONLINE) (2016). REDLANDS, CA: ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE. ALL RIGHTS RESERVED.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	13DEC'16	ISSUED WITH LETTER	RAC	AS	JC

BAFFINLAND IRON MINES CORPORATION

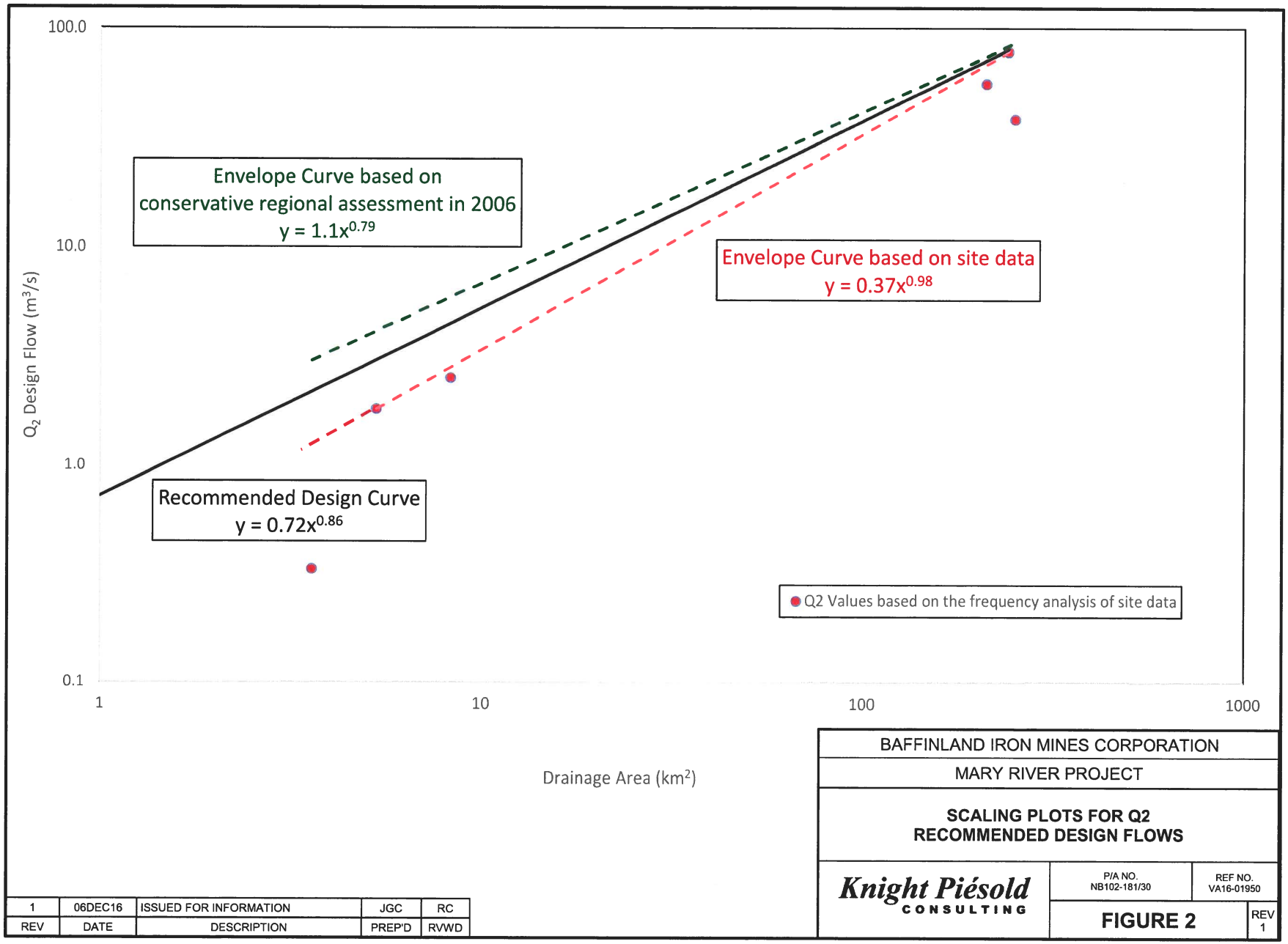
MARY RIVER PROJECT

ACTIVE HYDROMETRIC STATIONS

Knight Piésold CONSULTING

P/A NO.	REF NO.
NB102-181/39	VA16-01950

FIGURE 1 REV 0



REV	DATE	DESCRIPTION	PREP'D	RVWD
1	06DEC16	ISSUED FOR INFORMATION	JGC	RC

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

SCALING PLOTS FOR Q2 RECOMMENDED DESIGN FLOWS

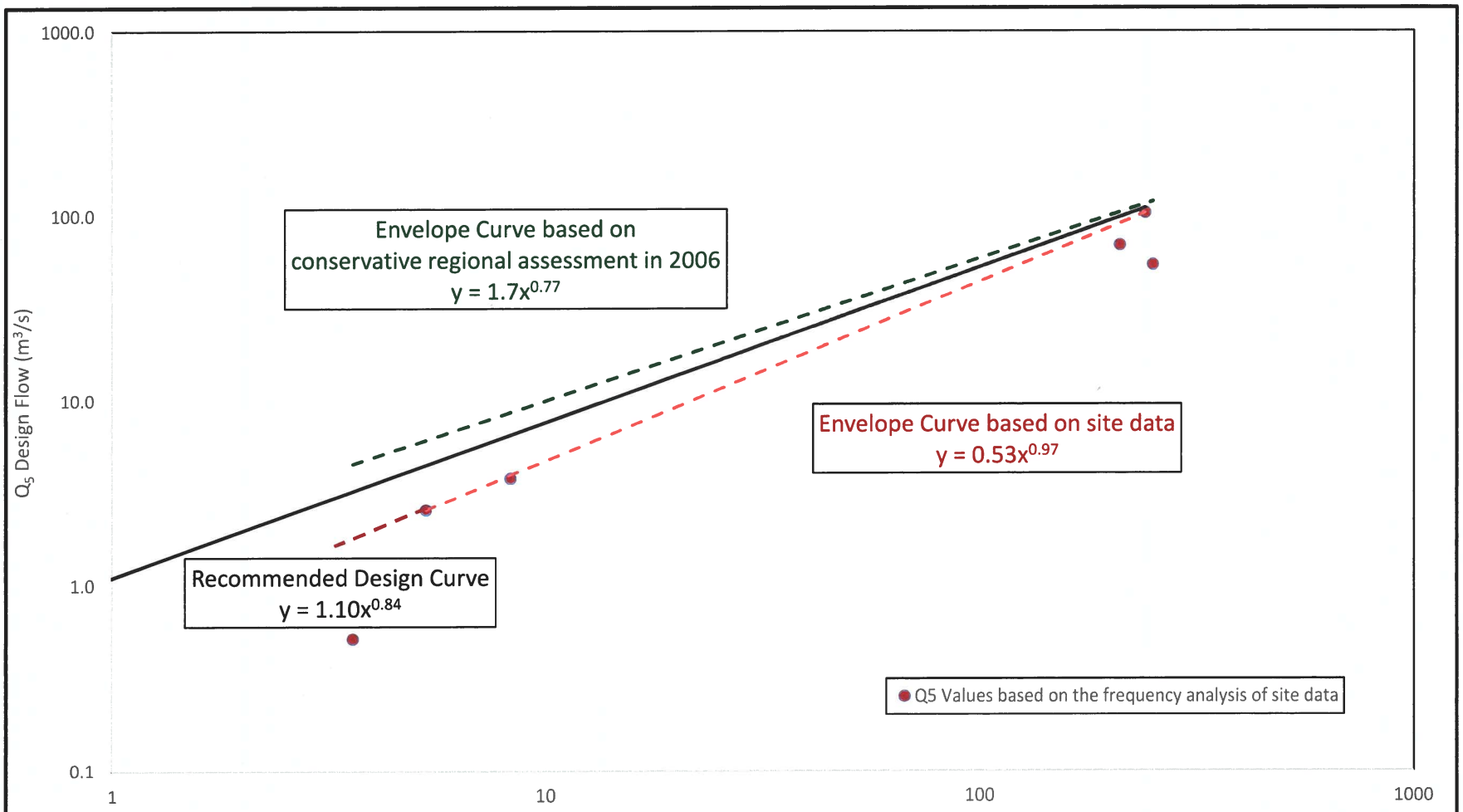
Knight Piésold CONSULTING

P/A NO. NB102-181/30

REF NO. VA16-01950

FIGURE 2

REV 1



REV	DATE	DESCRIPTION	PREP'D	RVWD
1	06DEC16	ISSUED FOR INFORMATION	JGC	RC

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

SCALING PLOT FOR Q5 RECOMMENDED DESIGN FLOWS

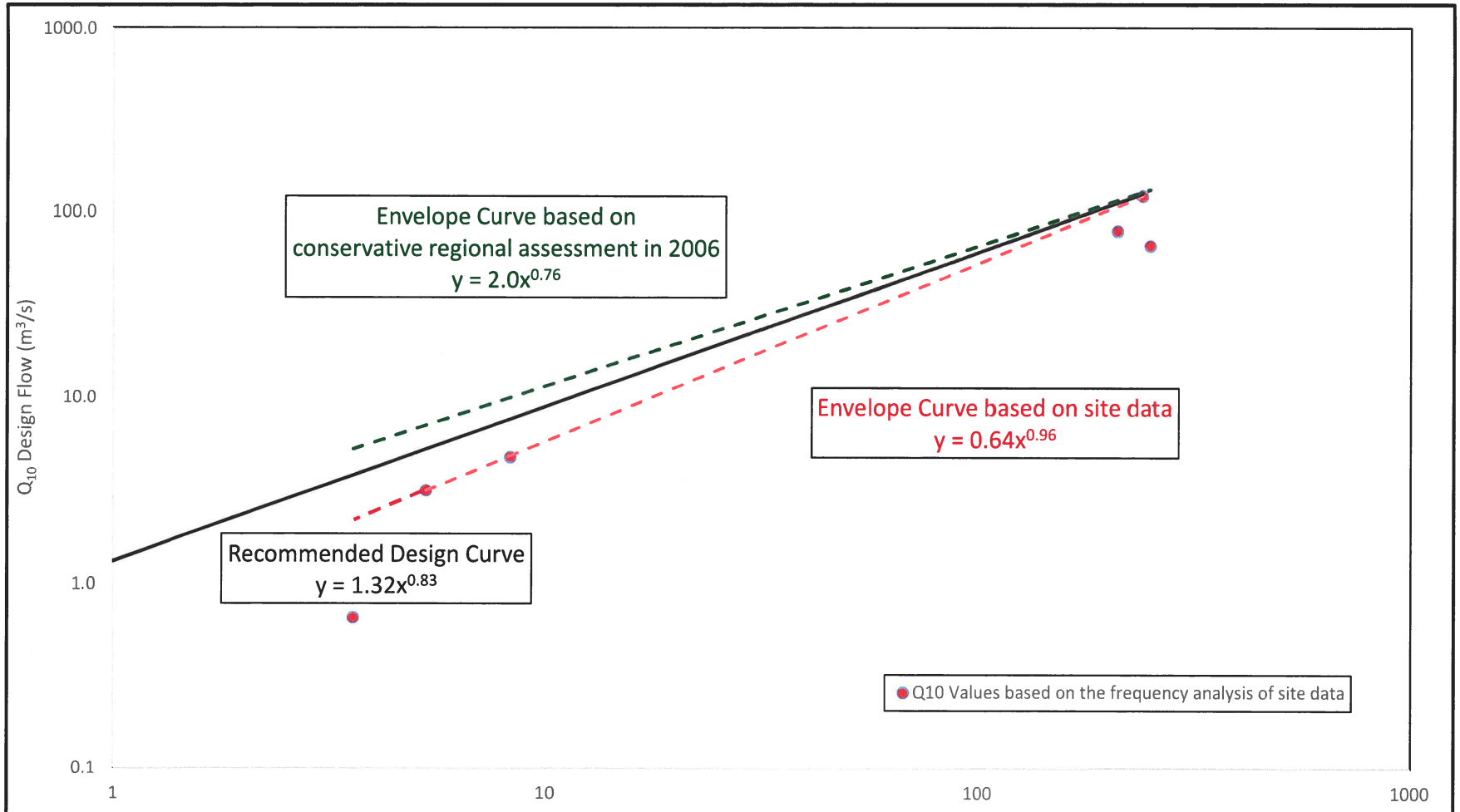
Knight Piésold CONSULTING

P/A NO. NB102-181/30

REF NO. VA16-01950

FIGURE 3

REV 1



REV	DATE	DESCRIPTION	PREP'D	RVWD
1	06DEC16	ISSUED FOR INFORMATION	JGC	RC

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

SCALING PLOT FOR Q10 RECOMMENDED DESIGN FLOWS

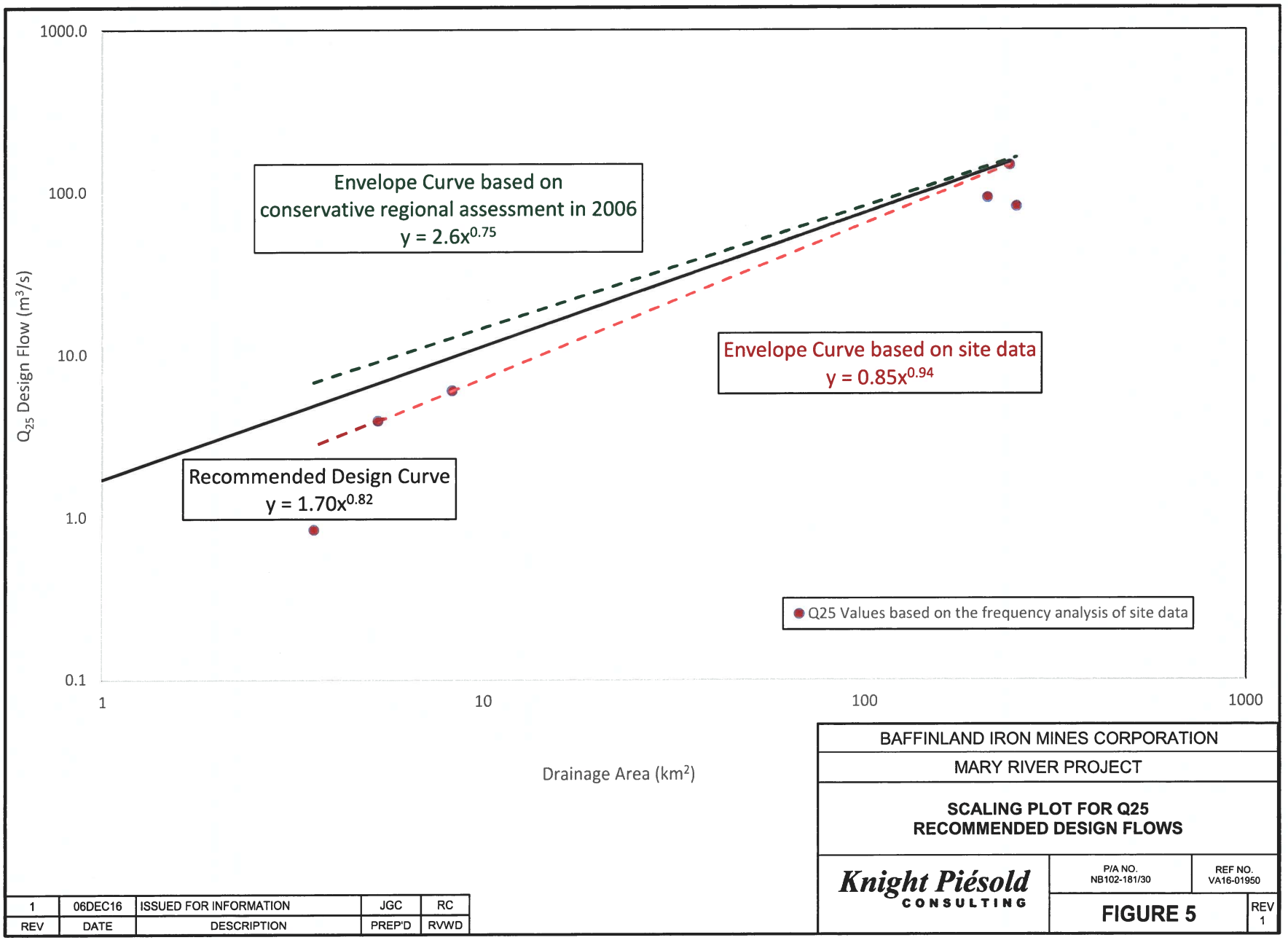
Knight Piésold CONSULTING

P/A NO. NB102-181/30

REF NO. VA16-01950

FIGURE 4

REV 1



REV	DATE	DESCRIPTION	PREP'D	RVWD
1	06DEC16	ISSUED FOR INFORMATION	JGC	RC

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

SCALING PLOT FOR Q25
RECOMMENDED DESIGN FLOWS

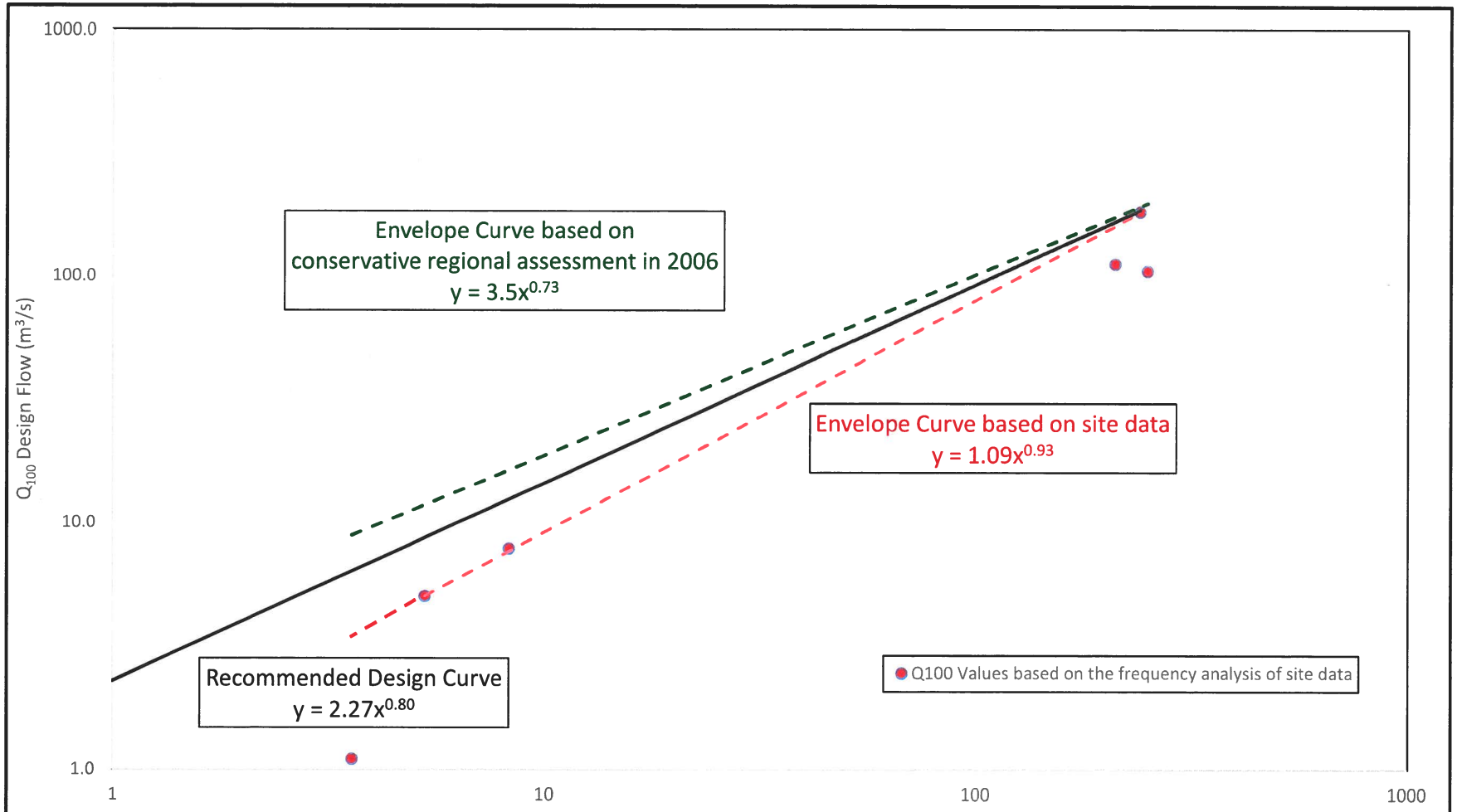
Knight Piésold CONSULTING

P/A NO. NB102-181/30

REF NO. VA16-01950

FIGURE 5

REV 1



REV	DATE	DESCRIPTION	PREP'D	RVWD
1	06DEC16	ISSUED FOR INFORMATION	JGC	RC

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

SCALING PLOT FOR Q100 RECOMMENDED DESIGN FLOWS

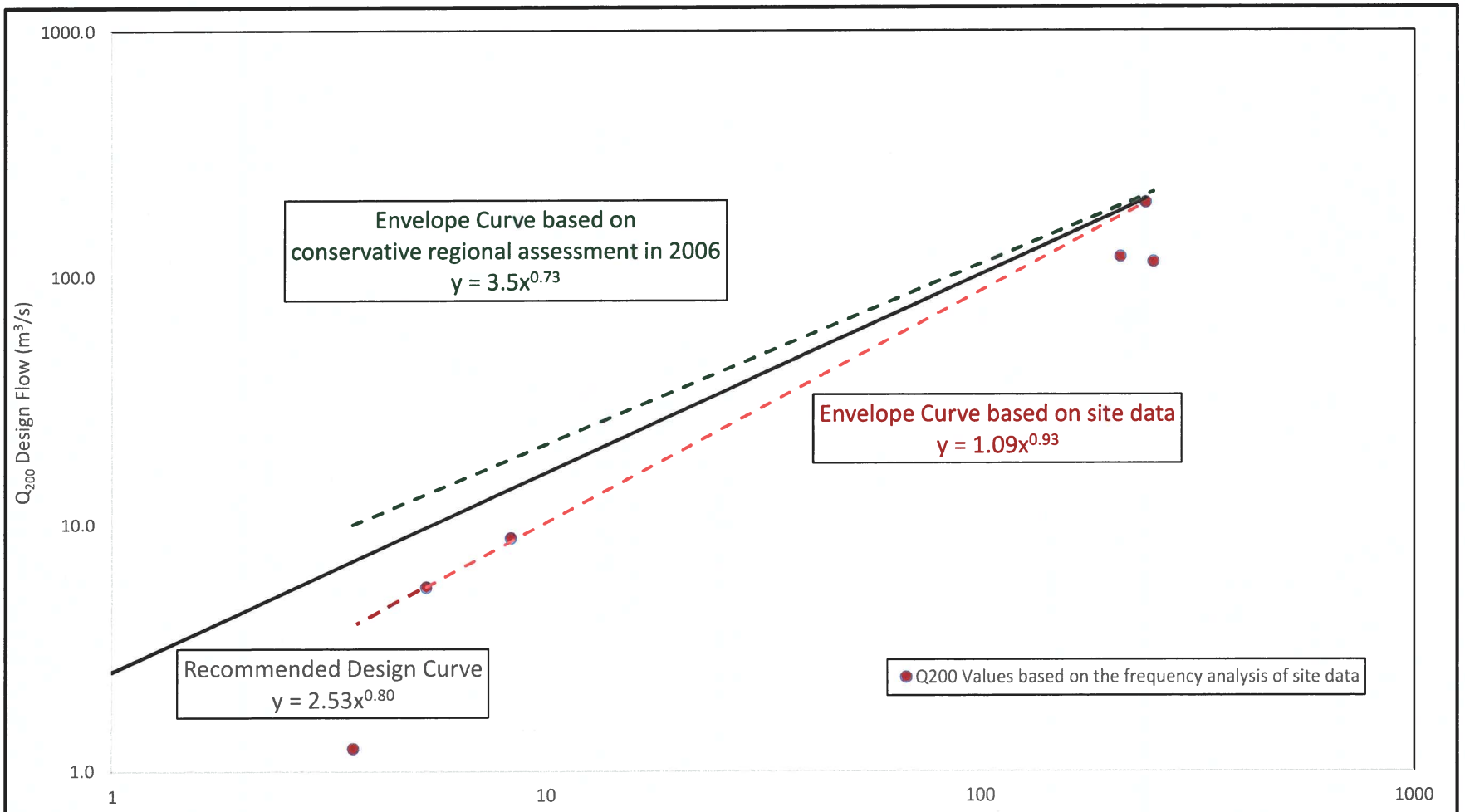
Knight Piésold CONSULTING

P/A NO. NB102-181/30

REF NO. VA16-01950

FIGURE 6

REV 1



REV	DATE	DESCRIPTION	PREP'D	RVWD
1	06DEC16	ISSUED FOR INFORMATION	JGC	RC

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

SCALING PLOT FOR Q200 RECOMMENDED DESIGN FLOWS

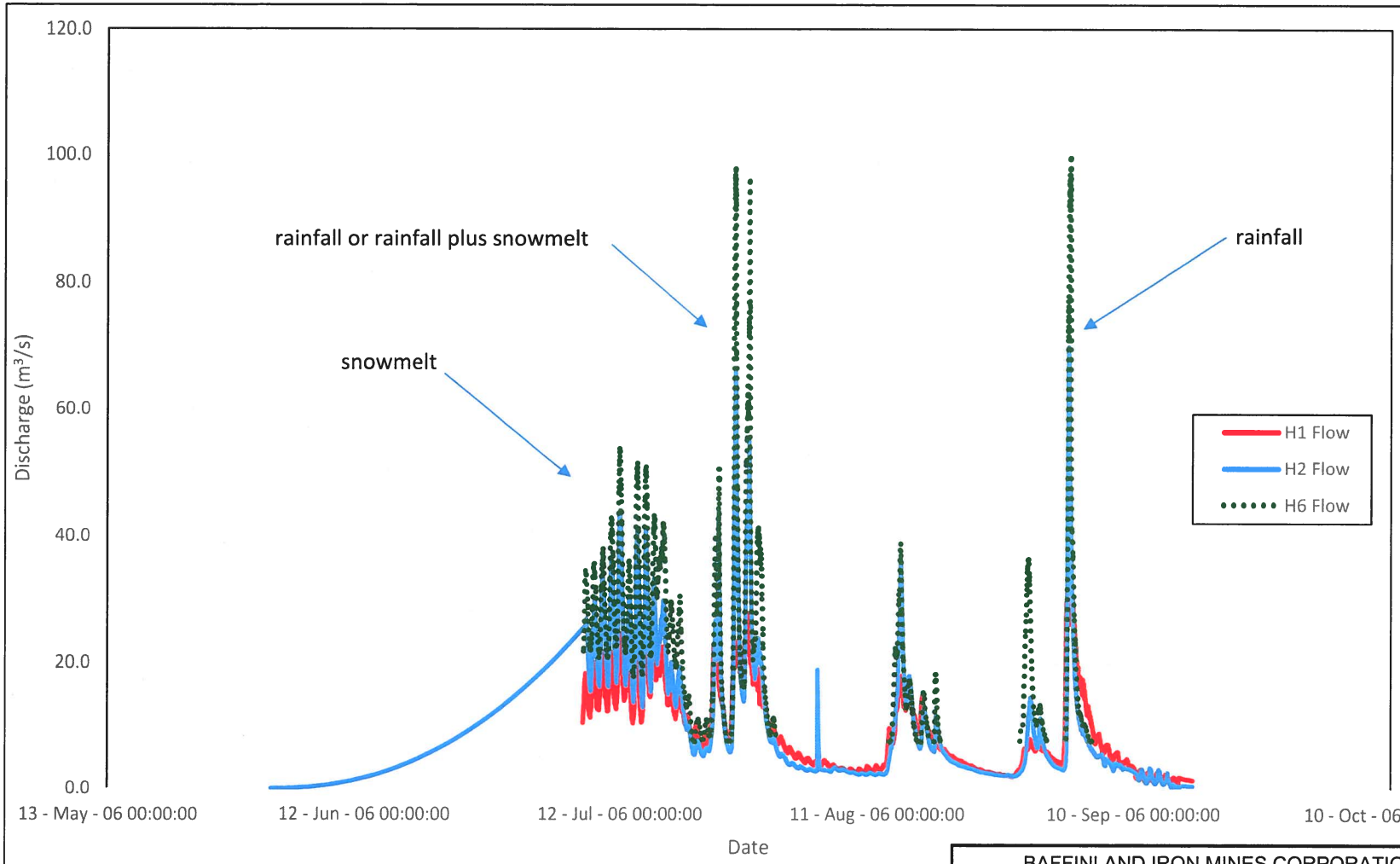
Knight Piésold CONSULTING

P/A NO. NB102-181/30

REF NO. VA16-01950

FIGURE 7

REV 1



Basin Areas : H1: 250 km²
H2: 210 km²
H6: 240 km²

REV	DATE	DESCRIPTION	PREP'D	RVWD
0	06DEC16	ISSUED FOR INFORMATION	JGC	RC

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

2006 HYDROGRAPHS FOR H1,H2 and H6

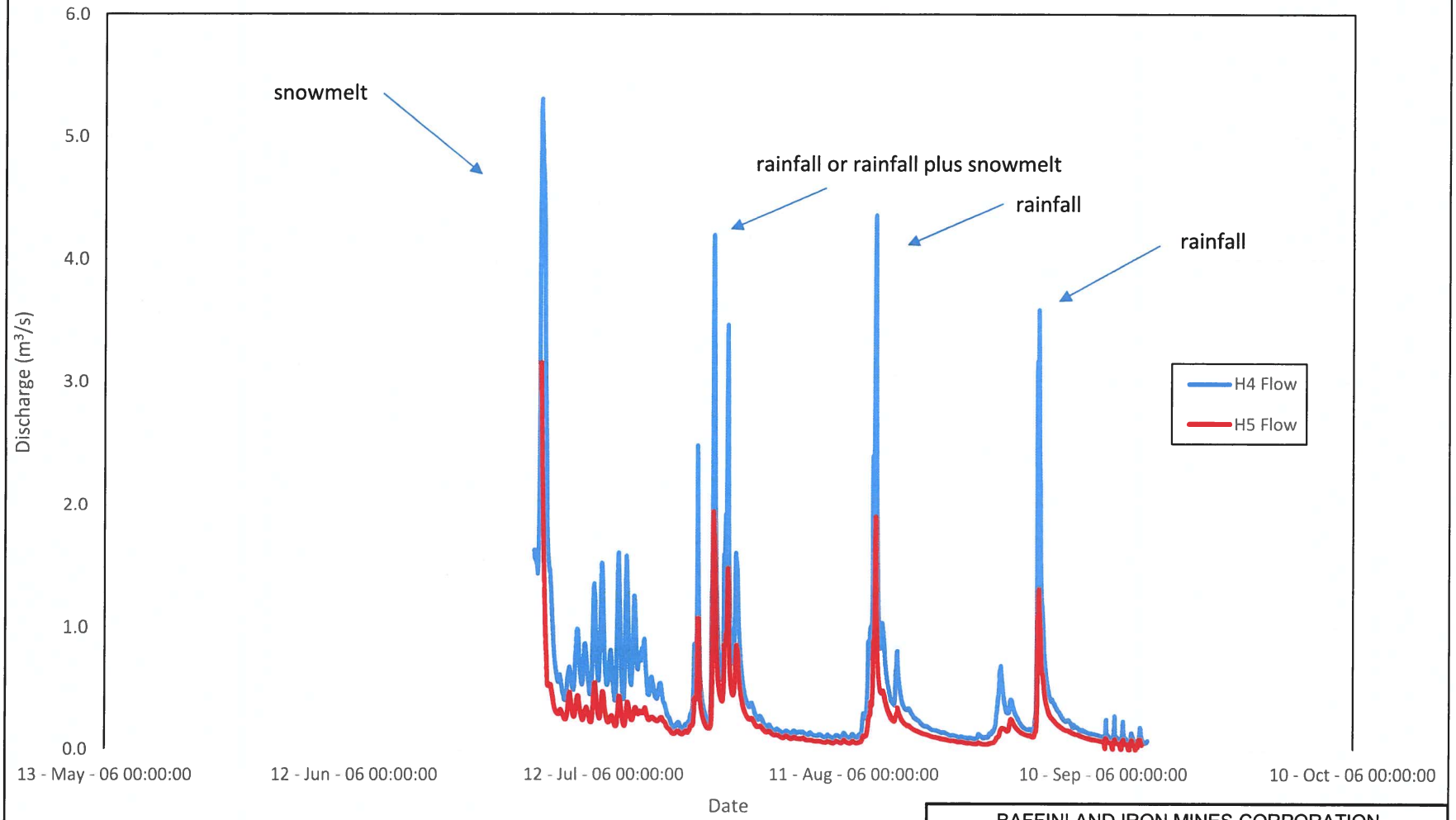
Knight Piésold CONSULTING

P/A NO. NB102-181/30

REF NO. VA16-01950

FIGURE 8

REV 0



Basin Areas : H4: 8.3 km²
H5: 5.3 km²

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

2006 HYDROGRAPHS FOR H4 AND H5

Knight Piésold CONSULTING

P/A NO. NB102-181/30

REF NO. VA16-01950

FIGURE 9

REV 0

REV	DATE	DESCRIPTION	PREP'D	RVWD
0	06DEC16	ISSUED FOR INFORMATION	JGC	RC