Baffinland

December 5, 2014

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Re: Baffinland Responses to Agency Technical Comments on the Amendment to the Type 'A' Water Licence 2AM-MRY1325

Dear Phyllis,

Baffinland was provided technical comments submitted to the Nunavut Water Board (NWB) on the Amendment to the Type 'A' Water Licence 2AM-MRY1325 from the following groups:

1) Qikiqtani Inuit Association (November 14, 2014)
2) Environment Canada (November 14, 2014); and
3) Aboriginal Affairs and Northern Development Canada (November 14, 2014).

Baffinland would like to provide to the NWB the following responses found in Attachment A to all agency comments.

Please do not hesitate to contact me if there are any problems or concerns.

Respectfully,

Oliver Curran

C.C:
Stephen Bathory (QIA)
Mark Dahl (EC)
Jean Allen (AANDC)
David Hohnstein (NWB)
Sean Joseph (NWB)

Enclosure(s):

- Attachment A- Baffinland Responses to Technical Agency comments on Type 'A' Water Licence 2AM-MRY1325 Amendment Application.
- Attachment B – Knight Piésold: Document NB102-00181/10-1, Rev 0, Bulk Sampling Program – Road Upgrade Design Summary.
- Attachment C - Fisheries and Oceans Canada Letters of Advice December 16th and December 20th, 2013.

Appendix A:

Baffinland Responses to Technical Agency comments on Type 'A' Water Licence 2AM-MRY1325 Amendment Application

Attachment 1: Technical Comments Regarding Amendment to NWB Type A Water Licence 2AM-MRY1325

Technical Comments Regarding Amendment to NWB Type A Water License 2AM-MRY1325		
Number	**Comment**	**Baffinland Response**
	Qikiqtani Inuit Association	
1	With regards to the monitoring of contact water from the Milne Port ore stockpile, BIMC notes (response to AANDC -3.2) that "Environment Canada has advised Baffinland that the mine effluent discharge to Milne Inlet will not be subject to MMER [Metal Mining Effluent Regulations], though the Fisheries Act will still apply, including Section 36(3) regarding the prohibition of discharges of a deleterious substance in waters frequented by fish". From MMER, "Effluent" means an effluent – hydrometallurgical facility effluent, milling facility effluent, mine water effluent, tailings impoundment area effluent, treatment pond effluent, seepage and surface drainage, treatment facility effluent other than effluent from a sewage treatment facility – that contains a deleterious substance.	Baffinland does not disagree with QIA's reference to the definition of an effluent under MMER. While Baffinland cannot speak on behalf of EC on this interpretation, Baffinland assumes EC's judgment is based on the potential for environmental effects, and the perceived likelihood that effects could be detected in such a large receiving water. See further comments below.
a	It is unclear to the QIA how contact water from the ore stockpile is not considered an "effluent" under the MMER. The QIA request BIMC to provide any written advisement from Environment Canada that states that the contact water from the ore stockpile is not subject to MMER.	The QIA is referred to the NWB hearing record for advisement from EC with regards to applicability of the MMER to the Mary River Project. The following is noted: 1. EC made the determination of the applicability of the MMER to stockpile runoff effluent at Milne Port. 2. Section 36(3) provisions of the Fisheries Act still apply, and therefore it is incumbent upon Baffinland to ensure that the effluent discharged is not acutely toxic to aquatic life via effluent testing. 3. The ocean waters in Milne Inlet represent a very large receiving water, and tides and currents will help disperse what is a comparatively insignificant volume of effluent discharged (effluent will meet applicable standards). Monitoring the near field receiving environment near the discharge location is not likely to detect effects to marine life assuming the effluent is not acutely toxic.
b	The QIA requests BIMC to provide proposed effluent quality criteria for the discharge of the Milne Inlet ore stockpile runoff waters to Milne Inlet with supporting discussion on how the proposed criteria are protective of the receiving environment.	Baffinland proposes to test the effluent and compare the results against both the MMER Schedule 4 limits and aquatic toxicity testing specified under MMER Schedule 5. Exceedance of these limits/tests would imply that the effluent is potentially deleterious.
c	It is requested that Environment Canada provide clarification on the applicability of MMER to the discharge of contact water from the Milne Port ore stockpile to Milne Inlet.	No comment
d	The QIA requests Environment Canada to provide clarification on the responsible authority and applicable regulation(s) associated with the discharge of the contact water from the Milne Port ore stockpile to Milne Inlet. It is further requested that the required monitoring in the receiving waters under said regulations be summarized.	No comment

2	BIMC references (response to AANDC-3.2) their June 27, 2014 Aquatic Effects Monitoring Program5 (AEMP) to address monitoring associated with the ore stockpile contact water and the receiving environment. The QIA notes that the June 27, 2014 AEMP was submitted to the NWB in accordance with Part I, Item 2 of the Type 'A' Water Licence 2AM-MRY1325. The AEMP is currently undergoing review by Interested Parties for the NWB's consideration in rendering their decision on approval. It is the QIA's understanding that the scope of the Type 'A' Water Licence does not include the Early Revenue Phase (ERP) activities. BIMC's Water Licence amendment application was submitted to the NWB to include the construction and operation of infrastructure and facilities associated with the proposed ERP components into their Type 'A' Water Licence. Upon cursory review of the July 27, 2014 AEMP, the QIA notes the following: - Section 2.1 Problem Formulation, introduces the subject of runoff from the ore stockpile area at Milne Port and notes that it will be discharged to Milne Inlet. - Section 2.1 Problem Formulation, notes "Monitoring of effects to the marine environment is beyond the scope of this AEMP." - Section 2.4 Potential Issues and Concerns by Project Components, is silent on the topic of monitoring associated with the contact water from the ore stockpile. - Figure 3.3 Milne Port Surveillance Network Program (SNP) does not include a SNP monitoring station for the ore stockpile runoff ponds. Table 3.3 presents proposed SNP monitoring stations associated with the ERP; however, it is unclear if any of these monitoring stations are associated with Milne Port ore stockpile. Based on this the QIA has the following comments and requests for clarification.	Baffinland has received the QIA's comments on the AEMP and proposes to respond to these comments through the water licence process, via a response to comments issued to the NWB and/or update to the AEMP filed with the NWB and QIA Annual Report. The establishment of an SNP monitoring station for the ore stockpile runoff ponds as part of this water licence amendment is reasonable to Baffinland; as mentioned in Baffinland's response to QIA comment 1b above, Baffinland intends to conduct testing of the ore stockpile runoff (effluent) as part of its own due diligence to ensure compliance with the Fisheries Act.
a	The QIA's review of the July 27, 2014 AEMP is not to be considered a detailed technical assessment. The QIA's review of the July 27, 2014 AEMP will be issued to the NWB under a separate cover. That review will be restricted to the scope of the Type 'A' Water Licence and therefore does not address the ERP activities, since these activities are the subject of the current Water Licensing amendment process. The QIA seeks clarification from the NWB on how the July 27, 2014 AEMP submittal relates to this Water Licence amendment process. After clarification, the QIA will evaluate the necessity to complete a detailed technical assessment relative to ERP activities (not yet captured in the scope of 2AM-MRY1325).	No comment
b	The QIA requested (response to QIA-2) BIMC to provide the proposed SNP associated with the ERP (location of sampling, frequency of sampling, and parameters to analyze) for review and further comment. BIMC referred the QIA to the July 27, 2014 AEMP. SNP monitoring associated with the ore stockpile runoff ponds, waters along the Tote Road and quarries/borrows has not been addressed or no new SNP monitoring stations were proposed by BIMC within the July 27, 2014 AEMP. The QIA seeks clarification from BIMC regarding the SNP monitoring associated with the Milne Inlet ore stockpile runoff ponds, waters along the upgraded Tote Road and quarries/borrows that support the ERP activities.	See Baffinland's response to QIA comment 2 in regard to the establishment of an SNP Monitoring Station at the Milne Port ore stockpile runoff discharge location. Sampling and monitoring of runoff from Project components during construction activities is already regulated under the existing Type A Water Licence (refer to Part D 15 and 16). During road upgrades, particularly during work at or near crossings, construction monitoring includes monitoring of water quality upstream and downstream of potentially affected streams. Authorizations and Letters of Advice provided by DFO include requirements for minimizing and monitoring of siltation potentially originating from stream crossing construction sites. Baffinland respectfully disagrees with the QIA's assertion that crossings along the tote road and quarries/borrow areas should be assigned SNP monitoring stations. Road upgrades and aggregate sources are temporary features during construction. Further, the ARD Testing Protocol found within the Borrow Pit and Quarry Management Plan is Baffinland's means of pre-emptively avoiding quarry development where ARD/ML potential exists. The quarry management plans also provide downstream monitoring locations and schedules for water quality monitoring. Note that Baffinland's Environmental Protection Plan (July 2014) includes Operational Environmental Standards (OES) for Land Disturbance (OES 2.3), Sediment and Erosion Control (OES 2.9), and Tote Road Watercourse Crossing Installation (OES 2.18). Baffinland's March 2014 Surface Water and Aquatic Ecosystem Management Plan (BAF-PH1-830-P16-0026) provides a comprehensive basis and guide for monitoring and control of downstream runoff from development areas.

c	Table 3.2 and Figure 3.3 summarized established SNP monitoring stations associated with the ERP. The QIA notes that monitoring stations associated with “Surface discharge downstream of construction area at Milne Port” and “Surface Runoff and or Discharge Quarries” as listed in Table 3.2 are not depicted in Figure 3.3 or elsewhere. Additionally, the location of the Milne Port - Off-Spec Effluent Pond is unknown and the associated SNP for this location is also unknown. The QIA requests BIMC provide additional, or updated, map(s) to depict these SNP monitoring locations associated with the ERP.	The AEMP is not intended to create new SNP stations; as these are prescribed by the Type A Water Licence. Nor is the AEMP intended to replace the SNP program prescribed by the licence. Toward the bottom of page 2 of the AEMP, Baffinland makes the following distinction between the water licence SNP program and the AEMP: *Monitoring prescribed under the related and water licence prescribed Surveillance Network Program (SNP) focuses on detecting short-term project-related effects. The AEMP is designed to detect project-related impacts at greater temporal and spatial scales that are ecologically relevant (i.e., on a basin spatial scale).* As such, short-term project features such as aggregate sources do not fit under the scope of the AEMP. Baffinland's management plans and the Type A water licence identify relevant monitoring for shorter-term construction features of the Project and opportunities for monitoring.
d	The QIA seeks clarification from the NWB if ore stockpile runoff waters discharged to Milne Inlet are to be considered as part of the scope of the Water Licence amendment. Note, BIMC’s July 27, 2014 AEMP stated that all site drainage, treated sewage and treated oily water will be relocated to a point approximately 200m from the Milne Inlet shoreline. Attachment 1 to the Water Licence amendment application, states the proposed outfall is located north of the existing fuel farm facility and discharges to an existing drainage system approximately 100 m from the Milne Inlet shoreline. Without further information, the QIA assumes that contact water from the ore stockpile would be discharged to the same location.	There will be two separate monitoring stations for the Milne Ore Stockpile that correspond to the outlets of the East and West settling ponds. Baffinland will establish the exact location for the monitoring station based on discussions with the AANDC Water Resource Officer for the Project and direction provided. The monitoring locations will be immediately upstream from the ocean. The discharge location for the sewage treatment plant effluent (MP-01) will remain separate from the ore stockpile drainage. The location is accurately depicted in the Milne Port Site Layout (H349000-2000-00-015-0002) provided in Attachment 1 of the Type A Water Licence Amendment application. The outfall for the treated sewage effluent is approximately 30 m from the high tide mark of Milne Inlet. The sewage treatment plant is currently monitored for compliance at the plant location.
e	Related to item 2.d., the QIA requests clarification from BIMC on the relocation point for the discharge of site drainage, treated sewage and treated oil water. Further, the QIA requests clarification from BIMC on the location of discharge of the ore stockpile runoff waters.	The new discharge location for effluent discharge is shown in the Milne Port Site Layout H349000-2000-00-015-0002 and described in section 1.3 of the Type A Water Licence Amendment application. There will be two discharge locations for the ore stockpile runoff waters located at or near the outlet of two settling ponds, also depicted in above referenced drawing.
f	The QIA seeks clarification from the NWB if the effects monitoring in the Marine Environment associated with discharge of effluent waters to Milne Inlet is to be considered as part of the scope of the Water Licence. If effects monitoring within Milne Inlet is within the jurisdiction of the NWB, the QIA recommends the AEMP address this monitoring component.	No comment

g	The QIA seeks clarification from BIMC which monitoring plan(s) address monitoring of the effects to the marine environment that are associated with the discharge of effluent waters to Milne Inlet. QIA notes that this information may be related to the NIRB Project Certificate Term and Condition #76 which states "The Proponent shall develop a comprehensive Environmental Effects Monitoring Program to address concerns and identify potential impacts of the Project on the marine environment".	Baffinland has incorporated into the Shipping and Marine Wildlife Management Plan its comprehensive marine environmental effects monitoring program. The most recent revision of the Plan was tabled at the Marine Environmental Working Group meeting held in Iqaluit on November 27, 2014. One aspect of marine monitoring is with respect to the discharge of substances from Milne Port into the marine environment (including ore stockpile settlement pond outflow, treated sewage discharge and site surface runoff). Because of uncertainty amongst regulators (Environment Canada with respect to the Metal Mines Effluent Regulations and Fisheries and Oceans with respect to the deposition of deleterious substances under the Fisheries Act) about the scope and nature of any marine effects monitoring, a consultation is planned to clarify an appropriate study design. Results of this consultation will be reported to the MEWG.
3	The QIA requested (response to QIA-3) BIMC to provide the locations, within the Final Environmental Impact Statement (FEIS), where potential impacts on the receiving environment are associated with water withdrawal from along the Tote Road. BIMC's response pertains to the Nunavut Impact Review Board's (NIRB) screening assessment; however, does not address the QIA's initial request to understand the potential impacts on the receiving environment, thus waters on Inuit Owned Lands, from this ERP activity. The QIA requests BIMC provide a response to the QIA's September 16, 2014 information request. If the FEIS did not assess this activity for potential impacts to the receiving environment, it is requested that BIMC inform if this information is available in a different report.	Baffinland would like to refer the QIA to the Knight Piesold Hydrological Assessment Memo found in Attachment 2 of the Type A Water Licence Amendment re: *Hydrology Assessment of Water Sources for Dust Suppression along the Tote Road Mary River Project - Early Revenue Phase*
4	Further to the QIA's September 16, 2014 letter (QIA-3) regarding the Water Compensation Agreement, the QIA informs the NWB that this topic remains to be discussed between the QIA and BIMC.	No comment
5	The QIA's September 16, 2014 letter (QIA-7) notes that BIMC is seeking a 25 year licence term for this Water Licence amendment. BIMC provided no additional information to support an extended licence term. The QIA requests BIMC to provide the basis for a change in the licence term to support the proposed licence expiry date of 2040. Until further evidence is presented for review QIA cannot comment on the need for this amendment. QIA further refers the NWB to consider the reasons for decision associated with 2AM-MRY1325 on this topic.	No comment
6	The QIA's September 16, 2014 letter (QIA-5) informs the NWB that the QIA and BIMC have engaged throughout 2014 on the topic of financial security for the Mary River Project, inclusive of the ERP activities. The global financial security for the Mary River Project will be the subject of further discussion as part of the Annual Security Review.	No comment
7	The QIA submitted to the NWB on September 15, 2014 a review of the Interim Closure and Reclamation Plan for the Mary River Project (as referenced in Attachment 4 of the Water Licence amendment application). As noted in BIMC's October 3, 2014 response, the QIA and BIMC have agreement on an approach forward to fulfill the requirements of the closure and reclamation plan under the Commercial Lease. ERP activities in relation to the Interim Closure and Reclamation Plan will be addressed through said approach.	No comment

8	Part A, Item 1 of Water Licence 2AM-MRY1325 outlines the scope of the approved Mary River Project. Specific to the Tote Road, the Water Licence scope is defined as follows "Tote Road (approximately 100 km all-weather road), which extend from the Mine Site to Milne Port site in its current form except for routine maintenance and minor upgrades for the transportation of equipment during the Construction Phase of the project". The QIA understands that this scope does not permit an alteration to the Tote Road, except for routine maintenance and minor upgrades, from its form as of license issuance (June 10, 2013). Part D, Item 2 of the Water Licence requires final design and for-construction drawings for the applicable infrastructure, water crossings and roads that are listed. The QIA understands that the reference to roads in Part D, Item 2 is in reference to the railway water crossings and the associated road access corridor for the railway as presented in the Water Licence application (Section 2.6 Executive Summary, Attachment 7 – Water Crossings, and Attachment 9 – Water Crossing Drawings). To assume that Part D, Item 2 applies to the Tote Road would contradict the scope of the project as defined in Part A, Item 1. Within the original Water Licence application11, water crossings associated with the rail and the associated access road were provided, but no drawings associated with newly constructed water crossings for the Tote Road. Within the Executive Summary of the Water Licence application (Section 2.2) it is stated "Sections of the road will be upgraded to reduce hazards and risks. Some of the upgrade activities will consist of: - Improvement to the road base - Realignment of the road where necessary to facilitate passage of large loads and fuel tanker trucks · Improvement to the grade in certain areas · On-going efforts to reduce risk at stream crossings through the implementation of the freshet management plan No work other than routine maintenance and some improvements to stream crossings are envisaged. Therefore, there is no requirement for an additional HADD authorization or NWB authorization for water crossings. Large heavy loads will be transported during the winter months and over ice at stream crossings that do not have sufficient load bearing capacity." Since no NWB authorization was requested by BIMC, the QIA interprets this to be the reason why the Type 'A' Water Licence scope for the Tote Road is restricted to the "current form except for routine maintenance and minor upgrades for the transportation of equipment during the Construction Phase of the project". Within the Water Licence application there are no specifics regarding any new (i.e., not a replacement of an existing culvert in the same location, such as a culvert repair) water crossings or bridge replacements. The Type 'A' Water Licence scope is to be based on the original Water Licence application and is to conform to the NIRB's assessed project as defined in the FEIS12. Volume 1 of the FEIS (Section 2.3.1 Milne Inlet Tote Road), the scope of the Tote Road is defined as follows. "The Milne Inlet Tote Road was upgraded in 2008 from a winter road to an all-season road adequate for transporting equipment and ore using 45-t trucks. Figure 1-2.4 presents the alignment of the Milne Inlet Tote Road. The road will be maintained through the construction phase with some improvements to the road base and reductions of steep grades at certain locations. No major improvements or bridge replacements are proposed, and large oversized equipment will be brought over the road during winter". The QIA notes that the scope of the Tote Road as detailed in the 2012 Water Licence application is similar to that presented in the 2012 FEIS. The current Water Licence is to align with the NIRB decision from the FEIS and the Water Licence application.In 2013, BIMC applied to the NIRB to complete the ERP, which resulted in addendum to the FEIS. The FEIS addendum (Table 1-2.1) summarizes the key projectfacts for the ERP and Approved Project. Specific to the Tote Road the stream crossings associated with the Tote Road were summarized as follows: "Total of 115 stream crossing - 4 bridges - 75 culvert replacements - 40 culvert extension Design as per 2008 Tote Road upgrade report [Knight Piésold: Document NB102-00181/10-1, Rev 0, Bulk Sampling Program– Road Upgrade Design Summary]"	

8	The Knight Piésold report is presumed to be the upgrade design report for the Tote Road in 2008 to improve the Tote Road from a winter road to an all-weather road to support the bulk sampling program. This source document is unavailable to the QIA to confirm, but is likely a key source that depicts design intent and alignment of the Tote Road in 2008. The ERP activities utilize the Tote Road to haul ore by trucks to the Milne Port. The FEIS addendum (Section 2.2.1 Scope of the ERP) states "the upgrade to the tote Road (limited realignment, replacement of culverts, addition of bridges) are an integral part of the Approved Project as well as the ERP and were included in the scope of the Final Environmental Impact Assessment (FEIS) submitted for Project Certificate No. 005" The QIA notes the contrast in the 2012 FEIS addendum scope for the Tote Road compared to the 2012 Water Licence application, which generally defines the scope of the Tote Road to be limited to routine maintenance and minor upgrades. The addendum to the FEIS contains a new appendix associated with the Tote Road Drawings (Appendix 3C). BIMC states that "Project Certificate condition No. 29 requires that Baffinland "provide the respectiv regulatory authorizes with construction engineering design and drawings". In accordance with this requirement, Appendix 3C contains design drawings for the Tote Road upgrades. These drawings are provided in the ERP submission for information purposes". Further, BIMC claims the Tote Road upgrades are approved under the Project Certificate No. 005 and that subsequent Department of Fisheries and Oceans (DFO) authorizations allow BIMC to undertake this work. The QIA notes that the upgrades to the Tote Road, as presented in Appendix 3C of the FEIS addendum, pertain to alignment changes and do not present culverts or bridges.	
a	To aid in the development recommendation for items to include in an amended Water Licence that includes the ERP activities, the QIA seeks to further understand the scope of the existing Water Licence. The QIA seek clarification from the NWB as to the scope of the Tote Road upgrades permitted under the Water Licence in order to further understand the following phrases and terms used in Part A, Item 1 of the Water Licence. - "current form" of the Tote Road - Routine maintenance - Minor upgrades With respect to road realignment, road expansion (widening or thickness), culvert construction and bridge construction associated with the Tote Road, clarification is sought if any of these activities are within the scope of the Water Licence, and if so, the extent of the activity permitted.	This is a clarification request to the NWB. However Baffinland wants to note that activities are required primarily for the purpose of safety and ensuring compliance with applicable safety regulation under the Mine Health and Safely Act and Regulations.
b	The QIA requests BIMC provide the following reference document to further understand the 2008 designed road and culvert characteristics since they are the basis for the design of the replacement culverts. Knight Piésold: Document NB102 -00181/10-1, Rev 0, Bulk Sampling Program – Road Upgrade Design Summary.	Attached is the 2007 document requested by QIA found in Attachment B of this document. It should be noted that the original design basis for the stream crossings on the road used the available hydrological record which is limited due to the available years of monitoring. The updated design for the current upgrades to the road were provided to the DFO in August 2013. The upgraded design is based on the effectiveness of the original 2007 design as well as performance data for all crossings during the 2008 to 2013 period. The DFO reviewed the updated August 2013 design for the stream crossings and determined that the proposed work would not likely result in impacts to fish and fish habitat provided that our proposal is implemented as planned. Refer to DFO Letters of Advice dated December 16 and December 20, 2013 found in Attachment C of this document.

c	The QIA requests the hydrology and hydraulic characteristics of the 75 replacement culverts that are referenced in the addendum to the FEIS and planned for replacement.	The DFO reviewed the updated August 2013 design for the stream crossings and determined that the proposed work would not likely result in impacts to fish and fish habitat provided that our proposal is implemented as planned. Refer to DFO Letters of Advice dated December 16 and December 20, 2013 found in Attachment C.
d	Watercourse crossings (i.e., culvert and bridge construction and operation) have potential to impact fisheries resources and alter water quality and flow from natural conditions. Short- and long-term effects can arise as a result of erosion of ditches and slopes, sediments can be released due to construction activities and erosion processes. Specific to the Tote Road, the QIA requests BIMC to provide the locations within management plans or reports where the specifics regarding monitoring of water quality, quantity and/or flow are detailed for: - The construction phase for the culvert and bridge locations. - The post-construction and pre-reclamation phase for the culvert and bridge locations.	Monitoring of crossings both during and post construction are included in the proposal documents submitted to DFO. The July 2014 Environmental Protection Plan for the project contains several Operational Environmental Standards (OESs) that are relevant to the management and monitoring of construction activities along the Tote Road. These include OES 2.17 Road Construction and Borrow Development, and OES 2.18 Tote Road Watercourse Crossing Installation. In addition the Surface Water and Aquatic Ecosystem Management Plan (July 2014) also includes control and monitoring methodologies to be adopted for construction activities along the Tote Road.

Technical Comments Regarding Amendment to NWB Type A Water License 2AM-MRY1325						
Number	Category	Reference	Issue	Rationale	Response	Baffinland Response
AANDC						
2.1	Monitoring of Milne Port Ore Stockpile Runoff Ponds	Attachment 1, Drawing H349000-2000-00-015-0017 Milne Port Early Revenue Phase Site Layout; Attachment 1, Drawing H349000-2345-10-035-0001 Milne Port Ore Stockpile Sedimentation Ponds; Attachment 1, Drawing H349000-2100-10-015-0001 Milne Port – Site Preparation Site Layout Drainage Plan; Fresh Water Supply, Sewage, and Wastewater Management Plan BAF-PH1-830-P16- 0010 (January 31, 2014), Section 5.3 (Treated Wastewater Generation and Discharge/Outfall Locations), Table 5.7 (Effluent Discharge Quality Limits for Ore Stockpiles and Pits), page 18; Aquatic Effects Monitoring Plan (AEMP) BAF-PH1-830-P16-0039 (June 27, 2014), Section 3.4.1 (Surveillance Network Program Overview), Table 3.2 (Established SNP Monitoring Stations Associated with ERP) and Table 3.3 (Future SNP Stations Associated with ERP), pages 26 and 30.	See submission	Baffinland has identified the discharge limits which will apply to the Milne Port ore stockpile runoff. It is not clear at what monitoring location compliance with these limits will be established. If monitoring of the ore stockpile runoff is proposed in the new outfall ditch (new MP-01) prior to its discharge to the marine environment, Baffinland needs to address how one monitoring location will be used to measure compliance with two different sets of discharge limits, one for ore stockpile runoff, the other for WWTP releases.	AANDC requests that the amended Type A Water Licence clearly identify where compliance with the proposed discharge limits for the Milne Port ore stockpile runoff will be established (i.e., where a monitoring station will be established for the Surveillance Network Program to isolate treated ore stockpile runoff quality). This new monitoring station should also be included in updated versions of the Fresh Water Supply, Sewage, and Wastewater Management Plan and the Aquatic Effects Monitoring Plan.	There will be two separate monitoring stations for the Milne Ore Stockpile that correspond to the outlets of the East and West settling ponds. Baffinland will establish the exact location for the monitoring station based on discussions with the AANDC Water Resource Officer for the Project and direction provided by same. The monitoring locations will be upstream from the ocean. The discharge location for the sewage treatment plant effluent (MP-01) will remain separate from the ore stockpile drainage. The location is accurately depicted in the Milne Port Site Layout (H349000-2000-00-015-0002) provided in Attachment 1 of the Type A Water Licence Amendment application. The sewage treatment plant is currently monitored at the plant location.
2.2	Design of Milne Port Ore Stockpile Runoff Ponds	Attachment 1 (Part 6), Design Criteria – Civil, Document H349000-1000-10-122-0001, Rev. 1 August 28, 2013, Section 7.4.2, page 16	See submission	It is important to establish how the Milne Port ore stockpile runoff sedimentation ponds were designed to confirm they are adequately sized for their intended purpose and to minimize impact on the receiving environment.	AANDC requests additional clarification from Baffinland on how the run-off coefficient design criterion of 0.0 was applied in the design of the Milne Port ore stockpile runoff sedimentation ponds and what method is proposed to discharge the stockpile runoff from the ponds to the receiving waters.	Baffinland would like to clarify that they used a runoff co-efficient of 0.0 for the ore stockpile area only and 0.9 runoff coefficient for the remaining pad areas as per the civil design criteria. Regarding the discharge of the Stockpiles, Baffinland provided emergency overflow weirs with rip-rap at the ponds outlets. Pond 2 (east), a discharge channel was constructed all the way to the receiving water body since there is a sharp drop in elevation before reaching the receiving water body. Rip-rap was provided at the erosion prone areas, not at the very flat areas. Pond 1 (west), contains rip-rap for a certain length after the overflow. The area around this pond is flat unlike Pond 2 and close to the receiving water body.

2.3	Interim Closure and Reclamation Plan and Security Estimate	Attachment 4, Interim Closure and Reclamation Plan for the Mary River Project and associated estimated security deposit.	See submission	The security estimate must reflect the true cost of project closure to ensure the project can be closed and the site reclaimed with minimal impact to the environment.	AANDC recommends that the deficiencies in the final and marginal security cost estimates be addressed as part of the 2015-16 Annual Security Review.	Agreed. Baffinland recognizes an annual adjustment to reclamation security (or Annual Security Review) is required under Section 9.2 of the Commercial Lease, No. Q13C301, agreed to between Baffinland Iron Mines Corporation (Baffinland) and the Qikiqtani Inuit Association (QIA), as well as a requirement under the Type 'A' Water Licence 2AM-MRY1325 (Part J, Item 3). The amount of security required to be posted following the Annual Security Review is established assuming a 3rd Party Contractor will perform the work in a 'worst-case' scenario for all disturbed areas, project components and project activities to ensure the project can be closed and the site reclaimed with minimal impact to the environment at any given time.

AANDC Appendix 2: Comments on Proposed Updates to Terms and Conditions (T&C) of Water Licence 2AM-MRY1325				
T&C	**Existing T&C**	**Suggested Updates to T&C**	**AANDC Comment**	**Baffinland Response**
Licence Term	The existing licence expires on June 10, 2025.		In the amendment application, BIMC requested a 25 licence term. AANDC recommends that the licence term remain unchanged, as the rationale for the 12 year licence term in the NWB Reasons for Decision remain valid.	No comment.
Part B, Item 10	The Licensee shall notify the NWB of any changes in development plans or conditions associated with the project, including the intent to begin the Operations Phase, at least sixty (60) days prior to any such change.		The licence should distinguish between the two phases of Operations: the ERP Phase (3.5 Mt/a) vs. the Full Operations Phase (18 + 3.5 Mt/a). Additionally, it is unclear whether a change in development or condition would include the creation of a mine pit. AANDC recommends that notification be required prior to the creation of a mine pit and that any change in development (particularly the creation of a mine pit and commencement of full (rail haul) operations) is prohibited until all the required information is submitted to the NWB for review and approval.	Baffinland disagrees. Baffinland has approval to build, operate and close the Mary River Project. Mining of deposit # 1 has commenced and notification to the board has occurred. The Type A Licence already incorporates several mechanisms to notify the NWB as required regarding any changes in development plans (refer to Part G of the Licence - submission of drawing prior to construction, update of management plans and AEMP, annual update of closure plan and security, annual report). Furthermore, as development of pit #1 advances and a pit is formed, the Waste Rock Management Plan will be updated regularly as well as the AEMP.
Part C, Item 2	Where the Licensee files evidence, in writing with the Board and with notice to the Minister and the Qikiqtani Inuit Association that the Licensee has furnished and maintained security with the Qikiqtani Inuit Association in an amount that the Qikiqtani Inuit Association confirms is sufficient to secure the mine closure and reclamation costs (including cumulative and legacy liabilities) estimated for the upcoming year to be required for the portion of the Project located on Inuit-owned lands, the Board may reduce the amount of security required to be held under Part C, Item 1...	Where the Licensee files evidence, in writing with the Board and with notice to the Minister and the Qikiqtani Inuit Association that the Licensee has furnished and maintained security with the **landowner** in an amount that the **landowner** confirms is sufficient to secure the mine closure and reclamation costs (including cumulative and legacy liabilities) estimated for the upcoming year to be required for the portion of the Project located on Inuitowned lands **and/or Crown land**, the Board may reduce the amount of security required to be held under Part C, Item 1...	It should be noted that AANDC Land Administration Division may require financial security under Crown land leases. The proposed updates would be inclusive of both landowners. AANDC notes that the total financial security amount may be reduced in accordance with Schedule C, Items 7 and 9.	No comment

AANDC Appendix 2: Comments on Proposed Updates to Terms and Conditions (T&C) of Water Licence 2AM-MRY1325				
T&C	**Existing T&C**	**Suggested Updates to T&C**	**AANDC Comment**	**Baffinland Response**
Part D, Item 13	The Licensee shall use fill material for construction from approved sources that been demonstrated by appropriate geochemical analyses to not produce Acid Rock Drainage and to be Metal Leaching properties.	The Licensee shall use fill material for construction from approved sources that **has** been demonstrated by appropriate geochemical analyses to not produce Acid Rock Drainage and to be **non**-Metal Leaching.	AANDC proposes a change to what is considered to be a typo in the licence.	No comment
Part E, Items 3 and 4	Water use limits for Domestic and Industrial Purposes during the Construction Phase and Operations Phase, respectively.		Part E, Items 3 and 4 establish water use limits during Construction and Operation Phases, respectively. A new term and condition indicating source-specific water use limits during ERP are recommended.	Baffinland does not believe this is required. All the potential sources have been identified as well as limits to the amount drawn from each source has to abide by DFO guidelines.
Part E, Item 5; Schedule A	The Licensee may recycle water and use reclaimed water from the various Treatment Facilities, surface water management ponds and embankment dams and approved discharge locations under the licence if such waters meet appropriate discharge criteria for those facilities.	The Licensee may recycle water and use reclaimed water from the various Treatment Facilities, surface water management ponds and embankment dams and approved discharge locations under the licence if such waters meet appropriate discharge criteria for those facilities **and is of appropriate quality for the intended recycled use.**	A definition for “Recycled Water” and/or “Reclaimed Water” is recommended in the amended water licence.	Baffinland would like to seek clarification as to why this is required.
Part E, Item 9	The Licensee shall notify the Inspector and the Board at least ten (10) days in advance of using water from any sources not identified in the Application as required approval as per Part E, Item 8.		As written, this term and condition is unclear. Notification and approval should be provided in advance of using water from any sources not identified in the Application (exception being for emergency purposes). Item 8 (referenced in this term and condition) requires approval to use streams as a water source but Item 9 includes any water source and thus should not be limited to only streams.	This condition is good as is. This condition was provided by the NWB in recognition of the need for flexibility for the construction requirements for the railway service road, embankment and bridges, and, Steensby infrastructure. It is difficult to predict with precision where all the water draw points will be for this portion of the work.

AANDC Appendix 2: Comments on Proposed Updates to Terms and Conditions (T&C) of Water Licence 2AM-MRY1325				
T&C	**Existing T&C**	**Suggested Updates to T&C**	**AANDC Comment**	**Baffinland Response**
Part F, Item 3	The Licensee shall provide a revised Waste Rock Management Plan that takes into consideration for this and future revisions under this Licence, the following: a. Updates to the on-going Waste Rock Characterization Program (including the further refinement of acid rock drainage and metal leaching aspects of the foot wall and hanging wall; b. Any additional details on the segregation of potentially acid generating waste rock; c. Update to the geochemical modeling; d. Update on pit water quality predictions; e. Results of ongoing humidity cell kinetic testwork; f. The incorporation of on-site test pile program results with respect to ARD/ML and impacts to modeling results; and g. Waste Rock Storage Facilities with consideration for climate change.		AANDC notes that there is no timeline associated with the requirement to provide the information or linkages to any project development stage.	These conditions apply for the life of the Project. Updates are or will be provided either on an annual basis (as part of the annual report), or as required.
Part F, Item 21, Table 6; Part F, Item 23, Table 8; Part F, Item 24, Table 9	Effluent discharge quality limits for oil water treatment facilities, bulk fuel storage facilities, and landfarm facilities.		AANDC notes that the effluent discharge quality limits for lead is more stringent in Table 8 (1ug/L) in Part F, Item 23 for the bulk fuel storage facilities and Table 9 (0.001 mg/L) in Part F, Item 24 for the landfarm facilities than in Table 6 (0.2 mg/L) for oily water treatment facilities.	No comment
Part F, Item 26	All discharge from the Ponds associated with the Run of Mine Ore Stockpile, Ore Stockpile, West and East Sediment Ponds…shall not exceed the Effluent quality limits of Part F, Item 25.	All discharge from the Ponds associated with the Run of Mine Ore Stockpile, Ore Stockpile, West and East Sediment Ponds, **Milne Port Ore Stockpile Ponds**…shall not exceed the Effluent quality limits of Part F, Item 25.	It is unclear whether this term and condition will apply to the ore stockpile ponds at Milne Port.	No comment

AANDC Appendix 2: Comments on Proposed Updates to Terms and Conditions (T&C) of Water Licence 2AM-MRY1325				
T&C	**Existing T&C**	**Suggested Updates to T&C**	**AANDC Comment**	**Baffinland Response**
Part I, Items 7 and 8	The Licence requires the Licensee to provide GPS co-ordinates of all locations where water is used and wastes are deposited but no datum source is required.		To ensure consistency, it is recommended that the Licence either specify the datum (i.e. NAD83) to be used or require the Licensee to specify the datum when submitting GPS-coordinates.	No comment
Part I, Item 22; Schedule B	The Licensee shall establish additional Monitoring Stations, as may be required, to effectively and adequately monitor surface runoff from the Mary River Project site(s) or discharge from Site Drainage and Surface Water Management System water associated with the Mary River Project. Within thirty (30) days of establishment of additional Monitoring Stations, the Licensee shall inform the Board and the Inspector.		Part I, Item 22 requires notification to the Board and Inspectors prior to establishment of additional monitoring stations. However, there is no requirement to provide such information in reports or updated plans. AANDC recommends that any additional monitoring stations be included in monthly and annual reports.	No comment
Part J, Item 3	The Licensee shall, on an annual basis, provide an annual work plan and updated estimate of anticipated mine closure and reclamation costs for the upcoming year shall in accordance with the requirements of Schedule J.		Part J, Item 3 requires the Licensee to provide a Work Plan but approval of the plan by the Board is not required. Considering that the financial security for the Mary River Project is based on the annual work plans, approval by the Board should be required under this Part so that it is enforceable.	Baffinland disagrees. The annual work plan is determined by the company based on construction and operational requirements. Agreement on the security to be posted is at the discretion of the Board.
Part J, Item 13	The Licensee shall notify the Board in writing, at least sixty (60) days prior to entering into a Care and Maintenance Phase.	The Licensee shall notify the Board in writing, at least sixty (60) days prior to entering into a Care and Maintenance Phase. **This notice shall include revised management plans, an updated reclamation cost estimate, and a schedule for anticipated activities.**	Part J, Item 13 requires 60 day notification prior to entering into Care and Maintenance but it does not indicate what the notification should include.	Part J, items 14 requires the Proponent to submit a Care and maintenance Plan for approval by the NWB. Baffinland would like to seek clarification on the concern that AADNC has with this existing condition?

AANDC Appendix 2: Comments on Proposed Updates to Terms and Conditions (T&C) of Water Licence 2AM-MRY1325				
T&C	**Existing T&C**	**Suggested Updates to T&C**	**AANDC Comment**	**Baffinland Response**
Part J, Item 14	Within thirty (30) days of the Licensee providing the Board with notification of the Licensee's intention to enter into Care and Maintenance, the Licensee shall provide the Board with a Care and Maintenance Plan that details the Licensee's plans for maintaining compliance with the Terms and Conditions of the Licence.		Part J, Item 14 requires the Licensee to submit a Care and Maintenance Plan. AANDC requests that interested parties are provided an opportunity to comment on the Care and Maintenance Plan prior to approval. It is also recommended that the Care and Maintenance Plan be consistent with the Mine Site Reclamation Guidelines for the Northwest Territories (INAC, 2007) as may be amended from time to time.	Baffinland notes that all information transmitted to the Board is posted on the NWB's public website. It is also Baffinland's understanding that interested parties (including AANDC) can comment on this information at any time. Furthermore, as a "land owner", AANDC and QIA hold the security deposit for closure and reclamation activities. The current Interim Mine Closure and Reclamation Plan for the Project prepared in accordance with Mine Site Reclamation Guidelines for the Northwest Territories (2013), the Qikiqtani Inuit Association (QIA) Abandonment and Reclamation Policy for Inuit Owned Lands (Version 3.0, 2013) and other relevant guidelines, contains a section that deals with temporary and long term care and maintenance. Baffinland does not understand the concern of AANDC on this point.
Schedule A	"Operations Phase" means the set of activities associated with mining, crushing, screening and transportation of the ore generated by the Mary River Project excluding the construction and decommissioning phases;		The definition for "Operation Phase" is too broad as it includes both ERP and Full Operations. AANDC recommends a separate definition for the ERP Operations Phase (3.5 Mt/a) and a modified definition that is appropriate for the Full Operations Phase (21 Mt/a).	No comment
Schedule A	"Care and Maintenance" in respect of a mine, means the status of the facility when the Licensee ceases production or commercial operation temporarily for an undefined period of time;	"Care and Maintenance" is a term to describe the status of a mine when it undergoes a temporary closure, with the intent to resume mining activities in the future. Temporary closures can last for a period of weeks, or for several years, based on economical, environmental, political, or social factors. Temporary closure activities must maintain all operating facilities necessary to protect humans, wildlife, and the environment.	AANDC recommends that the definition for "Care and Maintenance" be updated to be consistent with the Mine Site Reclamation Guidelines for the Northwest Territories (INAC, 2007).	No comment

AANDC Appendix 2: Comments on Proposed Updates to Terms and Conditions (T&C) of Water Licence 2AM-MRY1325				
T&C	**Existing T&C**	**Suggested Updates to T&C**	**AANDC Comment**	**Baffinland Response**
Schedule C	Timing, Evidence and Process for the ASR		The existing ASR process does not allow time for parties to review the Licensee's ASR submission prior to filing with the Board information that supports an increase, maintenance, or reduction to the total financial security and as a result, AANDC has requested for two consecutive years, that the Board modify the ASR process. AANDC recommends that this section (Items 1-5) in Schedule C be reviewed and modified by the Board to allow interested parties to review the work plan and cost estimate prior to submitting comments and recommendations. A written submission, followed by a response by the Licensee is recommended prior to the ASR teleconference to increase the effectiveness and efficiency of the ASR.	Given that all parties participated in the development of the ASR process in 2013. Baffinland believes that more than 1 month should provide reviewers enough time for their review. With regards to a written response from the licencee, a discussion could be had to understand what AANDC has in mind for timelines. It should be noted that water the Commercial Lease between Baffinland and the Qikiqtani Inuit Association there are set timelines that need to be followed. IF there is a concern regarding the ASR process and groups feel there needs to be a change, it should involve all stakeholders. All are involved in the ASR process, so Baffinland suggests that a discussion be held there.
Schedule I	Conditions Applying to General and Aquatics Effects Monitoring		AANDC notes that the monitoring program will need to be adjusted to include new monitoring sites associated with ERP activities.	No comment

Technical Comments Regarding Amendment to NWB Type A Water License 2AM-MRY1325	
Comment	**Response**
Environment Canada	
In the application Baffinland has proposed an increase in the licence term from 12 to 25 years. Environment Canada is however, of the opinion that the current term (12 years) is appropriate as it will allow sufficient time for monitoring to inform the licence renewal process. Further, Environment Canada is in agreement with the reasoning presented in the NWB's June 2013 Reasons for Decision report which indicated that a term of 12 years provided a reasonable balance between investor interests and the uncertainties related to operational conditions and the lack of site specific data. Environment Canada therefore recommends that the existing term of 12 years remain unchanged.	Baffinland agrees.
With regard to the format of the TM and PHC: Environment Canada recommends that the TM and PHC be held either in writing or by teleconference.	Baffinland supports this recommendation.

Appendix B:

Knight Piésold: Document NB102-00181/10-1, Rev 0, Bulk Sampling Program – Road Upgrade Design Summary.

ISO 9001:2000
FS 87377

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

BULK SAMPLING PROGRAM
ROAD UPGRADE DESIGN SUMMARY
(REF. NO. NB102-00181/10-1)

Rev. No.	Revision	Date	Approved
0	Issued in Final	July 13, 2007	

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BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

BULK SAMPLING PROGRAM
ROAD UPGRADE DESIGN SUMMARY
(REF. NO. NB102-00181/10-1)

EXECUTIVE SUMMARY

Baffinland is currently undertaking advanced exploration at the Mary River Project site, consisting of delineation drilling of the iron ore deposit. Baffinland is also proposing to undertake a bulk sampling program in 2007 and 2008, extracting 250,000 t of iron ore from two small open pits from Deposit No. 1 to prove the marketability of the Mary River Project ore and secure long term customers. This report presents the design for the upgrades to the existing Tote Road to allow haulage of the bulk sample from the Mary River deposit to Milne Inlet.

The main milestone dates for the bulk sampling program are as follows:

- November/December 2006 - Submit Environmental Screening Document and Permit Applications
- May 2007 - Screening completed
- July 2007 - Permits issued, begin road and airstrip upgrades
- August 2007 - Mobilize camp and equipment for bulk sample
- November 2007 - Camp and infrastructure constructed, bulk sampling begins
- May 2008 - Mining of bulk sampling completed
- January 2008 - Start haulage of ore to Milne Inlet
- August/September 2008 - Ore loaded onto ships and delivered to market

Construction of the Bulk Sampling Road will require upgrades to an existing Tote Road. This road was established in the 1960's and is approximately 105 km in length from the exploration camp near Mary River to Milne Inlet. The road has been designated a public use road during the Nunavut Land Claims Agreement process and is found in the North Baffin Land Use Plan as such. Upgrades to the Tote Road will include road bed improvements, road widening and installation of drainage crossings along the route.

Site investigations completed in 2006 included a field reconnaissance program to identify all potential drainage crossings, document existing road conditions and identify potential borrow sources. The general findings of these investigations are summarized as follows:

- Four categories of frost/thaw susceptibility were identified to delineate the road bed foundations including Non Susceptible, Potentially Susceptible, Moderately Susceptible and Highly Susceptible.
- Approximately 247 drainages were identified where water crossings may be required. The crossings were categorized as Extra-Small, Small, Medium, Large and Extra-Large.

- Three significant areas of granular material were identified and have been called the Milne Inlet Borrow Area, the Mid-way Camp Borrow Area and the Mary River Borrow Area.

The upgrades to the existing Tote Road will be completed so that the upgraded road will be capable of handling single lane truck traffic for a period of approximately 1 year. During mining of the bulk sample, ore will be transported from the bulk sample pits on Deposit No. 1 along a 7 km haul road for crushing and stockpiling at the Mary River Site. The ore will be transported to Milne Inlet using a fleet of conventional highway tri-axle trucks with pup trailers. It is expected that approximately 6,000 to 7,000 truck loads will be required to haul the 250,000 t of bulk sample to Milne Inlet.

A series of typical road structure (fill) sections have been designed to address the various foundation conditions present along the road alignment. Fill placement will be completed to form an 8 m wide roadbed of various thicknesses depending on the frost/thaw susceptibility of the underlying foundation soils previously identified and encountered at the time of construction.

The Bulk Sampling Road drainage crossings require culverts and other structures at the Small through Extra-Large crossing locations to safely pass the specified design storm event. In lieu of established design criteria for Nunavut, the design requirements for hydrology provided in the Ontario Ministry of Natural Resources document “Guidelines and Criteria for Approvals - Under the Lakes and Rivers Improvement Act” (LRIA) have been implemented as a guide for this project.

Based on the initial investigations, a minimum of 73 drainage crossings will require installation of structures to pass runoff flows (Small, Medium, Large and Extra-Large category crossings). Corrugated steel culvert pipes will be used for 69 of these crossings. Modified sea containers will be used for the four Extra-Large crossings (three of the Extra-Large crossings will use corrugated steel culvert pipes along with the sea containers). Many of the crossings will require multiple culvert installations in order to provide the required capacity to pass the design flows. Some of the crossings will also be constructed with a lower elevation “overflow swale” to allow controlled overtopping of the crossing during higher runoff events.

Scheduling of construction (i.e. work fronts) will be dependent on available access across more significant drainages, prioritization due to foundation requirements and coordination with environmental or archaeological requirements of the construction program.

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

BULK SAMPLING PROGRAM
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SECTION 1.0 - INTRODUCTION

1.1 PROJECT BACKGROUND

Baffinland Iron Mines Corporation (Baffinland) is planning to develop its Mary River iron ore deposits in the North Baffin region of Nunavut, Canada. The location of the Mary River Project (the Project) is shown on Figure 1.1. Site coordinates are approximately Latitude 71°20' north and Longitude 79°14' west. The nearest settlement is Mittimatalik (Pond Inlet) which lies on the coast 160 km to the north of the site.

Exploration activities during the 1960's involved construction of three gravel airstrips, the 105 km Milne Inlet Tote Road (Tote Road), site access roads, and buildings at both the exploration site and at Milne Inlet.

Baffinland is currently undertaking advanced exploration at the Mary River Project site, consisting of delineation drilling of the iron ore deposit. Baffinland started mineral exploration activities at the Mary River Project in 2004.

1.2 BULK SAMPLING PROGRAM

Baffinland has been undertaking industry standard testing of its iron ore from Deposit No. 1, utilizing the services of specialized laboratories. This test work is provided to potential customers. However, each ore is unique and each blast furnace operates with a unique mixture of ores, pellets and sinter feeds. Therefore, a "production-scale" test of the ore in blast furnaces is required.

Traditionally, steelmakers operating blast furnaces require a relatively low risk source of consistent ore, over a relatively long period of time, typically 10 years or more. In order to prove the marketability of the Mary River Project ore and secure long term customers, Baffinland is proposing to undertake a bulk sampling program in 2007 and 2008, extracting 250,000 t of iron ore from two small open pits from Deposit No. 1. The material from the Bulk Sampling Program will be provided to potential customers.

The bulk sampling program will also allow other key parameters associated with future mining at the Mary River Project to be defined. The moisture content of crushed ore and the proportion of lump ore compared to fine ore after crushing and transporting are key components associated with the value of the ore. The effect of crushing and transporting the bulk sample under the typical weather conditions experienced at the site will be monitored and these key variables will be measured in order to increase confidence in estimates of transportation costs and sales revenues.

A public access easement for the purpose of transportation exists for the Tote Road between Milne Inlet and the Mary River deposits and is part (Schedule 21-2) of the "Agreement between the Inuit of the Nunavut settlement area and Her Majesty the Queen in right of Canada", signed May 25, 1993. This agreement ensures that access to the corridor is unimpeded and that rents or leases on the corridor cannot be imposed by governments or other groups.

The bulk sampling program will involve upgrades to the existing Tote Road to support haul truck traffic, and construction of a larger camp to support the program. An ore stockpile will be required at Milne Inlet and in August 2008 the ore will be loaded on ships for transport to steel mills in Europe.

1.3 PROJECT SCHEDULE

The main milestone dates for the bulk sampling program are as follows:

- November/December 2006 - Submit Environmental Screening Document and Permit Applications
- May 2007 - Screening completed
- July 2007 - Permits issued, begin road and airstrip upgrades
- August 2007 - Mobilize camp and equipment for bulk sample
- November 2007 - Camp and infrastructure constructed, bulk sampling begins
- May 2008 - Mining of bulk sampling completed
- January 2008 - Start haulage of ore to Milne Inlet
- August/September 2008 - Ore loaded onto ships and delivered to market

Due to the limited construction season and large scope it is anticipated that construction of the road upgrades will be completed progressively up to the time of bulk sample haulage.

1.4 SCOPE OF REPORT

This report presents the design for the upgrades to the existing Tote Road to allow haulage of the bulk sample from the Mary River deposit to Milne Inlet. The report outlines the required upgrades to the road structure and the drainage crossings. The "Extra-Small" category drainage crossings are not included as these can be managed through general road maintenance.

SECTION 2.0 - EXISTING TOTE ROAD

The existing Tote Road connects Milne Inlet to the Mary River Project site and consists of a track levelled over the natural ground surface. This road was established in the 1960's and is approximately 105 km in length from the exploration camp near Mary River to Milne Inlet. The road has been designated a public use road during the Nunavut Land Claims Agreement process and is found in the North Baffin Land Use Plan as such. The existing Tote Road alignment is shown on Drawing No. 100. Baffinland currently has land use permits that allow for seasonal use as a winter road along this transportation corridor from March to May.

The alignment of the road appears to have been historically selected through ease of access at the time of original construction. A plan view of the existing road alignment showing station markers is provided on Drawing No. 300. Features such as drainage channels, hydrologic systems, slope stability, underlying geology, and the preservation of aquatic flora and fauna do not appear to have been taken into consideration during selection of the road alignment. The existing Tote Road is often aligned parallel and in close proximity to major drainage channels. In many places it is eroded and carved with gullies from runoff. Many stream crossings have make-shift culverts constructed of old barrels, and many of these have caved in or have been washed downstream.

Baffinland intends to upgrade the existing Tote Road as part of the proposed bulk sampling program. The upgrades require the road to be widened to allow for the unimpeded passage of haul trucks. Upgrades to the stream crossings are also required, involving the installation of culverts and several larger structures. Larger crossings may be constructed using reinforced shipping containers as large flow capacity culverts, structurally capable of handling the traffic loading. The advantage of these over bridges or conventional culverts is their ease of installation and removal and their multiple uses (shipping and culverts). Installation of culverts and other structures would be carried out as required to satisfy both the haulage requirements of the bulk sample, and to minimize impacts to the surrounding environment and fish habitat.

SECTION 3.0 - SUMMARY OF RECENT INVESTIGATIONS

3.1 GENERAL

An initial review of the existing Tote Road was completed in June/July 2006 by Knight Piésold as part of the planned bulk sampling program. A second review was completed in June/July 2007 by Knight Piésold to refine the initial foundation assessment. The field reviews involved reconnaissance of the road alignment, initially by helicopter, followed by traversing the entire route by All Terrain Vehicle (ATV) and foot. The preliminary site investigations were also completed to identify all potential drainage crossings, document existing road conditions and identify potential borrow sources. The results of the initial investigation are provided in the Knight Piésold report entitled "Bulk Sampling Program Tote Road Investigations Summary" (Ref. No. NB102-00181/6, Rev. 0) dated October 13, 2006. The following sections discuss the information obtained from the investigations.

3.2 DRAINAGE CROSSINGS INVESTIGATION

The drainage paths along the Tote Road were identified where water crossings may be required. The drainage crossings are summarized below:

- Approximately 247 drainages were identified where water crossings may be required
- Crossings were categorized into five main categories based on catchment area, geometry and estimated peak flows: Extra-Small, Small, Medium, Large and Extra-Large
- A significant number of drainages (Extra-Small) are ephemeral, and for much of the year maintenance should not be of major concern. Small culverts should be installed for these as required during construction and operations of the road.
- Small through Extra-Large drainage crossings (73) require structures to pass the design flows. Culverts, or a composite culvert and overflow swale arrangement, are proposed for the majority of these crossings (i.e. Small to Large). However, a system using reinforced sea containers, culverts and overflow swales is proposed for the Extra-Large drainage crossings due to the significant design flows. Data sheets for the Extra-Large crossing locations are provided in Appendix A.

3.3 EXISTING ROAD CONDITION INVESTIGATION

The existing foundation conditions along the Tote Road were identified and documented during the 2006 and 2007 reviews. The foundation information is shown on Table 3.1 and summarized below:

- Four categories of frost/thaw susceptibility were selected to delineate the road bed foundations from the investigations. The categories and the associated approximate road embankment thickness requirements to produce stable foundation during all seasons are summarized as follows:

Non Susceptible - This foundation condition is expected to require minimal road embankment construction and will likely consist of only grading and surfacing. Approximately 27.5 km of the road alignment was identified with this foundation condition.

Potentially Susceptible - This foundation condition is expected to require up to 0.3 m of road embankment construction. Approximately 37.5 km of the road alignment was identified with this foundation condition.

Moderately Susceptible - This foundation condition is expected to require up to 0.6 m of road embankment construction. Approximately 12.5 km of the road alignment was identified with this foundation condition.

Highly Susceptible - This foundation condition is expected to require up to 1 m of road embankment construction. Approximately 27.5 km of the road alignment was identified with this foundation condition.

Proper supervision and design modifications based on the foundation materials encountered during construction will be an important and integral part of the road upgrades.

3.4 BORROW SOURCES INVESTIGATION

In June/July 2006, during the road and drainage crossings investigations, a borrow sources investigation was completed. The following summarizes the findings of this investigation.

The investigations showed that the availability of borrow sources along the road alignment was limited and sporadic. Three significant areas of suitable material were identified as the Milne Inlet Borrow Area, the Mid-way Camp Borrow Area and the Mary River Borrow Area. Plans for each of the borrow source locations are provided on Drawing Nos. 200, 201 and 202, respectively. Photo summary sheets for the three areas, including photos of selected test pits, are provided in Appendix B.

Samples collected during the investigation were tested for index geotechnical properties to determine their suitability as road construction material. A summary of the samples collected is provided on Table 3.2. Tests for moisture content and grain size were carried out in the Knight Piésold soils lab at the Mary River exploration camp. The results of the testing are presented on Table 3.3. The gradation results for all samples tested are provided on Figure 3.1. Gradation results for the Milne Inlet, Mid-way Camp and Mary River Borrow Areas are shown on Figures 3.2, 3.3 and 3.4, respectively.

Descriptions of the materials encountered at each of the borrow locations are as follows:

Milne Inlet Borrow Area - dry to damp, coarse sand and gravel ranging to coarse to medium grained sand some gravel. There was negligible silt size material in the samples tested from this area. Trace cobbles and boulders were also noted in this area.

Mid-Way Camp Borrow Area - dry, gravel and coarse sand ranging to medium grained sand with trace gravel and trace silt. Up to 15 percent cobbles with minor occurrences of boulders were also noted in the area.

Mary River Camp Borrow Area - very dry to damp, coarse gravel and well graded sand to fine sand. Trace cobbles were also noted in this area.

The primary deposits generally range from clean poorly graded fine sand to well graded sand and gravel with minor cobbles. There appears to be no continuity and consistency that would indicate a predictable trend in the origin and location of this material; a deposit in one location will vary significantly from another only a few hundred metres away. The area, and hence size of these potential deposits as indicated on the figures, has been determined by aerial photo interpretation and ground-truthing and is therefore only approximate in nature.

The borrow deposits were not drilled, so the total depth of overburden, the depth to permafrost and ice content at depth were not determined. However, each of the primary areas represents significant areas of glaciofluvial deposits, indicating that there should be sufficient fill material to supply the estimated 400,000 to 600,000 m^3 required for completion of the road upgrades.

Other smaller potential deposits were encountered at various locations along the road alignment and are generally identified in discrete lenses of highly variable spatial continuity and consistency. Local deposits of suitable material along the road alignment will be preferentially used in compliance with the quarry concessions (i.e. permits).

SECTION 4.0 - DESIGN SUMMARY

4.1 GENERAL

The upgrades to the existing Tote Road will be completed so that the upgraded road will be capable of handling haul truck traffic for a period of approximately 1 year. During mining of the bulk sample, ore will be transported from the bulk sample pits on Deposit No. 1 along a 7 km haul road for crushing and stockpiling at the Mary River Site. The ore will be transported to Milne Inlet using a fleet of conventional highway tri-axle trucks with pup trailers. It is expected that approximately 6,000 to 7,000 truck loads will be required to haul the 250,000 t of bulk sample to Milne Inlet.

4.2 DESIGN CRITERIA

4.2.1 Road Design

A detailed geometric design has not been completed for the road alignment at this time, however the following general criteria will be used for construction of the road embankment upgrades:

Design Vehicle - The vehicle expected to be used for the haul between Mary River and Milne Inlet is a conventional highway tri-axle dump truck with a pup trailer. The maximum grade for this vehicle is 8%. The vehicle specifications are shown in Appendix C.

Road Geometry - The road will be widened from the existing approximately 5 m width to between 8 to 10 m to accommodate the truck traffic. Pullouts or passing areas (localized areas of road approximately 16 to 20 m wide) will be constructed at regular intervals to allow traffic to pass.

4.2.2 Drainage Crossing Design

The Bulk Sampling Road requires culverts and other structures to safely pass the specified design storm event for the various stream crossings. Contact with various government agencies for Nunavut did not disclose any established requirements regarding hydrology design (design storm or flood return periods) for temporary road construction. Therefore, in lieu of established design criteria for Nunavut, the design requirements for hydrology provided in the Ontario Ministry of Natural Resources document “Guidelines and Criteria for Approvals - Under the Lakes and Rivers Improvement Act” (LRIA) have been implemented as a guide for this project. The LRIA is an Ontario Government document used to regulate design flood return periods for various road types and water crossing sizes. Information presented in Section 5.7.3 “Design Flood Magnitudes” in the LRIA was used to establish the design return periods for each category of crossing. The design return period requirements as presented in the LRIA are provided on Table 4.1. The following presents the hydraulic design criteria (design return period) adopted for the Bulk Sampling Road based on the requirements presented in the LRIA:

Crossing Size (Category)	Design Storm Event Return Period (years)
Small	1 in 10
Medium	1 in 10
Large	1 in 25
Extra-Large	1 in 25

4.3 HYDROLOGY DESIGN

4.3.1 General

Baffin Island is one of the northernmost and coldest parts of Canada. The project area, which is situated towards the northern end of the Island, has a mean annual temperature of approximately -12 C and monthly average temperatures that are below -20 C from December to March and above freezing only from June through August, with an average high of 4.4 C in July. These extremely cold temperatures combined with permafrost ground conditions result in a short period of runoff typically occurring from late June to early September.

All drainage systems (with perhaps the exception of the very largest systems) freeze completely solid or are dry during the winter months. The drainage courses usually begin to flow in late May and peak in June or July with rising temperatures, rainfall and snowmelt, before dropping steadily through to early November when flows essentially cease. The peak runoff period is quite short and the volume of the annual hydrograph is low (relative to the rest of Canada) due the region's very low average annual precipitation of approximately 200 mm. The annual runoff coefficient is very high due to the low temperatures (low evaporation) and the ground conditions of permafrost (low infiltration) and minimal vegetative cover (low transpiration). The ground conditions are conducive to a very rapid basin runoff response, and peak flows are correspondingly quite large relative to rates of snowmelt and rainfall. Annual peak flows are due to snowmelt, rainfall, or rain and snowmelt, and most commonly occur in July, but may occur at any time during the non-freeze period. Flood water levels in the streams and rivers typically rise and fall very quickly.

Surface water is abundant and the region is plentiful with small lakes and streams. The mean annual runoff in the area is typically in the order of 10 l/s/km^2.

4.3.2 Peak Design Flows

The design of the drainage crossings for the bulk sampling haul road required the development of a peak flow model. The hydrologic data currently being collected in the project area are of very short duration and the rating curves for the various measurement

sites are not yet fully developed; therefore, the data are not appropriate for this application. Alternatively, long-term historical peak flow and extreme rainfall data collected by Environment Canada were used. These data were combined with an understanding of the hydrologic characteristics of the area, as described above, to develop a series of peak flow scaling equations. Each equation corresponds to a different return period (flood severity) and requires an input of drainage area to generate a design flow estimate. The return periods selected for the bulk sample road were 25-year (Extra-Large and Large crossings) and the 10-year (Medium and Small crossings) and are presented, as follows:

- $Q_{10} = 2.0 \times A^{0.76}$
- $Q_{25} = 2.6 \times A^{0.75}$

Where: Q = peak instantaneous flow in m^3/s
A = drainage area in km^2

These equations were developed according to a regional scaling model using linear moment (L-moment) statistics computed from the historical peak daily flow records for five WSC stations, as summarized on Table 4.2. The regional scaling plots for the mean and L-standard deviation are shown on Figure 4.1. The "least squares fit" equations for these plots are shown in red, and the upper envelope equations are shown in black. The upper envelope equations were selected for design purposes because of the requirement to incorporate a reasonable margin of error into a model based on such a limited dataset, and because the flood values produced with the envelope equations agree much more closely with those generated by rainfall runoff modelling using the IDF values summarized on Table 4.3 and on Figure 4.2.

Additionally, estimates of the L-coefficient of skewness (L-Cs) are also required for generating flood quantile values. The values shown on Table 4.2 indicate a wide range, with two of the five values negative. However, research at the University of BC (Cathcart, 2001) has indicated that the L-Cs may follow a similar scaling pattern to the L-Cv (ratio of the mean to the L-Stdev), given a large enough sample size, and that L-Cs values at any specific scale are often similar to, but slightly less than, that of the L-Cv. Given this information, and the understanding that higher L-Cs values correspond to higher design flows, it was considered prudent, yet reasonable, to use relatively high L-Cs values; therefore, L-Cs values were selected to be slightly less than their associated L-Cv values.

Statistical parameters for basin scales of 10 km^2 and 1,000 km^2 were determined to be:

For 10 km^2: $Q_{mean} = 3.3\ m^3/s$
L-Stdev = 0.84 m^3/s
L-Cv = 0.25
L-Cs = 0.20

For 1,000 km^2: Q_{mean} = 192 m^3/s
L-Stdev = 35 m^3/s
L-Cv = 0.18
L-Cs = 0.16

These parameters were then used to develop synthetic distributions of flood values at the two basin scales, and for this purpose a generalized extreme value (GEV) distribution type was selected. The GEV is commonly used in Canada to model flood distributions and is found to consistently provide a reasonable, yet conservative, fit to measured data (Cathcart, 2001). The derived distributions provided peak daily flood estimates for different return periods at the two scales. These values were used to develop scaling equations for peak daily flows at different return periods.

For design purposes peak instantaneous values, rather than peak daily values, are required. The preceding discussion dealt with the estimation of peak daily flows, as there are not sufficient peak instantaneous regional data to develop meaningful scaling relationships. However, a limited number of concurrent peak daily and instantaneous flow data sets are available for the region, as summarized on Table 4.2. These values permitted the development of a regional envelope curve relating drainage areas to ratios of instantaneous to daily peak flow values, according to the equation:

- $I/D = 2.8 \times A^{-0.10}$

Where: I/D = ratio of instantaneous peak flow to daily flow
A = drainage area in km^2

Application of this equation to the peak daily flow estimates resulted in a series of design flood estimates at different scales, from which the design flow equations for required return were derived. These equations are considered applicable for basin areas ranging from 0.5 km^2 to 1,000 km^2.

4.4 HYDRAULIC DESIGN

The hydraulic design for the water crossings is discussed in the following sections and summarized on Tables 4.4 to 4.8.

4.4.1 Culverts

Culverts are required for the crossings classified as Small, Medium and Large, as well supplementing design flows for the sea containers at some of the Extra-Large crossings. The hydraulic capacity of individual culverts was determined by water flowing under inlet control, as presented in the “Handbook of Steel Drainage & Highway Construction”, with a ratio of the maximum upstream water level to culvert diameter of 2.0 (HW/D = 2.0). That is, for a culvert diameter equal to 1.0 m, the maximum upstream water level was restricted to 2.0 m at peak flows. The entrance loss coefficient (ke) was assigned a value of 0.9, for an

entrance projecting from fill condition. Multiple culverts are required at some crossings to satisfy the peak flow requirements. Adequate fill material will be required to provide sufficient cover over the culverts to satisfy wheel load restrictions and the HW/D requirement.

The hydraulic calculations for the culverts are summarized on Tables 4.5 to 4.8 for the Small, Medium, Large and Extra-Large water crossings, respectively.

4.4.2 Sea Containers

Sea containers are specified for the Extra-Large crossing locations because of their capacity to pass large flows and anticipated relative ease of installation. The hydraulic capacity of the sea containers was evaluated by applying engineering theories of open channel flow to the container profiles and dimensions. The exterior dimensions of the sea container selected for this application are 2.4 m wide x 2.9 m high x 6.1 m long (8' x 9.5' x 20'). Peak flows for each crossing were derived for the 25-year return storm.

The hydraulic capacity of each sea container was determined by considering the container as a rectangular open channel, with its flow conditions defined according to the equation:

$$HW = y_c + (1 + k_e)\frac{v_c^2}{2g}$$

Where: HW = upstream water level (m)
y_c = critical flow depth (m)
K_e = entrance loss coefficient
v_c = water flow critical velocity (m/s)
g = acceleration due to gravity (9.81 m/s^2)

The upstream water level was set below the container crown with freeboard (i.e. water depth <2.9 m), to prevent overtopping and corresponding potential wash out of the crossing. The flow depth in the sea container was also restricted to less than half the container depth to minimise the longitudinal drag forces from the water that could potentially cause the sea containers to move downstream. The entrance loss coefficient (ke) was assigned a value of 0.9, which corresponds to a culvert entrance projecting from fill, as specified in the "Handbook of Steel & Highway Construction Products" from the Corrugated Steel Pipe Institute.

Critical flow and critical depth were determined in accordance with equations presented in "Open-Channel Hydraulics," by Ven Te Chow, as follows:

$$y_c = \sqrt[3]{\frac{Q^2}{gb}}$$

Where: Q = water flow (m^3/s)
b = base width of flow area (m)

and,

$$v_c = \sqrt[3]{\frac{Qg}{b}}$$

The analysis found the flow capacity of each container to be approximately 10 m^3/s, with the following flow characteristics:

- Flow capacity of individual sea container 10 m^3/s
- Maximum Flow Velocity 3.4 m/s
- Height of sea container 2.9 m
- Upstream water level 2.4 m
- Freeboard from overtopping sea container 0.5 m

The flow capacity for the individual sea containers was used to determine the required number of containers for each of the Extra-Large crossings. The hydraulic calculations for the sea containers are summarized on Table 4.8 for the Extra-Large crossings.

4.4.3 Overflow Swales

Overflow swales were specified for conditions when the width of a crossing did not allow for sufficient culverts to pass the peak design flow. A swale is a lowered section of the road that is armoured against erosion and designed to allow water to pass over the road. This technique for water crossings can be referenced in the "Environmental Guide for Access Roads and Water Crossings" by the Ontario Ministry of Natural Resources. A swale is not designed to have water flowing through it year round, but rather is in place as a temporary measure for when flows are unusually high. Minor maintenance or repair work to the swales may be required in the event the design storm occurs.

The overflow swales were designed as spillways with the hydraulic capacity of a broad-crested weir, as defined by the equation:

$$Q = CLH^{1.5}$$

Where: Q = water flow (m^3/s)
C = coefficient of discharge
L = length of swale (m)
H = height of water above spillway invert (m)

The coefficient of discharge (C) was assigned as 1.45 for a broad-crested weir with breadth larger than 4.5 m, as presented in the "Standard Handbook for Civil Engineers" (Frederick S. Merritt, Editor).

The geometric shape of the swales is trapezoidal. The minimum dimensions to allow easy and unimpeded access for the haul trucks are a length of 4.0 m and side slopes of 3H:1V, when the depth of swale is approximately 0.4 m or less, or 5H:1V, when the depth of swale is greater then 0.4 m.

The hydraulic calculations for the overflow swales are summarized on Tables 4.6 to 4.8 for the Medium, Large and Extra-Large water crossings, respectively.

4.5 SEA CONTAINER STRUCTURAL UPGRADES

Baffinland employed an independent consultant to provide the design and fabrication requirements for the modified sea containers for this project. Each modified sea container will be complete with guide railing and also connections on the front face to provide anchorage attachments. Rig mats will be used as decking to span over the top of the sea containers. The design drawings for the sea container culverts are shown in Appendix D

SECTION 5.0 - ROAD CONSTRUCTION

5.1 GENERAL

The road construction will involve two general components, the road structure (upgrading the existing Tote Road) and the drainage crossings. QA/QC and environmental protection will be significant for construction of all components. It is recommended that fulltime supervision be provided to ensure compliance with the design criteria and environmental standards.

5.2 BORROW AREA MANAGEMENT

Three borrow areas have been identified for use as fill material for the road structure and drainage crossings. The quantity of fill required is estimated to be approximately 400,000 m^3 to 600,000 m^3 and will be dependent on the foundation conditions encountered during construction.

Operation of the borrow areas for road and drainage crossing fill (i.e. granular materials) will involve shallow and broad stripping and stockpiling of the active layer during the summer months. During these months thawing of the underlying permafrost will allow easier excavation to greater depths. It is recommended that stockpiling of as much material as possible be carried out during the warmer months to take advantage of the thawed zones. During colder months (i.e. spring and winter), ripping and stockpiling of the material will be required using a bulldozer. Throughout borrow area operations, it is expected that some processing of materials may be required to meet the design specifications, including screening, crushing and sorting.

Two rock quarries located within the identified borrow areas may be developed for various construction purposes including rockfill or for use as rip-rap, etc. It is anticipated that this material will be obtained through drilling and blasting techniques, although ripping and mechanical excavation can be reviewed. Some processing of these materials will be required to meet the design specifications including crushing, screening and material sorting.

A borrow area management and erosion and sedimentation control plan will be implemented to protect the fill materials, the downstream receiving waters and to ensure ease of operation during construction. The plan will ensure the borrow areas are developed with due consideration for drainage and runoff from the excavated surfaces so as not to cause erosion of the adjacent terrain. The excavation will be completed as required to minimize water from collecting and standing in the borrow area. Following excavation from a borrow area, the sides of the borrow areas will be brought to stable slopes with slope intersections shaped to provide a natural appearance.

If organic material or topsoil exists over materials to be borrowed it will be stripped and stockpiled for future use in reclamation activities.

The total quantity of material used to construct the road will be determined by surveying the borrow areas before and after construction.

5.3 ROAD STRUCTURE

5.3.1 General

The upgraded Bulk Sampling Haul Road will extend from Deposit No. 1 to Mary River and on to Milne Inlet and will be approximately 105 km in length. Fill placement will be completed to form various required roadbed thicknesses depending on the frost/thaw susceptibility of the underlying foundation soils encountered at the time of construction. A preliminary classification of the route and estimated roadbed thicknesses was previously presented in the Knight Piésold report entitled "Bulk Sampling Program Tote Road Investigations Summary" (Ref. No. NB102-00181/6, Rev. 0). All fill will be placed in accordance with the requirements of the Technical Specifications, which will be provided under separate cover.

5.3.2 Foundation Preparation

Foundation preparation for the road bed will generally be limited to minor grading and levelling prior to placement of new fill. However, some areas may require excavation and removal of poor quality or frost susceptible soils or topsoil and organic material. The excavated material will be placed and levelled in areas of construction disturbance, preferably in the Borrow Areas.

5.3.3 Road Structure Fill

Fill will be obtained from the pre-established borrow areas. All fill materials should be reasonably well graded, have low ice/moisture content and be cohesionless non-frost susceptible soils.

The fill will be placed, spread, levelled and compacted according to the Technical Specifications.

Maintenance will be required following the thawing of the road fill materials. This may include regrading and recompaction of the road surface, placement of geosynthetics and/or excavation and reconstruction of portions of the road.

5.3.4 Road Typical Sections

A series of typical road sections have been designed to address the various foundation conditions present along the road alignment. The foundation classifications and recommended typical road sections are shown on Drawing No. 320 and summarized below, based on frost susceptibility:

- **Non Susceptible** - These materials are generally coarse in nature, primarily consisting of outwash or alluvial sand and gravel. It is anticipated that only minor fill will be required for road surfacing and grading. **Section A(150) shown on Drawing No. 320.**

- **Potentially Susceptible** - These materials have increased silt content. Often boulders and larger material present at surface. It is anticipated that less than 0.3 m of fill will be required over these areas. Potentially susceptible materials are also associated with wet areas on outwash type areas. **Section A(300) shown on Drawing No. 320.**
- **Moderately Susceptible** - These materials primarily consist of till with moderately high silt content. They are highly variable in nature, often with boulders and sorting of material at surface. It is anticipated that in the range of 0.3 to 0.6 m of fill will be required over these areas. **Section A(500) shown on Drawing No. 320.**
- **Highly Susceptible** - These materials have very high clay and silt content. They are often identified by patterned ground with pockets of pure clay, silt and very fine sands and/or wet organics. During thawing of the active layer, materials have little to no strength due to high pore pressures and slow rate of dissipation (drainage). It is anticipated that greater than 1 m of fill will be required over these areas. Geotextile, Geogrid or soil reinforcement, insulation or combination of these may be used to reduce fill along some of the more frost/thaw sensitive foundation areas of the road alignment. The insulation will be placed in accordance with standard procedures for this type of application. **Sections A(1000), B(1000) or C(1000) shown on Drawing No. 320.**

5.3.5 Quality Assurance and Quality Control

Representatives from Knight Piésold will oversee the Quality Assurance/Quality Control (QA/QC) program for the road upgrades on a full-time basis. The program will also include ongoing design modifications (field fitting) based on the foundation materials and drainage crossing spatial limitations encountered during construction. All design modifications will be tracked and reported.

Control testing will be carried out on fill materials from the borrow areas to assist with identification of suitable materials to be used in the work. Record testing of the placed fill will be carried out to document the quality of the completed work. Testing will include in situ density, moisture content, grain size and specific gravity determinations.

5.3.6 Construction Scheduling

Scheduling of construction, (i.e. work fronts) will be dependent on available access across more significant drainages, prioritization due to foundation requirements and coordination with any environmental or archaeological requirements of the construction program.

Construction scheduling will be a joint effort between the Contractor, the Engineer and Baffinland.

5.4 DRAINAGE CROSSINGS

5.4.1 General

The drainage crossings along the Bulk Sampling Road have been categorized as Extra-Small, Small, Medium, Large and Extra-Large. Table 4.4 presents the classification criteria that were used for each of the crossings. A minimum of 73 drainage crossings will require installation of structures to pass runoff flows during operation of the road and are applicable to the Small, Medium, Large and Extra-Large category crossings. Corrugated steel culvert pipes will be used for 69 of these crossings. Modified sea containers will be used for 4 of the crossings. Many of the crossings will require multiple culvert installations in order to provide the required capacity to pass the design flows. Some of the crossings will also be constructed with a lower elevation "overflow swale" or to allow controlled overtopping of the crossing during higher runoff events. These areas are expected to require repair and maintenance in the event of their use. Peak design flows were calculated as described in Section 4.3.2. The hydraulic capacities of the sea containers and culverts (as required) that are specified for each of the crossings were calculated with the methods described in Section 4.4.

5.4.2 Culvert and Sea Container Installation

All culvert pipes shall be installed as shown on the drawings according to the supplier's recommendations and Technical Specifications and in compliance with all applicable regulatory requirements. Foundation preparation for the culvert and sea container installations will generally involve grading, levelling and preparation of a compacted pad, consisting of well graded sand and gravel, onto which the structures will be installed. Some areas may require excavation and removal of poor quality materials as required by the Engineer.

The culverts currently at the site (and additional culverts shipped to the site) are assumed to be 6 m lengths. Therefore, installation will require couplers to connect multiple culverts to provide sufficient length to accommodate the road design width and cross-section. Culvert backfill will be placed and compacted in accordance with the Technical Specifications. Backfill around pipes (i.e. haunching, crown, etc) shall be carefully placed in thin lifts and compacted using hand compaction equipment to prevent damage to the pipes. All other fill material will be General Fill and shall be compacted using standard vibratory roller equipment.

Erosion protection measures may be required to protect the abutment fill at the major crossings. Geogrid Soil Reinforcement may be required to stabilize some of the higher abutments at the major crossings. Non-woven geotextile may also be used for the overflow swales to provide additional support and erosion protection during periods of the high flows. A site assessment by the contractor and site Engineer is recommended, prior to installations, to identify the stabilization requirements.

All culverts and sea containers will be installed in accordance with the fisheries authorizations. A minimum of one (1) culvert per crossing location will be embedded a maximum 10% of the diameter into the bed of the crossing to provide flow for fish passage during low flow conditions.

5.4.3 Extra-Small Crossings

A total of 174 drainage crossing locations are classified as Extra-Small. These drainages have a smaller catchment area and only experience intermittent flow during times of heavy runoff. No special construction will be completed at these crossings. These crossings will be maintained to ensure the stability of the road fill. Smaller diameter culverts (0.5 m diameter) may be required based on performance and maintenance requirements.

Details of CV077, the one Extra-Small crossing that was determined to be navigable by Transport Canada are shown on Figure 5.1.

5.4.4 Small Crossings

A total of 43 drainage crossings were classified as Small and the locations are shown on Drawing No. 410. The Small Crossings are further subdivided into two types as follows:

- Type Small-A Single Culvert
- Type Small-B Multiple Culverts
- Type Small-C Multiple Culverts with Multiple Diameters

Table 4.5 provides a summary of the structures required for each of the crossings including the number of culverts and dimensions. Typical design sections and details are provided on Drawing No. 411 for each type of Small crossing.

5.4.5 Medium Crossings

A total of 13 drainage crossings are classified as Medium and the locations are shown on Drawing No. 420. The Medium crossings are further subdivided into two types as follows:

- Type Medium-A Multiple Culverts
- Type Medium-B Single Culvert and Swale
- Type Medium-C Multiple Culverts and Swale

Table 4.6 provides a summary of the structures required for each of the crossings including the number of culverts and overflow swale dimensions. Typical design sections and details are provided on Drawing No. 421 for each type of Medium crossing.

5.4.6 Large Crossings

A total of 13 drainage crossings are classified as Large and the locations are shown on Drawing No. 430. The Large crossings are further subdivided into two types as follows:

- Type Large-A Single Culvert and Swale
- Type Large-B Multiple Culverts and Swale

Table 4.7 provides a summary of the structures required for each of the crossings including the number of culverts and overflow swale dimensions. Typical design sections and details are provided on Drawing No. 431 for each type of Large crossing.

Details of BG17, CV040, CV072, CV099 and CV129, the five Large crossings that were determined to be navigable by Transport Canada are shown on Figures 5.2 to 5.6.

5.4.7 Extra-Large Crossings

General

Four drainage crossings are classified as Extra-Large and are identified as Site Numbers CV128, BG50, CV217 and CV223. The locations of the Extra-Large crossings are shown on Drawing No. 440. Table 4.8 provides a summary of the structures required for each of the crossings including the number of sea containers, culverts and overflow swales. Plans and sections for each of the Extra-Large crossings are provided on Drawing Nos. 441 to 444 for Site Numbers CV128, BG50, CV217 and CV223, respectively.

Sea Containers

The structural upgrades and deck details for the modified sea containers to be used for the Extra-Large crossings have been designed and will be fabricated by an independent organization contracted by Baffinland. Knight Piésold has not been involved with the details of this design work.

Abutments and Approach Details

Abutments will be required at each approach to the Extra-Large drainage crossings to provide access for the haul trucks onto the rig mat situated over the modified sea containers. Design of the Bin Wall abutments has been completed with the assistance of Armtec, a supplier of this product. The Bin Walls were designed to function as gravity retaining walls with an additional uniform surcharge of 18 kPa to represent live loads exerted by the ore hauling trucks.

The abutments will consist of Armtec Design 'C' Bin Walls or approved equivalent. The Bin Walls require an allowable foundation bearing pressure of approximately 100 kPa and therefore an assessment of the site specific foundation materials will be required prior to

the installation. The maximum allowable height for this type of Bin Wall is 3,759 mm. Wall heights exceeding the above will increase the required allowable foundation bearing pressure. The actual Bin Wall height will be determined for each crossing abutment at the time of construction based on the geometry of the final crossing location. Backfill material to be placed immediately adjacent to and retained by the Bin Walls requires a free draining granular fill with a compacted unit weight of approximately 19 kN/m^3 and meeting Armtec material and compaction specifications. Technical Specifications and typical assembly drawings provided by Armtec are provided in Appendix E. Standard marine Bin Wall components are recommended with 2.0 mm minimum thickness for front stringers. Should ice forces be a concern additional protection of the front stringers with ice plates may be considered or this can be accomplished through the installation of adequate large boulder sized material. The bottom edge of the Bin Walls must be founded below potential scour elevations or otherwise protected by appropriate measures.

General details of the Bin Wall abutments for each of the crossings are provided on the drawings. Assembly, installation and backfill will be in accordance with the supplier's specifications.

The available freeboard below the top of the sea containers at peak flows is approximately 0.5 m. Based on this, the crest elevation of the road to be constructed for the approaches to the crossing abutments has been set at 0.3 m below the top of the sea containers. This will reduce the fill volume required for the road at each crossing site in addition to providing additional water discharge capacity, essentially acting as an overflow swale where controlled overtopping can occur to protect against washing out the sea container structures during flows exceeding the design. Road grades within the crossing have been assigned as 15H:1V to provide easy access for the haul trucks.

Anchorage

The sea containers will be anchored to stabilize the structures during periods of increased flow. The method of anchorage will include installation of Helical Anchors (screw piles) into the foundation soils directly adjacent to the upstream edge of the sea containers. A cable will be used to attach the screw pile to the connector loops to be provided on the front of the sea containers.

The type and size of the screw pile recommended for this application is the Chance SS200 Helical Pier/Anchor. Installation will require a high torque motor attached to a backhoe. Pre-drilled pilot holes may be required to install the screw piles into the permafrost, therefore it is recommended that a small drill be made available for pre-drilling. It is recommended that a test be completed at site to determine the ability to install these piles into the coarse grained frozen soils. Technical supplier information pertaining to the screw piles and their installation is provided in Appendix F. As previously stated, Knight Piésold understands that the sea containers will be fastened together in a minimum series of four (4). Therefore, the screw piles should be installed such that three (3) screw piles are

provided per set of four (4) connected sea containers. The actual locations will be dependent upon ground conditions and crossing geometry.

Connection of the screw piles to the sea containers will require a minimum 19 mm (3/4-inch) diameter aircraft cable. It is the understanding of Knight Piésold that adequate loops will be provided with the sea containers to allow this connection to be made. These may need to be welded to the sea containers at site based on the installation plan.

5.5 ENVIRONMENTAL PROTECTION

Environmental protection measures will be incorporated into all aspects of the construction to ensure that the environment and receiving waters are protected from contaminated runoff and increased sediment loadings. An environmental protection and monitoring plan will be prepared and must be adhered to throughout the work, including but not limited to the following:

- Borrow areas drainage, sediment control and post construction closure (i.e. slope regrading and stabilization)
- Sediment control during drainage crossing construction in areas with sensitive receiving waters
- Use of preset haulage routes to minimize impacts to the landscape
- Proper handling and storage of fuels, etc.
- Allowance in scheduling of work fronts for archaeological investigation and documentation

5.6 ARCHAEOLOGICAL/HERITAGE FEATURES

The Tote Road corridor has high archaeological potential based on existing knowledge and completed studies. Numerous archaeological sites were recorded during the 2006 survey along the existing road alignment.

Planned mitigation to address the known archaeological sites within close proximity of the Tote Road includes relocating the road slightly to avoid the sites within the 30 m buffer zone. Some sites may require temporary protection measures during construction. Deviations from the existing road alignment will be investigated by the archaeology team and cleared before construction begins.

At borrow source locations, project or contractor personnel will work with the archaeologists to identify areas suitable for excavation where no archaeological sites exist. The borrow areas are of sufficient size compared with the required sand and gravel volumes such that avoidance of archaeological sites should be possible.

If all options for avoidance of impacts to archaeological sites are exhausted, the archaeologists will assess and mitigate the sites. Should an archaeological site be discovered as work is undertaken, appropriate actions will be taken in accordance with the Territorial Land Use Regulations, including suspension of land use operations, and notification of the land use inspector and CLEY of the location of the site and nature of any unearthed materials, structures or artefacts.

SECTION 6.0 - RECOMMENDATIONS

The following recommendations are provided to assist with the construction of the Bulk Sampling Road:

- Proper supervision is recommended during the construction activities so that potential design modifications, based on the foundation materials encountered during construction, are implemented
- Scheduling of the work fronts and borrow operations should be carried out in consideration of drainage crossings flow conditions (i.e. equipment access) and environmental/archeological restrictions
- Continual reviews will be completed during construction to verify foundation types along the road alignment
- A site assessment by the Baffinland personnel, the contractor and the site Engineer is recommended at each of the more significant drainage crossings prior to installations of structures for crossings to optimize the final locations of the structures/installations and identify any required environmental protection and embankment stabilization requirements
- An assessment of the foundations materials for the Bin Wall Abutments is required to confirm the specified allowable bearing capacity
- Ongoing excavation and stockpiling of material in the borrow areas is recommended (i.e. during the warmer summer months) to take advantage of the thawed zones. Advance haulage of material to some of the crossing locations is also recommended, access permitted.
- Processing may be required in the borrow areas, consisting of material sorting, screening and/or crushing, to meet the design specifications for the road and drainage crossing installations
- A drill rig should be allotted to pre-drill pilot holes for installation of the screw pile anchorage for the sea containers if required. Also, sufficient cable and attachments should be provided to accommodate the screw pile installation location.
- Following construction, ongoing inspection, monitoring and maintenance of the road and drainage crossings will be required to ensure integrity over the course of operations
- Sea containers to be used at the Extra-Large drainage crossings are intended as temporary measures and should be removed following completion of the bulk sampling program. Medium and Large crossings may need to be assessed on an individual basis to determine the risks associated with leaving these in place for longer periods.

SECTION 7.0 - REFERENCES

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SECTION 8.0 - CERTIFICATION

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

Prepared by:

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

PERMIT TO PRACTICE
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Date JUL 13 2007
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The Association of Professional Engineers, Geologists and Geophysicists of NWT/NU

Reviewed by:

Steven R. Aiken, P.Eng.
Manager Environmental Services

Approved by:

Ken D. Embree, P.Eng.
Managing Director

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TABLE 3.1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

BULK SAMPLING PROGRAM - ROAD UPGRADE DESIGN SUMMARY

SUMMARY OF ROAD FOUNDATION CLASSIFICATIONS

From Station (km)	To Station (km)	Frost/Thaw Susceptibility	Distance (km)				Comments
			Non Susceptible	Potentially Susceptible	Moderately Susceptible	Highly Susceptible	
0.0	10.0	Non Susceptible	10				
10.0	12.5	Potentially Susceptible		2.5			
12.5	15.0	Highly Susceptible				2.5	
15.0	17.5	Potentially Susceptible		2.5			
17.5	22.5	Non Susceptible	5				
22.5	30.0	Potentially Susceptible		7.5			Potentially Susceptible or Wet Conditions
30.0	42.5	Highly Susceptible				12.5	
42.5	52.5	Potentially Susceptible		10			Potentially Susceptible or Wet Conditions
52.5	55.0	Moderately Susceptible			2.5		
55.0	57.5	Highly Susceptible				2.5	
57.5	60.0	Moderately Susceptible			2.5		
60.0	62.5	Non Susceptible	2.5				
62.5	72.5	Highly Susceptible				10.0	
72.5	80.0	Moderately Susceptible			7.5		
80.0	95.0	Potentially Susceptible		15			Potentially Susceptible or Wet Conditions
95.0	105.0	Non Susceptible	10				
			27.5	**37.5**	**12.5**	**27.5**	

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Note:
1. The road foundation classifications are approximate.

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TABLE 3.2

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

BULK SAMPLING PROGRAM - ROAD UPGRADE DESIGN SUMMARY

SUMMARY OF BORROW AREA SOIL SAMPLES COLLECTED

Sample ID	Northing (m)	Easting (m)
SC01	7,914,886	555,864
SC02	7,915,009	556,044
SC03	7,915,123	556,945
SC04	7,914,498	555,608
SC05	7,915,011	553,158
SC06	7,916,048	551,809
SC07	7,917,048	550,998
SC08	7,919,138	548,317
SC09	7,919,571	547,674
SC12	7,920,136	535,844
SC13	7,920,141	535,721
SC14	7,920,267	535,399
SC15	7,920,043	535,150
SC16	7,920,835	534,570
SC17	7,921,631	534,188
SC18	7,922,500	533,341
SC19	7,922,652	532,967
SC20	7,923,631	531,792
SC21	7,924,000	531,614
SC22	7,925,040	531,494
SC23	7,925,272	530,948
SC24	7,925,586	530,515
SC25	7,926,396	529,851
SC26	7,926,662	529,626
SC27	7,926,671	529,371
SC28	7,926,975	529,366
SC29	7,927,170	529,137
SC30	7,927,583	528,786
SC31	7,932,132	527,107
SC32	7,934,776	526,864
SC33	7,935,391	526,743
SC34	7,935,426	526,527
SC35	7,935,664	526,364
SC36	7,936,599	525,955
SC37	7,937,544	525,445
SC38	7,939,009	524,863
SC39	7,943,974	523,202
SC40	7,945,124	523,093
SC41	7,951,280	522,068
SC42	7,955,053	520,940
SC43	7,956,048	520,493
SC50	7,971,897	505,806
SC51	7,971,575	506,120
SC52	7,971,539	506,094
SC53	7,970,196	507,618
SC54	7,967,487	510,390
SC55	7,967,080	511,690
SC56	7,966,264	513,623
SC57	7,962,445	516,657
SC58	7,938,042	525,476
SC59	7,933,287	526,962
SC60	7,929,361	528,114
SC61	7,926,462	529,172
SC62	7,926,457	529,154
SC63	7,914,589	558,036
SC64	7,955,046	520,922
SC65	7,927,223	528,770
SC66	7,926,666	529,628
SC67	7,914,674	554,925

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12-Jul-07

Notes:

1. All sample locations were obtained using a handheld GPS and are presented in UTM NAD 83 coordinate system and in metres.
2. Samples were collected from ground surface.

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TABLE 3.3

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

BULK SAMPLING PROGRAM - ROAD UPGRADE DESIGN SUMMARY

SUMMARY OF LABORATORY TEST RESULTS FOR BORROW AREA SAMPLES

Sample ID	Moisture Content (%)	Specific Gravity	Grain Size		
			%Gravel	%Sand	%Silt and Clay
SC1	1.4		57.9	41.1	1.0
SC2	1.9		4.5	95.2	0.3
SC3	5.4		0.3	99.3	0.4
SC4	3.1		0.1	99.5	0.4
SC5	9.0		52.4	47.3	0.3
SC6	3.4		39.3	59.9	0.8
SC7	7.3		37.3	59.7	3.0
SC8	9.1		59.2	38.6	2.2
SC9	3.4		40.7	58.7	0.6
SC12	6.7		25.0	73.3	1.7
SC13	8.0		18.2	78.2	3.6
SC14	4.7		62.3	35.7	2.0
SC15	5.1		56.2	41.8	2.0
SC16	7.8		19.7	76.7	3.6
SC17	7.8		9.8	85.6	4.6
SC18	6.6		33.4	65.1	1.5
SC19	7.5		11.2	85.1	3.7
SC20	8.1		29.5	66.4	4.1
SC21	9.5		28.1	68.4	3.5
SC22	7.9		8.7	85.9	5.4
SC23	8.0		26.5	69.6	3.9
SC24	6.2			MISSING DATA	
SC25	3.8		11.4	87.8	0.8
SC26	3.0		8.0	91.5	0.5
SC27	3.2		35.4	63.6	1.0
SC28	3.1		47.5	48.9	3.6
SC29	3.9		56.3	38.9	4.8
SC30	3.9		1.8	96.9	1.3
SC31	4.7		29.2	66.6	4.2
SC32	3.9		55.3	39.7	5.0
SC33	5.1		47.1	43.0	9.9
SC34	5.0		5.3	89.1	5.6
SC35	4.0		31.2	62.7	6.1
SC36	3.4		47.2	49.8	3.0
SC37	4.0		49.0	37.4	13.6
SC38	5.6		57.5	26.0	16.5
SC39	4.3		52.1	35.7	12.2
SC40	3.9		45.1	35.1	19.8
SC41	4.2		14.1	83.9	2.0
SC42	4.7		30.3	64.8	4.9
SC43	3.3		42.4	54.2	3.4
SC50	3.1		33.2	65.5	1.3
SC51	4.2		6.7	92.9	0.4
SC52	N/A	2.65	48.8	50.9	0.3
SC53	3.5	2.68	37.4	62.2	0.4
SC54	6.5		12.6	75.3	12.1
SC55	4.0		3.3	96.3	0.4
SC56	3.0	2.65	57.6	40.8	1.6
SC57	3.1		47.1	50.0	2.9
SC58	3.1		18.6	81.0	0.4
SC59	3.9		48.2	49.7	2.1
SC60	3.2	2.69	0.2	99.2	0.6
SC61	2.5		51.0	47.4	1.6
SC62	3.1		0.8	97.8	1.4
SC63	3.1		20.9	78.0	1.1
SC64	3.7		23.3	74.9	1.8
SC65	3.4		1.7	98.0	0.3
SC66	2.5		10.6	89.0	0.4
SC67	3.3		3.2	96.6	0.2

I:\102-00181-6\Assignment\Report\Report 2, Rev. 0 - Bulk Sample Road Survey\Tables\[Tables 2.1 to 2.6.xls]Tab 2.1
12-Jul-07

Note:

1. All samples were tested in Mary River field lab during summer 2006 field programs.

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TABLE 4.1

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

BULK SAMPLING PROGRAM - ROAD UPGRADE DESIGN SUMMARY

LAKES AND RIVERS IMPROVEMENTS ACT
MINIMUM DESIGN FLOODS FOR ROAD CROSSINGS

Road Classification	Design Flood (see notes below)	
	Total Span (up to 6.0 m)	Total Span (over 6.0 m)
Freeways and Urban Arterial Roads	50 year	100 year or Regulatory Flood depending on local conditions
Rural Arterial and Collector Roads Local (may be paved)	25 year	50 year
Local (unpaved) Roads and Resource Access Roads	10 year	25 year
Temporary Detours	1 to 5 year	1 to 10 year

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Notes:

1. Total span is assumed as the sum of individual culvert or bridge openings.
2. The water surface for the design flood should not extend beyond the underside of the bridge or culvert, and should freeboard should be provided where there is potential for ice or debris blockage.
3. Debris blockage should be considered for all spans under 15 m. If grating is proposed at the entrance of a culvert, extra capacity is required to account for the blockage.
4. A 1 m freeboard is recommended for large bridges and culverts.
5. Potential scour of the streambed during floods should not be relied upon in assessing flood levels or bridge or culvert capacity.

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TABLE 4.2

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

BULK SAMPLING PROGRAM - ROAD UPGRADE DESIGN SUMMARY

REGIONAL FLOOD STATISTICS FOR DAILY AND INSTANTANEOUS PEAK FLOW RECORDS

Region	Station Name	WSC Data	Years of Record			Drainage Area (km^2)	Peak Daily Flows								Peak Instantaneous Flows							Ratio I/D
		Sta. ID	Begin - End	Daily	Instantaneous		mean (m^3/s)	unit mean ($m^3/s/km^2$)	Stdev (m^3/s)	Cv	Cs	L-Stdev (m^3/s)	L-Cv	L-Cs	mean (m^3/s)	Stdev (m^3/s)	Cv	Cs	L-Stdev (m^3/s)	L-Cv	L-Cs	mean
Baffin Island	Duval River near Pangnirtung	10UF001	1977-1983	2	5	95.5									26.24	10.74	0.41	0.08	6.68	0.26	0.07	1.68
	Sylvia Grinnell River near Iqaluit	10UH001	1971-1999	17	9	3980	361.23	0.09	130.48	0.36	-0.26	70.11	0.19	-0.03	422.11	119.75	0.28	0.48	69.86	0.17	0.08	1.10
	Apex River at Apex	10UH002	1973-1992	13	7	58.5	7.85	0.13	3.41	0.43	0.76	1.94	0.25	0.23	10.85	6.02	0.56	0.86	3.55	0.33	0.28	1.37
	Marcil Creek near Arctic Bay	10UB001	1978-1983	3	2	143.9	10.2	0.07	6.80	0.67	0.12	3.74	0.37	0.04								1.56
	Mecham River near Resolute	10VC002	1971-1979	4	2	86.8	22.21	0.26	8.42	0.38	0.79	4.71	0.21	0.21								1.91
	Allen River near Mouth	10VC001	1970-1984	6	5	448.0	60.75	0.14	22.67	0.37	-0.09	12.69	0.21	-0.01	112.34	13.65	0.12	0.44	8.46	0.08	0.16	1.74
Regional Average													0.25	0.09						0.21	0.15	1.56
Northern Quebec	Hamelin River next to Arnaud River	03HA009	1963-1978		16	4120	283.13	0.07	79.85	0.28	0.21	46.63	0.17	0.03								
	Hamelin River d/s of Pelletier Lake	03HA012	1980-1993		14	3760	231.64	0.06	58.43	0.25	-0.59	33.45	0.14	-0.10								
	False River	03MB001	1973-1991		24	2140	182.46	0.09	96.53	0.53	-0.73	51.29	0.29	-0.19								
	Tunulic River next to the mouth	03MC001	1973-1993		20	3680	578.15	0.16	131.04	0.23	-0.01	74.66	0.13	-0.002								

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Notes:
1. Ratio I/D is the average of the annual ratios of the peak instantaneous to peak daily flows.
2. Statistics were not computed for datasets with 2 or less years of record.
3. Northern Quebec values provided for comparison purposes. Only peak daily statistics were computed.

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TABLE 4.3

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

BULK SAMPLING PROGRAM - ROAD UPGRADE DESIGN SUMMARY

ESTIMATED SITE RAINFALL IDF VALUES

Duration	Mean	St. Dv.	C.V.
5 min	0.8	0.3	0.35
10 min	1.2	0.4	0.35
15 min	1.5	0.5	0.35
30 min	2.5	0.9	0.35
1 hr	4	1.6	0.40
2 hr	6	2.4	0.40
6 hr	12	6.0	0.50
12 hr	16	8.0	0.50
24 hr	25	12.5	0.50

Year	2	5	10	15	20	25	50	100	200
Freq. Factor	-0.0164	0.719	1.305	1.635	1.866	2.044	2.592	3.137	3.679

Return Period Rainfall Amounts (mm)

Duration	2 yrs	5 yrs	10 yrs	15 yrs	20 yrs	25 yrs	50 yrs	100 yrs	200 yrs
5 min	0.8	1.0	1.2	1.3	1.3	1.4	1.5	1.7	1.8
10 min	1.2	1.5	1.7	1.9	2.0	2.1	2.3	2.5	2.7
15 min	1.5	1.9	2.2	2.4	2.5	2.6	2.9	3.1	3.4
30 min	2.5	3.1	3.6	3.9	4.1	4.3	4.8	5.2	5.7
1 hr	4.0	5.2	6.1	6.6	7.0	7.3	8.1	9.0	9.9
2 hr	6.0	7.7	9.1	9.9	10.5	10.9	12.2	13.5	14.8
6 hr	11.9	16.3	19.8	21.8	23.2	24.3	27.6	30.8	34.1
12 hr	15.9	21.8	26.4	29.1	30.9	32.4	36.7	41.1	45.4
24 hr	24.8	34.0	41.3	45.4	48.3	50.6	57.4	64.2	71.0

Rainfall Intensity (mm/hr)

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

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Note:
1. Data derived from IDF information published for climate stations at Clyde Airport (#2400800) and Pond Inlet Airport (#2403201) by the Atmospheric Environment Branch of Environment Canada.

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TABLE 4.4

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

BULK SAMPLING PROGRAM - ROAD UPGRADE DESIGN SUMMARY

SUMMARY OF WATER CROSSING CATEGORIES

Crossing Category	Catchment Area (sq km)	Number of Crossings
Extra-Small	<0.5	174
Small	0.5 - 2.5	43
Medium	2.5 - 7.5	13
Large	7.5 - 30.0	13
Extra-Large	>30.0	4
TOTAL CROSSINGS		247

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TABLE 4.5

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

BULK SAMPLING PROGRAM - ROAD UPGRADE DESIGN SUMMARY

SUMMARY OF CATEGORY SMALL CROSSINGS DETAILS

Site Number	Northing (m)	Easting (m)	Chainage (m)	Crossing Type	Approx. Span Width (m)	Catchment Area (m^2)	Design Peak Flow (m^3/s)	Crossing Details Required No. of CSP Culverts Ø = 1.2 m	Ø = 1.0 m	Ø = 0.5 m
BG27	7,919,342	547,876	86+609	Small-B	10	552,935	1.3	-	-	3
BG29	7,919,877	546,229	84+805	Small-A	10	976,757	2.0	-	1	-
BG30	7,919,858	546,070	84+636	Small-A	4	1,059,612	2.1	-	1	-
CV001	7,914,922	553,782	94+728	Small-C	2	1,637,753	2.9	-	1	2
CV023	7,920,201	544,739	83+147	Small-A	5	1,102,251	2.2	-	1	-
CV030	7,921,310	540,123	77+506	Small-C	15	1,265,589	2.4	-	1	1
CV043	7,923,419	532,044	67+469	Small-C	7	1,518,447	2.7	-	1	2
CV046	7,924,265	531,686	66+490	Small-C	10	2,286,224	3.7	-	1	4
CV057	7,928,657	528,379	60+712	Small-B	10	562,839	1.3	-	-	3
CV058	7,928,839	528,322	60+523	Small-C	10	2,424,180	3.9	1	-	1
CV059	7,929,356	528,102	59+960	Small-B	10	749,651	1.6	-	-	4
CV075	7,935,078	526,767	53+337	Small-B	5	1,061,023	2.1	-	-	5
CV076	7,935,335	526,617	53+028	Small-A	15	1,187,687	2.3	-	1	-
CV082	7,938,131	525,254	49+655	Small-B	10	530,673	1.2	-	-	4
CV083	7,939,876	524,454	47+643	Small-B	10	955,051	1.9	-	-	5
CV085	7,940,898	523,827	46+422	Small-B	10	882,744	1.8	-	-	5
CV086	7,940,983	523,746	46+300	Small-B	5	591,709	1.3	-	-	4
CV090	7,942,336	523,389	44+832	Small-B	5	863,100	1.8	-		5
CV093	7,944,890	523,116	42+216	Small-B	15	879,951	1.8	-	-	5
CV102	7,950,591	521,934	36+028	Small-C	10	1,932,365	3.3	-	1	3
CV106	7,953,392	521,663	33+170	Small-B	7	752,112	1.6	-	-	4
CV112	7,954,935	521,033	31+450	Small-C	5	2,279,159	3.7	1	-	1
CV113	7,955,659	520,747	30+655	Small-B	7	771,664	1.6	-	-	4
CV115	7,958,135	519,222	27+686	Small-C	10	1,414,903	2.6	-	1	1
CV117	7,958,681	519,010	27+073	Small-C	5	1,268,581	2.4	-	1	1
CV119	7,961,153	517,762	24+264	Small-A	10	1,168,163	2.3	-	1	-
CV120	7,961,707	517,294	23+515	Small-C	15	1,893,702	3.2	-	1	3
CV125	7,963,841	515,296	20+447	Small-A	5	1,189,650	2.3	-	1	-
CV146	7,968,870	508,786	11+348	Small-B	5	1,020,550	2.0	-	-	5
CV151	7,969,584	508,341	10+460	Small-B	10	586,477	1.3	-	-	4
CV152	7,969,684	508,201	10+280	Small-B	15	1,045,843	2.1	-	-	5
CV153	7,969,718	508,152	10+218	Small-B	10	1,060,947	2.1	-	-	5
CV154	7,970,076	507,620	9+570	Small-C	10	1,360,439	2.5	-	1	1
CV157	7,970,538	507,374	8+960	Small-C	10	1,467,596	2.7	-	1	1
CV165	7,971,635	506,128	7+038	Small-A	15	1,128,876	2.2	-	1	-
CV166	7,972,370	505,538	6+056	Small-B	5	818,859	1.7	-	-	5
CV170	7,972,923	505,015	5+267	Small-B	5	523,156	1.2	-	-	3
CV176	7,975,057	503,834	2+638	Small-B	10	522,093	1.2	-	-	3
CV187	7,913,414	560,957	103+078	Small-B	6	906,835	1.9	-	-	5
CV202	7,953,731	521,603	32+825	Small-B	4	673,298	1.5	-	-	4
CV203	7,952,435	521,782	34+153	Small-B	5	649,588	1.4	-	-	4
CV215	7,922,217	541,930	79+572	Small-B	4	760,446	1.6	-	-	4
CV226	7,913,553	560,458	102+563	Small-C	10	1,550,999	2.8	-	1	2

I:\102-00181-10\Assignment\Report\Report 1, Rev. 0 - Road Design\Tables\[Table 4.4 to 4.8.xls]Table 4.5 -Small
13/07/2007 12:19

Notes:
1. Crossings designed for peak flow from the 1:10 yr return storm.
2. Span width based on initial site assessment.
3. Crossing Type: Small-A - single culvert; Small-B - multiple culvert; Small-C - multiple culvert and multiple diameters.

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TABLE 4.6

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

BULK SAMPLING PROGRAM - ROAD UPGRADE DESIGN SUMMARY

SUMMARY OF CATEGORY MEDIUM CROSSINGS DETAILS

Site Number	Northing	Easting	Chainage	Crossing Type	Approx. Span Width	Catchment Area	Design Peak Flow	Crossing Details				
								Required No. of CSP Culverts		Emergency Overflow Swale		
	(m)	(m)	(m)		(m)	(m^2)	(m^3/s)	Ø = 1.2 m	Ø = 1.0 m	Length (L), m	Depth (y), m	Slopes (H:V)
BG01	7,914,919	557,991	99+672	Medium-B	15	5,611,782	7.4	1	-	10.7	0.4	3:1
BG04	7,915,113	553,250	94+148	Medium-C	10	6,847,505	8.6	2	-	4.4	0.4	3:1
BG24	7,918,878	548,766	87+710	Medium-A	5	5,505,790	7.3	3	-	-	-	-
CV047	7,924,326	531,667	66+426	Medium-A	5	4,111,108	5.9	2	-	-	-	-
CV060	7,930,342	527,622	58+856	Medium-C	10	5,256,834	7.1	-	2	5.2	0.5	3:1
CV091	7,944,176	523,111	42+961	Medium-A	5	3,452,918	5.1	-	3	-	-	-
CV092	7,944,187	523,107	42+949	Medium-A	5	3,452,918	5.1	-	3	-	-	-
CV098	7,948,306	522,197	38+525	Medium-B	10	2,840,586	4.4	-	1	6.1	0.4	3:1
CV104	7,952,788	521,732	33+794	Medium-A	5	5,198,489	7.0	2	-	-	-	-
CV111	7,954,524	521,355	31+990	Medium-B	10	3,115,619	4.7	-	1	6.9	0.4	3:1
CV114	7,956,528	520,278	29+647	Medium-B	10	3,144,617	4.8	-	1	7.0	0.4	3:1
CV224	7,915,044	556,238	97+758	Medium-A	4	2,834,518	4.4	-	2	-	-	-
CV087	7,941,040	523,704	46+223	Medium-A	5	9,872,768	11.4	3	-	-	-	-

I:\102-00181-10\Assignment\Report\Report 1, Rev. 0 - Road Design\Tables\[Table 4.4 to 4.8.xls]Table 4.6 - Medium
13-Jul-07

Notes:

1. Crossings designed for peak flow from the 1:10 yr return storm.
2. Span width based on initial site assessment.
3. Crossing Type: Medium-A - multiple culvert; Medium-B - single culvert with swale; Medium-C - multiple culvert with swale.
4. Drainage crossing CV087 was previously classified as a Category Large crossing. This location has been designed as a Category Medium due to spacial restraints.

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TABLE 4.7

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

BULK SAMPLING PROGRAM - ROAD UPGRADE DESIGN SUMMARY

SUMMARY OF CATEGORY LARGE CROSSINGS DETAILS

Site Number	Northing	Easting	Chainage	Crossing Type	Approx. Span Width	Catchment Area	Design Peak Flow	Crossing Details			
								Required No. if CSP Culverts	Emergency Overflow Swale		
	(m)	(m)	(m)		(m)	(m^2)	(m^3/s)	Ø = 1.2 m	Length (L), m	Depth (y), m	Slopes (H:V)
BG17	7,917,643	550,703	90+167	Large-B	10	13,766,712	18.6	2	5.7	1.3	5:1
BG32	7,921,622	540,706	78+161	Large-B	20	11,470,152	16.2	2	13.7	0.6	5:1
CV040	7,920,305	535,175	72+263	Large-B	15	12,020,780	16.8	2	10.4	0.8	5:1
CV048	7,925,875	530,415	64+312	Large-B	10	8,542,258	13.0	2	4.8	0.9	5:1
CV049	7,926,542	529,677	63+302	Large-B	15	11,983,534	16.7	2	10.3	0.8	5:1
CV072	7,934,576	526,897	53+878	Large-B	8	13,495,782	18.3	3	3.9	1.3	5:1
CV078	7,936,787	525,852	51+171	Large-A	15	19,439,928	24.1	1	12.3	1.1	5:1
CV079	7,937,276	525,562	50+600	Large-B	200	13,497,190	18.3	2	22.1	0.5	5:1
CV094	7,945,397	522,805	41+613	Large-A	7	10,006,204	14.6	1	5.5	1.3	5:1
CV099	7,948,820	521,811	37+840	Large-B	15	28,559,286	32.1	3	10.7	1.3	5:1
CV129	7,966,783	512,381	15+650	Large-A	12	10,622,786	15.3	1	9.5	0.9	5:1
CV216	7,921,700	542,774	80+646	Large-B	8	13,318,478	18.1	3	3.8	1.3	5:1
CV225	7,915,138	557,407	98+989	Large-A	10	12,179,754	17.0	1	7.1	1.2	5:1

I:\102-00181-10\Assignment\Report\Report 1, Rev. 0 - Road Design\Tables\[Table 4.4 to 4.8.xls]Table 4.7 -Large
13-Jul-07

Notes:
1. Crossings designed for peak flow from the 1:25 yr return storm.
2. Span width based on initial site assessment.
3. Crossing Type: Large-A - single culvert with swale; Large-B - multiple culvert with swale.

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TABLE 4.8

BAFFINLAND IRON MINES CORPORATION
MARY RIVER PROJECT

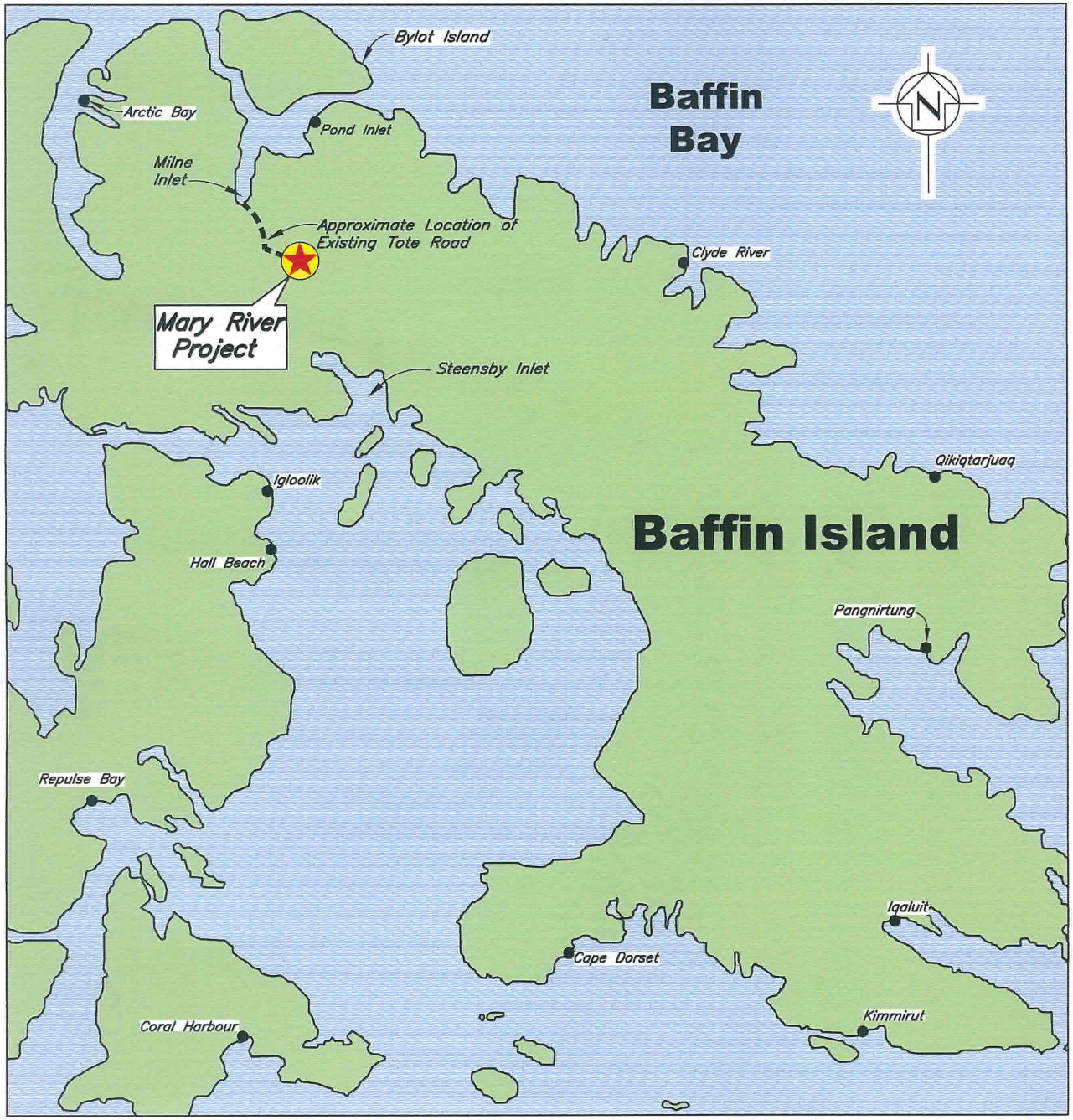
BULK SAMPLING PROGRAM - ROAD UPGRADE DESIGN SUMMARY

SUMMARY OF CATEGORY EXTRA-LARGE CROSSINGS DETAILS

Site Number	Northing	Easting	Chainage	Approx. Span Width	Catchment Area	Design Peak Flow	Crossing Details				
							Sea Containers	CSP Culverts	Emergency Overflow Swale		
	(m)	(m)	(m)	(m)	(m^2)	(m^3/s)	2.4 m x 2.9 m x 12.1 m	Ø = 1.2 m	Length (L), m	Depth (y), m	Slopes (H:V)
BG50	7,926,846	529,334	62+804	30	197,800,000	137	13	2	-	-	-
CV128	7,965,895	513,545	17+486	200	473,400,000	264	20	0	64	0.76	15:1
CV217	7,922,158	542,219	79+915	60	194,100,000	135	14	3	-	-	-
CV223	7,914,691	555,818	97+155	100	244,100,000	161	16	5	-	-	-

I:\102-00181-10\Assignment\Report\Report 1, Rev. 0 - Road Design\Tables\[Table 4.4 to 4.8.xls]Table 4.8 - Extra-Large
13-Jul-07

Notes:
1. Crossings designed for peak flow from the 1:25 yr return storm.
2. Span width based on initial site assessment



LEGEND:

- Water
- Existing Community

Scale (Approx.) 65 32.5 0 65 130 195 260 325 Km

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MARY RIVER PROJECT – BULK SAMPLING PROGRAM

PROJECT LOCATION MAP

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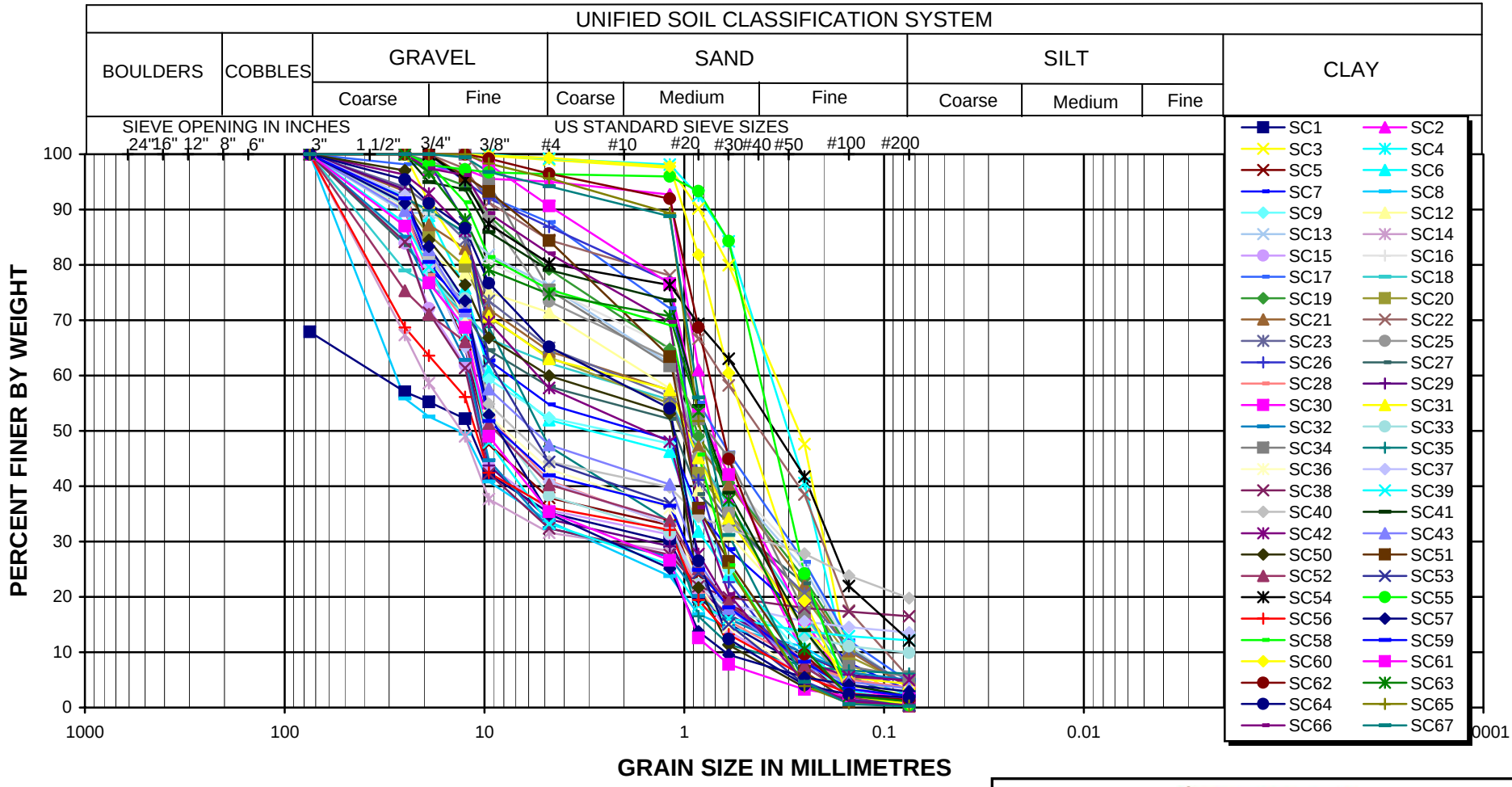
P/A NO.	REF.	REV.
NB102-00181/10	1	0

FIGURE 1.1



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MARY RIVER PROJECT
BULK SAMPLING PROGRAM

ROAD UPGRADE DESIGN SUMMARY
GRAIN SIZE ANALYSES - ALL SAMPLES

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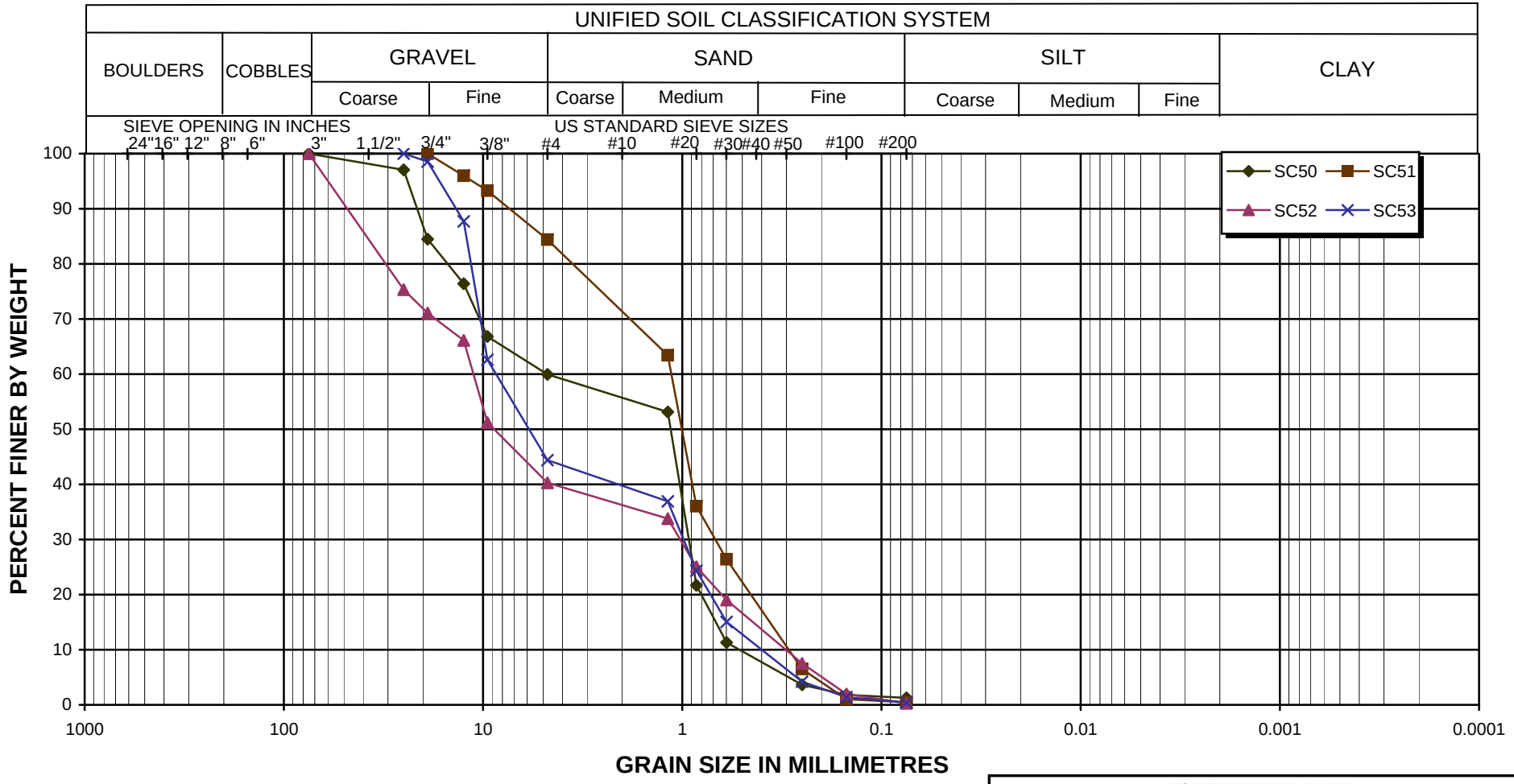
P/A NO.	REF.	REV.
NB102-00181/10	1	0

FIGURE 3.1



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MARY RIVER PROJECT
BULK SAMPLING PROGRAM

ROAD UPGRADE DESIGN SUMMARY
GRAIN SIZE ANALYSES - MILNE INLET BORROW AREA

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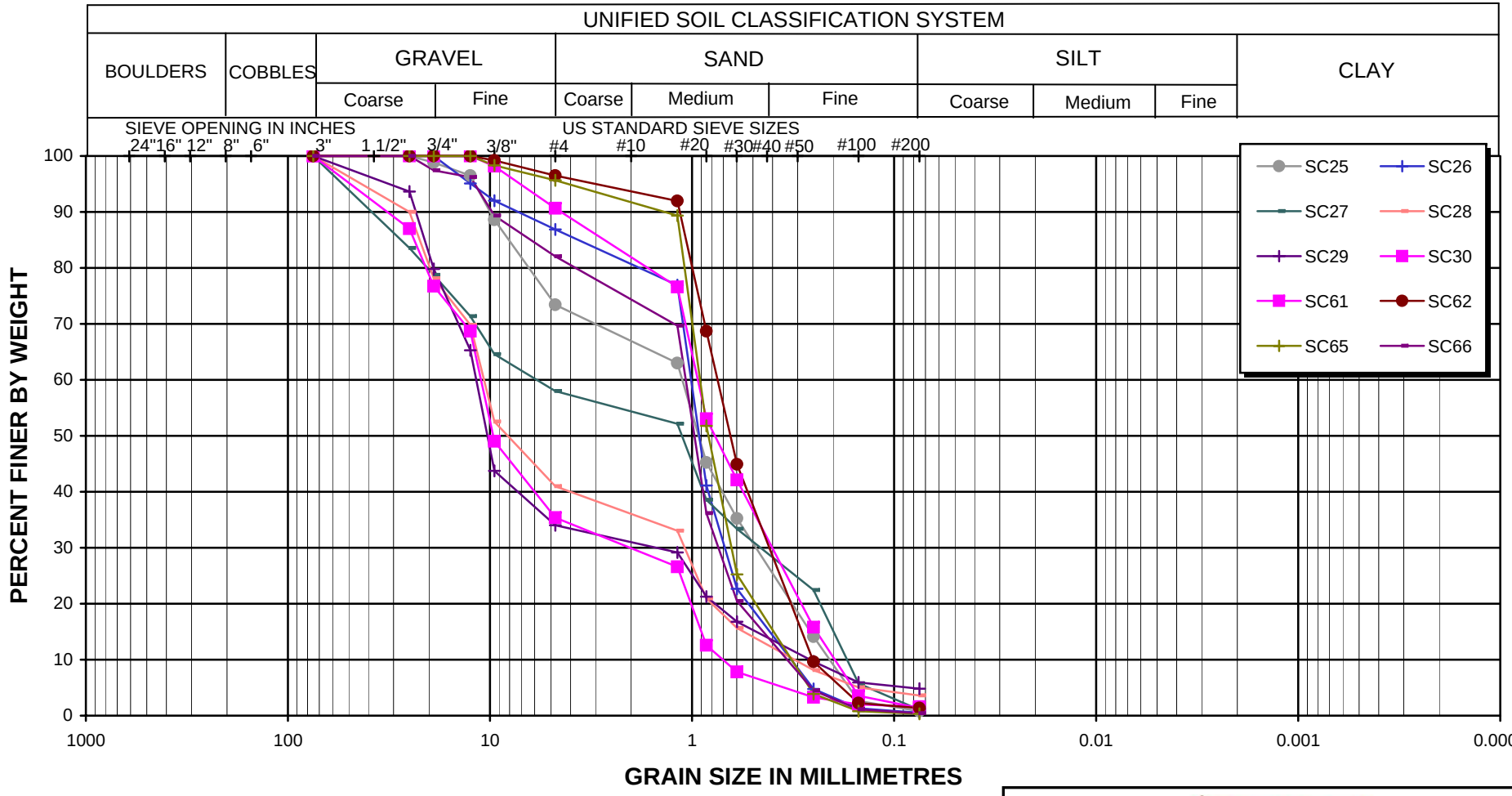
P/A NO.	REF.	REV.
NB102-00181/10	1	0

FIGURE 3.2



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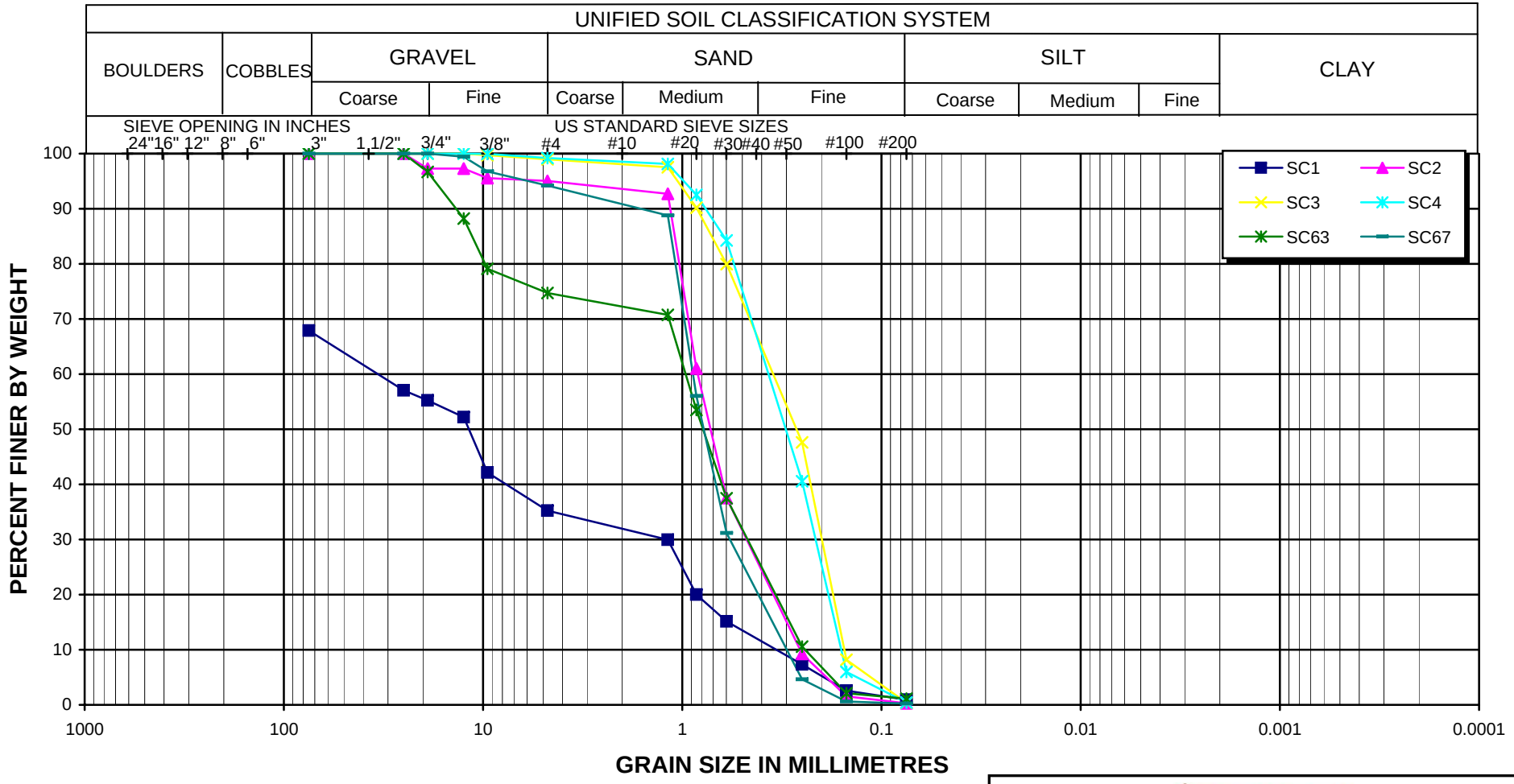
MARY RIVER PROJECT
BULK SAMPLING PROGRAM

ROAD UPGRADE DESIGN SUMMARY
GRAIN SIZE ANALYSES - MID-WAY CAMP BORROW AREA

Knight Piésold CONSULTING

P/A NO.	REF.	REV.
NB102-00181/10	1	0

FIGURE 3.3



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MARY RIVER PROJECT
BULK SAMPLING PROGRAM

ROAD UPGRADE DESIGN SUMMARY
GRAIN SIZE ANALYSES - MARY RIVER BORROW AREA

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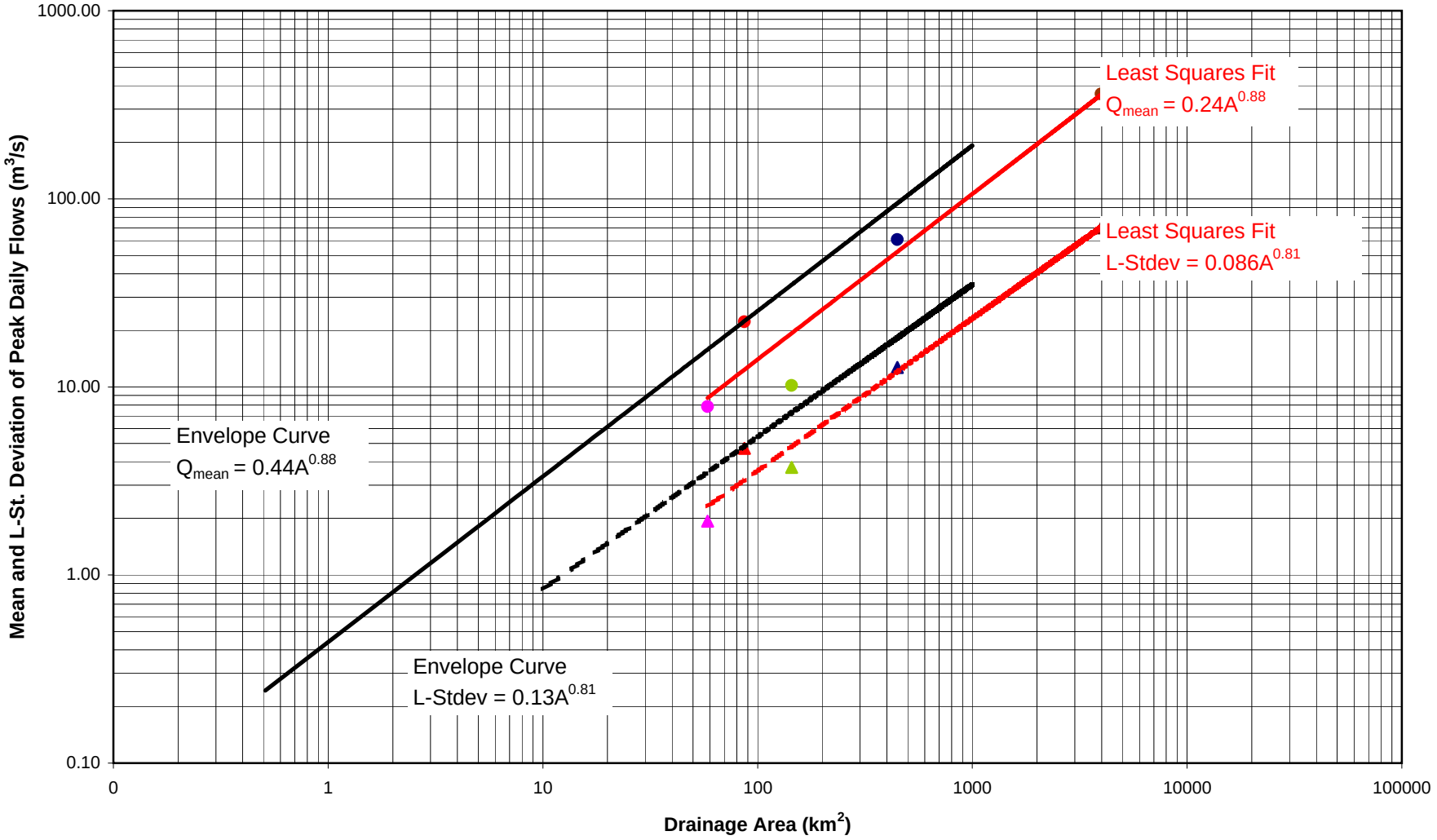
P/A NO.	REF.	REV.
NB102-00181/10	1	0

FIGURE 3.4



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MARY RIVER PROJECT
BULK SAMPLING PROGRAM

ROAD UPGRADE DESIGN SUMMARY
REGIONAL PEAK FLOW SCALING PLOTS

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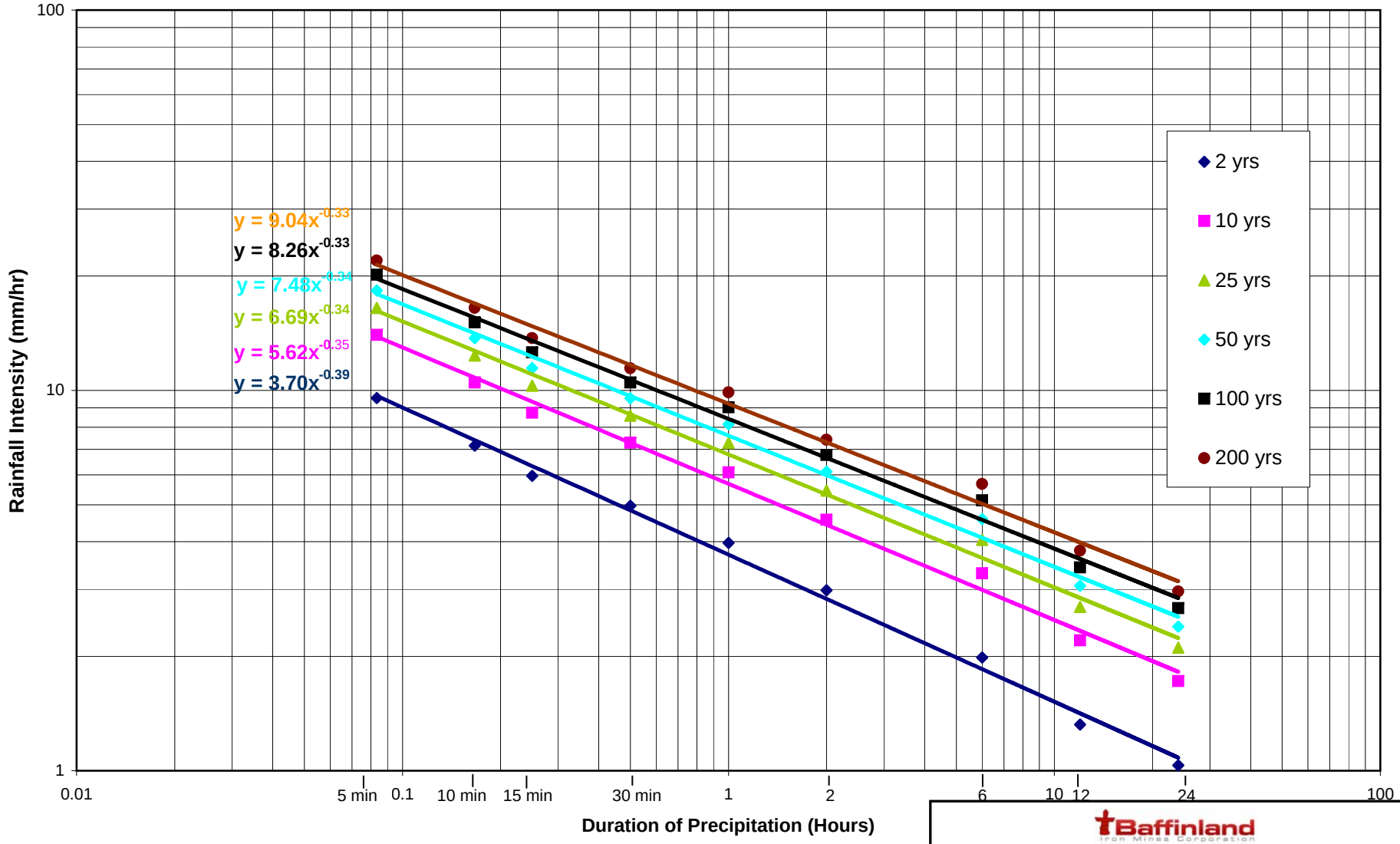
P/A NO.	REF.	REV
NB102-00181/10	1	0

FIGURE 4.1



Note:
1. IDF curves based on extreme precipitation data for Clyde Airport and Pond Inlet Airport, as published by Environment Canada.

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MARY RIVER PROJECT
BULK SAMPLING PROGRAM

ROAD UPGRADE DESIGN SUMMARY
SUMMARY OF IDF CURVES

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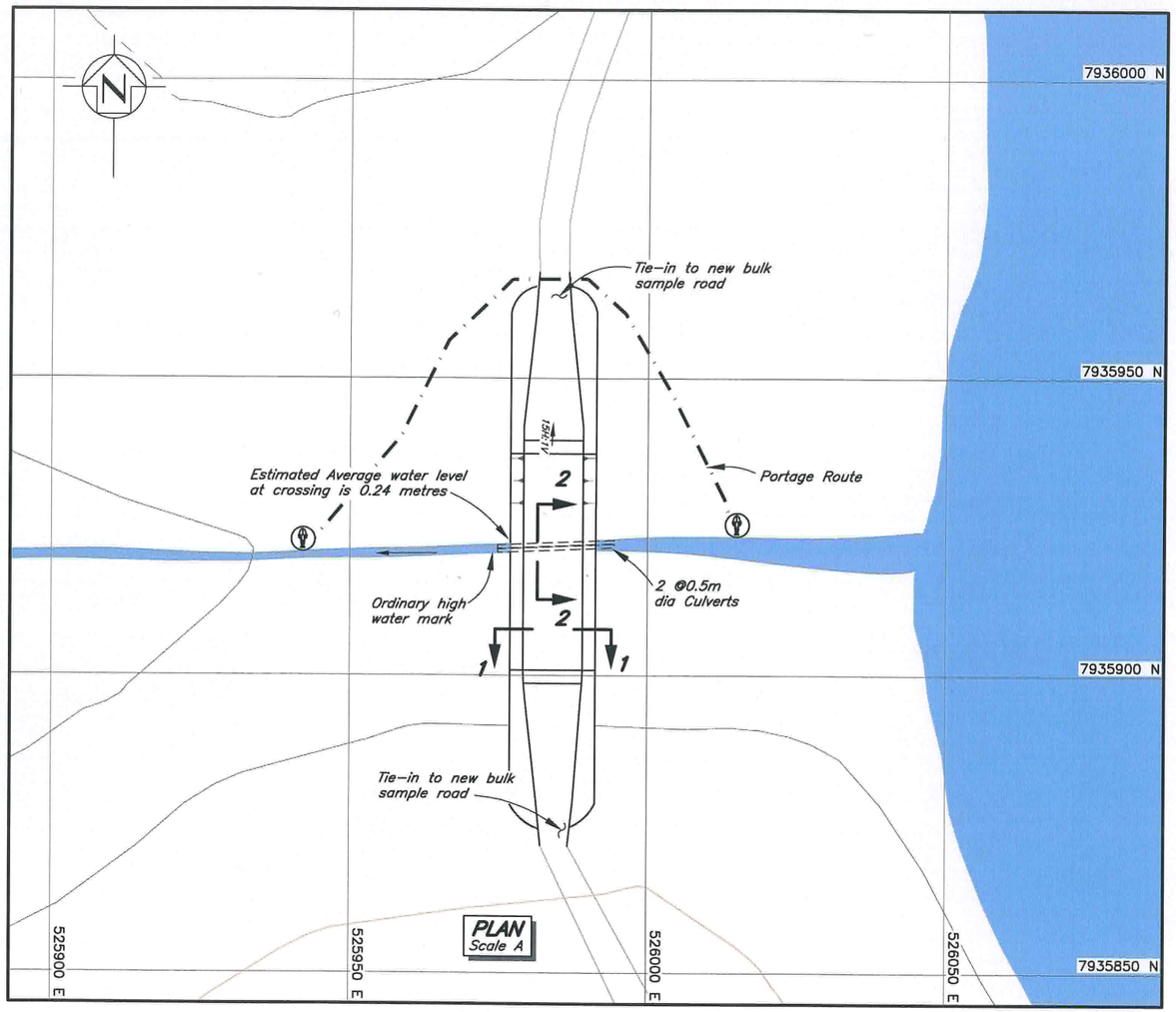
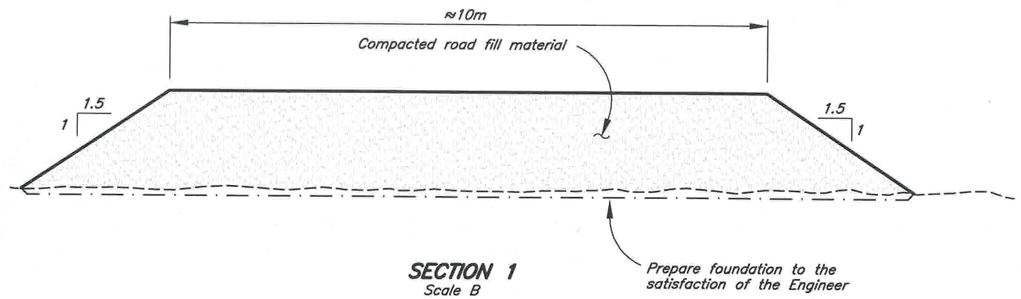
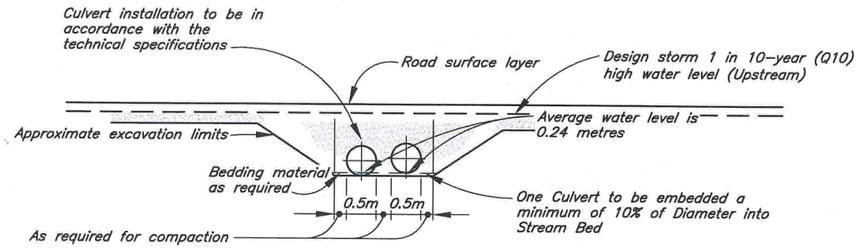
P/A NO.	REF.	REV
NB102-00181/10	1	0

FIGURE 4.2





SECTION 1
Scale B



SECTION 2
Scale C

LEGEND:

- Water
- Compacted road fill
- Portage Route
- Portage Sign

NOTES:

1. Mapping provided by Eagle Mapping (2006).
2. Contours are in metres, contour interval is 5 metres.
3. Original ground profile determined from initial site assessment of crossings.
4. Design storm for crossing is 1 in 10–year (Q10) return.
5. All installations and construction to be carried out in accordance with the Technical Specifications.
6. Portage routes will be field fitted based on conditions to ensure safe passage.

Scale A: 10 5 0 10 20 30 40 50 Metres

Scale B: 2 1 0 2 4 6 8 10 Metres

Scale C: 1 0.5 0 1 2 3 4 5 Metres

Baffinland
IRON MINES DEVELOPMENT

MARY RIVER PROJECT

BULK SAMPLING PROGRAM
ROAD UPGRADE DESIGN SUMMARY
CV077 – PLAN AND SECTIONS

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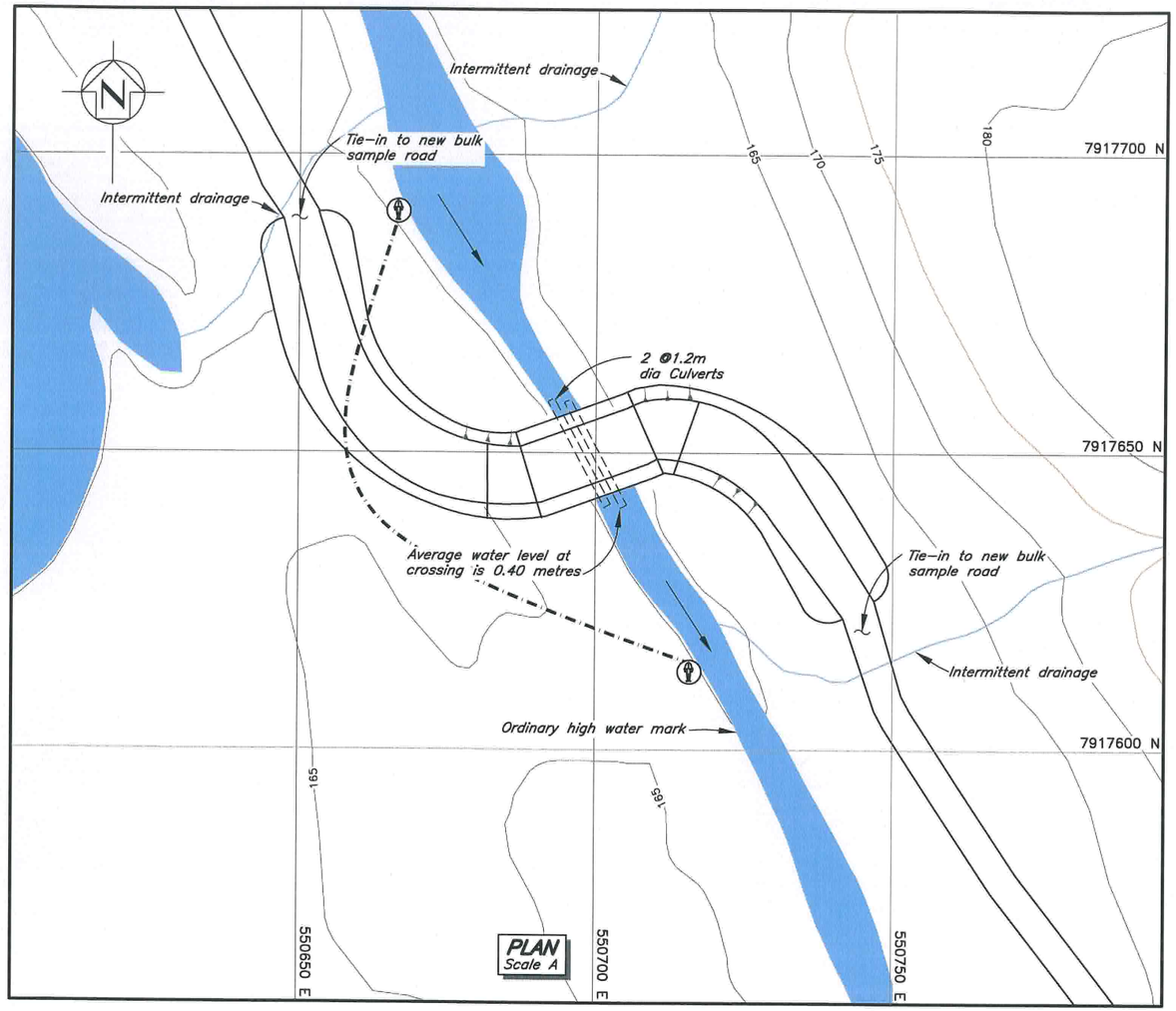
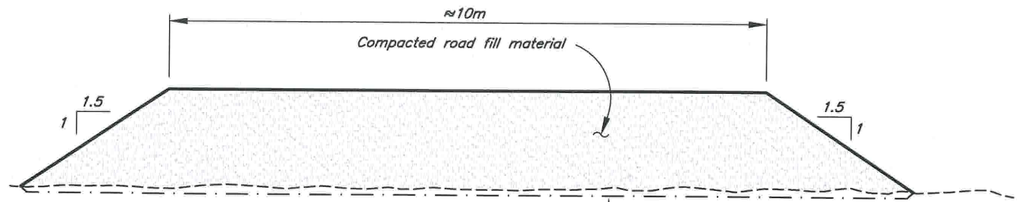
P/A NO.	REF.	REV.
NB102–00181/10	1	0

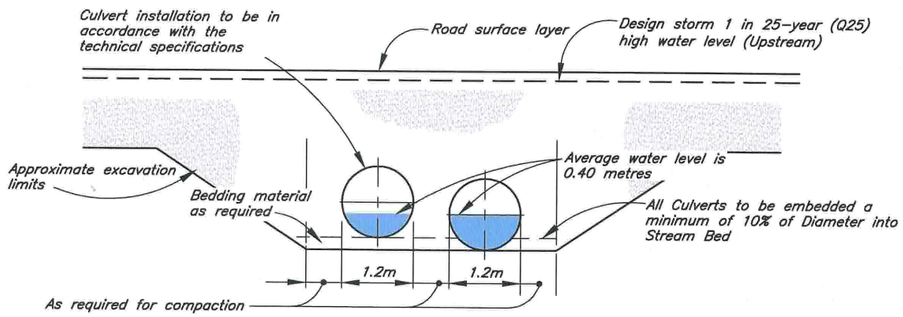
FIGURE 5.1



PLAN
Scale A



SECTION 1
Scale B



SECTION 2
Scale C

LEGEND:

- Water
- Compacted road fill
- Portage Route
- Portage Sign

NOTES:

1. Mapping provided by Eagle Mapping (2006).
2. Contours are in metres, contour interval is 5 metres.
3. Original ground profile determined from initial site assessment of crossings.
4. Design storm for large category crossing is 1 in 25–year (Q25) return.
5. All installations and construction to be carried out in accordance with the Technical Specifications.
6. Portage routes will be field fitted based on conditions to ensure safe passage.

Scale A: 10 5 0 10 20 30 40 50 Metres

Scale B: 2 1 0 2 4 6 8 10 Metres

Scale C: 1 0.5 0 1 2 3 4 5 Metres

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

BULK SAMPLING PROGRAM
ROAD UPGRADE DESIGN SUMMARY
BG17 – PLAN AND SECTIONS

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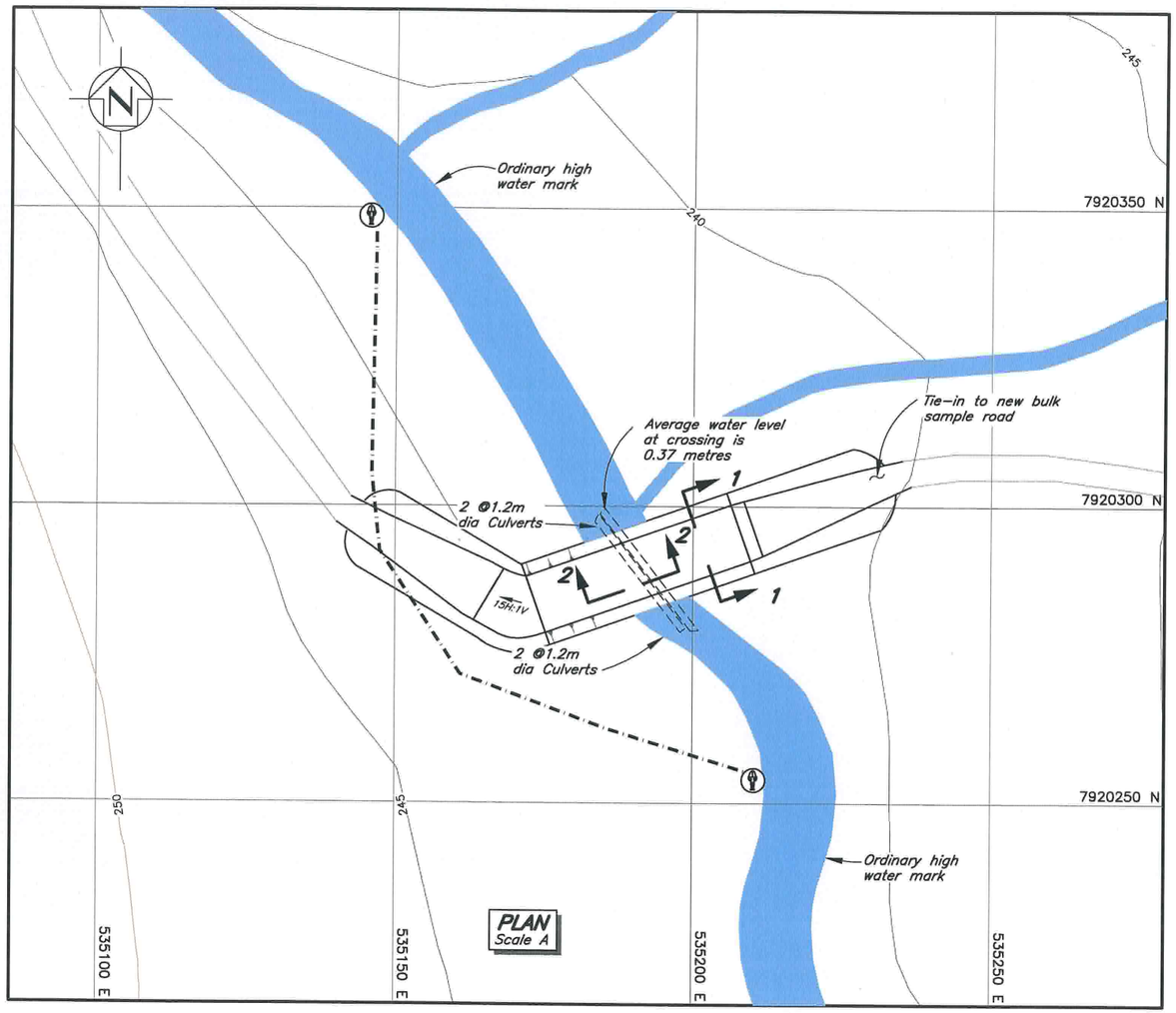
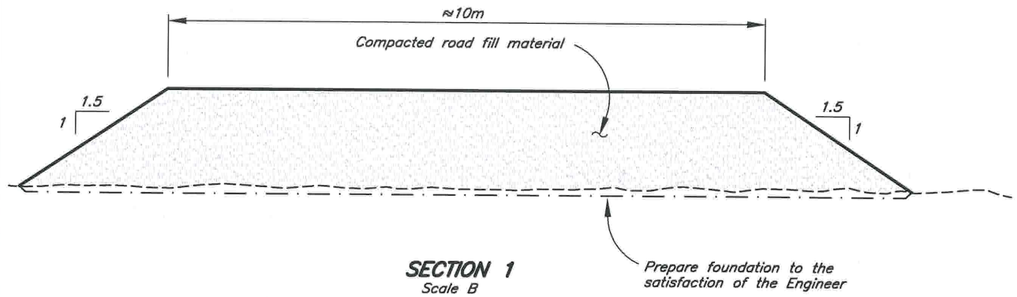
P/A NO.	REF.	REV.
NB102–00181/10	1	0

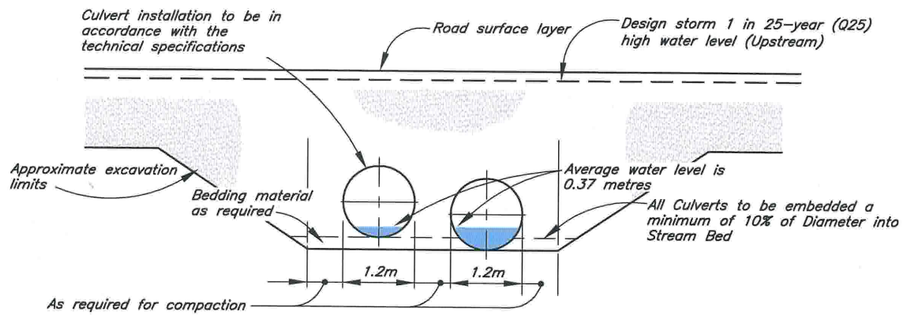
FIGURE 5.2



PLAN
Scale A



SECTION 1
Scale B



SECTION 2
Scale C

LEGEND:

- Water
- Compacted road fill
- Portage Route
- Portage Sign

NOTES:

1. Mapping provided by Eagle Mapping (2006).
2. Contours are in metres, contour interval is 5 metres.
3. Original ground profile determined from initial site assessment of crossings.
4. Design storm for large category crossing is 1 in 25–year (Q25) return.
5. All installations and construction to be carried out in accordance with the Technical Specifications.
6. Portage routes will be field fitted based on conditions to ensure safe passage.

Scale A: 10 5 0 10 20 30 40 50 Metres

Scale B: 2 1 0 2 4 6 8 10 Metres

Scale C: 1 0.5 0 1 2 3 4 5 Metres

Baffinland Iron Mines Corporation

MARY RIVER PROJECT

BULK SAMPLING PROGRAM
ROAD UPGRADE DESIGN SUMMARY
CV040 – PLAN AND SECTIONS

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P/A NO.	REF.	REV.
NB102–00181/10	1	0

FIGURE 5.3