APPENDIX 3F-2

RAILWAY STUDY

Baffinland Iron Mines Corporation	TECHNICAL DECISION MEMORANDUM	amec CANARAIL			
TDM No.:	TDM – 159952 – 5200 –000 -048	**Rev No.:**	2	**Project No.:**	BIMC 159952
Project Title:	Mary River Project				
Originated By:	Canarail Consultants Inc.				
Initiated Date:	May 04, 2010			**Completion Date:**	December 2, 2010
Estimated Hours:					
Distribution: (Originator Plus)	Matthew Pickard, Dick Matthews, Richard Cook, Doron Golan				

TDM Description: Evaluation of Alternative Port Sites and Connecting Railway Routes

Supporting Documentation:

[signature] 2 Dec 2010

Prepared by: Carolyn Fitzpatrick — **Date**

[signature] 10.12.02

Approved by: Railway Project Director – Don Gillstrom — **Date**

Approved by: Project Manager – Doron Golan — **Date**

Approved by: Owner – Dick Matthews — **Date**

ACTION REQUIRED

- ☐ **Cost Impact Reflected in Revised Estimate**
- ☐ **Schedule Impact**
- ☐ **Change Log**

REVISION HISTORY

Rev.	Description	Prepared By	Checked By	Approved By	Date
0	Issued for Information	CF	SM	DG	25 Oct 20101
1	Routes to Nuvuit peninsular added	LH	CF	DG	26 Nov 2010
2	Missing Table added	CF	CF	DG	2 Dec 2010

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

The Baffinland Iron Mines Corporation is developing a high quality iron ore mine in the Mary River District of north Baffin Island. Scoping and feasibility level engineering studies (Aker Kvaerner 2006 and 2008) focused on transportation routes for the ore from the Mary River Mine to potential port sites in Milne Inlet to the north and Steensby to the south. Two railway routes to Milne Inlet and five potential routes to Steensby were examined as part of these studies.

Despite the fact that the land transport to the Milne Inlet port site was both the shorter and less costly, Steensby was selected as the potential port site in a large part due to environmental considerations. An important floe edge exists at the entrance to Pond Inlet, where narwhal and the marine mammals aggregate in the spring. Ice breaking through Eclipse Sound and Pond Inlet was thought to be too disruptive to important travel and harvesting activities on the land fast ice in close proximity to the community of Pond Inlet. Additionally all east coast ports have access problems in the late winter and spring, due to the large ice ridges that are created by the predominant winds along the east coast.

To support the shipping of 18 MT of iron ore per year, shipping through Milne Inlet would require a ship frequency and size that is prohibitive due to a narrow width at Milne Inlet's southern end. Additionally, winter shipping in Milne Inlet would be problematic due to unfavourable ice conditions.

Five potential routes to Steensby were examined; the route which uses the corridor provided by the valley of Cockburn Lake was selected on the basis of environmental, safety and cost issues.

During the course of public consultation activities Baffinland Iron Mines Corporation was asked by local communities to examine port sites and connecting rail routes to the west and east coasts of Baffin Island and to the Nuvuit Peninsular. The following railway route and port options were requested for consideration:

1. Routes to the fiords along the east coast of Baffin Island, between Pond Inlet and Clyde River;

2. A route to the existing port facility at Nanisivik, to the west of the mine site, and

3. A southern route to Cape Jensen on the Nuvuit Peninsular, at the eastern entrance to Steensby Inlet.

This Technical Decision Memorandum documents the findings of that examination, focussing on the overland (railway) options. This memorandum does not assess the viability of port sites or shipping routes.

2 BASIS FOR COST ESTIMATE

Costs of construction of the different routes are based on average costs derived from the costs estimated for the Mary River-Steensby route in the DFS by Kiewit and O'Connell. These costs were developed on the basis of common costs and "Reach" specific costs for three sections (or Reaches) of approximately 50 km in length which were to some extent also quite distinctive in terms of topography, geology and difficulty of construction. These were used to derive average costs per kilometre for three types of ground conditions which were then applied to each of the routes under study.

Reach 1 of the Steensby route covers 56 kilometres of ice rich and/or thaw sensitive ground with deeply eroded drainage paths requiring high fills and few sources for the necessary rock fill. With an average cost per kilometre of $7,433,000; this has been applied to Type 1 Zones.

Reach 2 of the Steensby route covers 43 kilometres of low topography plateau requiring minimal fill. With an average cost per kilometre of $5,306,000; this has been applied to Type 2 Zones.

Reach 3 of the Steensby route covers 52 kilometres of highly variable topography needing rock cuts and benching which provides a substantial amount of fill material required in interspersed low lying thaw sensitive sections. This reach also required tunnels, the costs of which have been removed from these estimates. With an average cost per kilometre of $5,676,000; this has been applied to Type 3 Zones.

The original estimate for the construction of the Steensby route was $1,040,623,000 (including tunnels).

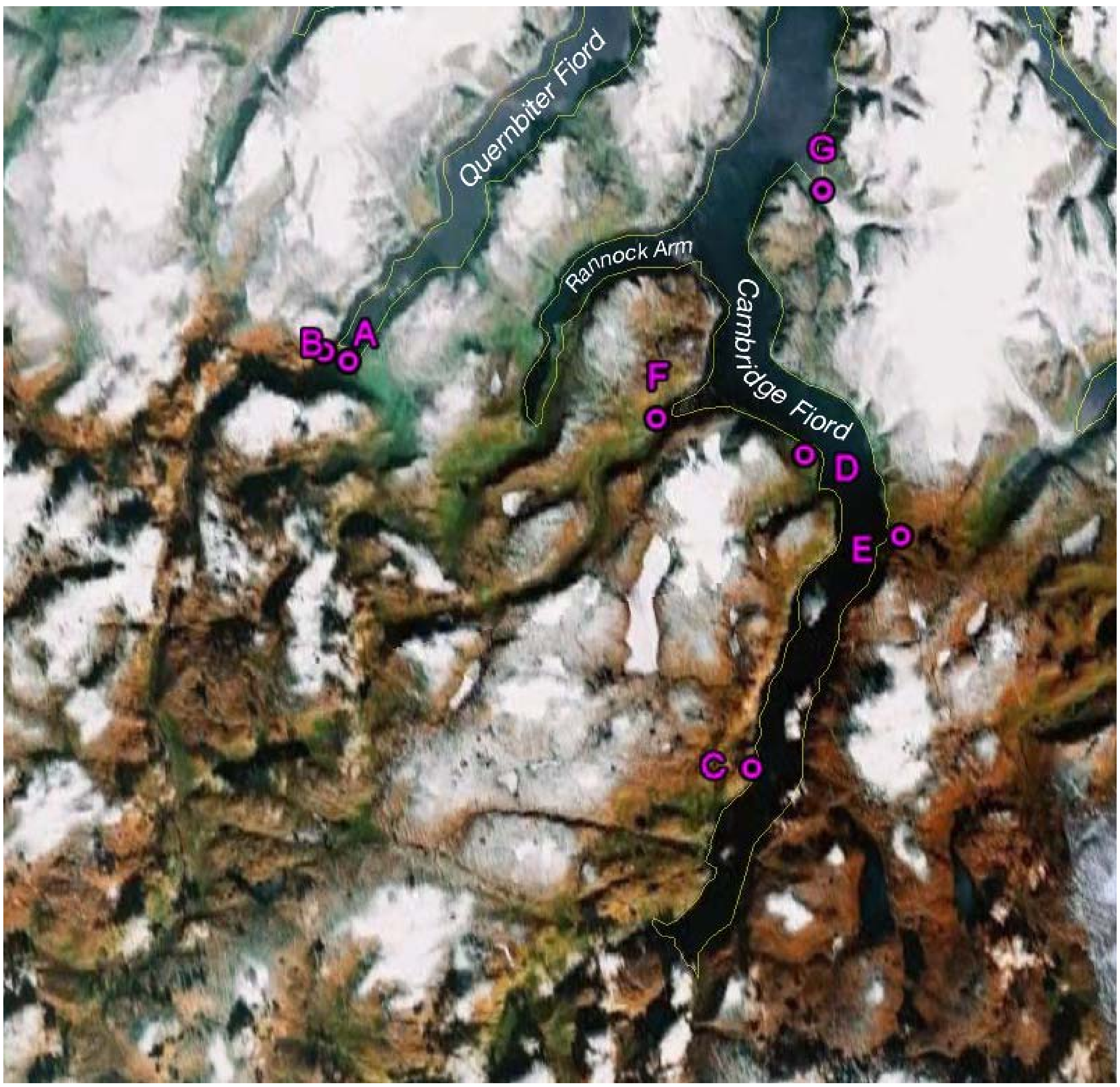
It should be noted that this assessment has been made on the basis of1:250,000 scale National topographic maps and knowledge of the based on observations from the air. No ground inspections of any kind have been carried out and the risk of significant costs associated with currently unknown geotechnical conditions are quite high.

3 EAST COAST PORT SITES AND RAILWAY ROUTES

3.1 EAST COAST PORT SITES

1:250,000 scale national topographic maps were used by Baffinland Iron Mines Corporation to identify seven (7)) potential east coast port sites for the purpose of evaluating potential railway alignments. Sites A and B at the foot of Quernbiter Fiord and sites C to G along Cambridge Fiord as far north as the Rannoch Arm.

Figure 3.1 – Potential East Coast Port Sites



Site G at almost 800m elevation is completely inaccessible with no possible site near sea level and was not evaluated. Site F at 500m elevation is equally inaccessible and an alternative location Site F' in Omega Bay was selected.

Figure 3.2 – Alternate Site F'

Access to Site D is difficult and was assessed from both the north and the south.

3.2 ROUTES TO EAST COAST PORT SITES

The route from the Mary River Mine to the east coast port sites has a common section of approximately 148 km which follows the Steensby route to a crossing of the Ravn River and then continues up the valley, on the south bank of the Ravn River, after which the routes branch off to each of the six retained port sites along the coast of Baffin Bay.

The routes to these six potential port sites range in total length from 191.5km to 242km, and are shown in the Figure 3.3 which follows.

Figure 3.3 – Routes to East Coast Ports

All the east coast routes follow the proposed alignment for the Steensby option, eastward to a crossing of the Ravn River approximately 20km east of Angajurjulak Lake. The routes then follow the Ravn River north and west to cross the divide of the Ravn and Quernbiter River watersheds.

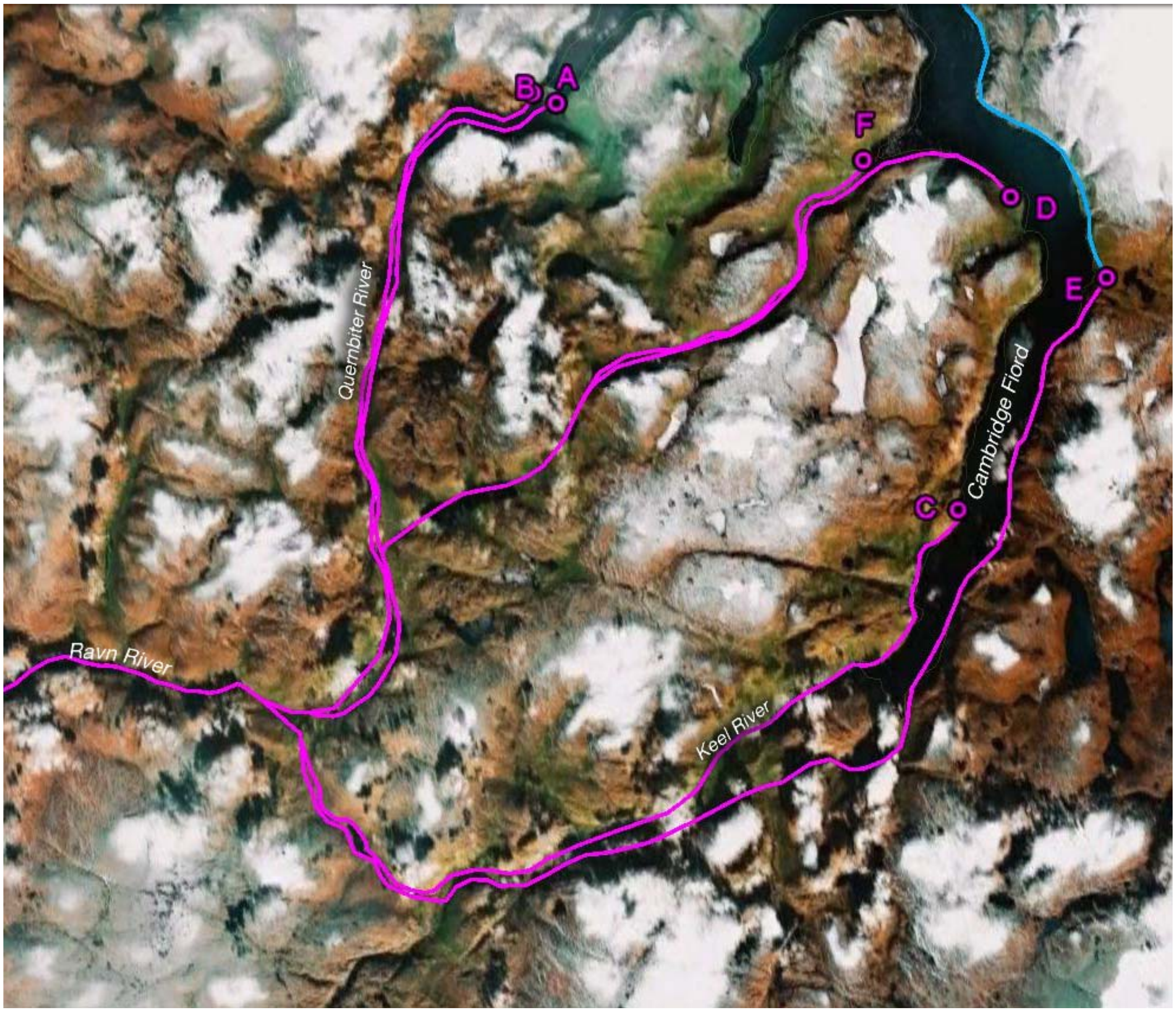
The routes to Port sites A and B, at the foot of Quernbiter Fiord, follow the valley of the Quernbiter River, the route to A on the north side of the valley and to B on the south side. A 30 km stretch of this valley is very narrow and, depending upon the dominant wind directions, could be prone to snow drift accumulation.

The route to port site F' and the north route to port D use the first 15 km of the route to site B as it follows the south bank of the Quernbiter river and then turns east to cross the divide between the Quernbiter River and the river that flows east into Omega Bay. The route to F' crosses to the north side of the river and stops at its mouth in Omaga bay. The route to D stays on the south side of the river and wraps around the south side of Omega Bay to approach the port site which lies just to the north of Aird Point. The high land to the south of Omega Bay has a small ice cap, which may result in ice movement towards the bay. This may (depending upon the rate of climate change) present a barrier to the construction of the railway line.

The south route to port site D and to port sites C and E use the valley of a tributary of the Quernbiter River to cross into the headwaters of the Keel River and to follow it down to Cambridge Fiord. The route to C takes the north side of the valley and then follows the northern coast of Cambridge Fiord. The south route to D continues northward along the west coast of Cambridge Fiord. The route to E takes the south side of the Keel River Valley, cuts south of the mountain at the head of Keel Bay and then takes the south coast of Cambridge Fiord to a point almost due east of Aird point.

Detail of the routes to the port sites is shown in Figure 3.4 which follows.

Figure 3.4 – Details of Routes to East Coast Ports



The costs derived for each of the routes based on average costs for typical zones as described in Section 2 are shown in Table 3.1. The routes are then compared in Table 3.2

Table 3.1 – Segment Costs of Alternative Routes East

EAST COAST ROUTES							
Section	Typical Zone (Reach)	Chainage		Length (km)	Unit Cost (CAD/km)	Total Cost (CAD)	
		From KP	To KP			Section	Route
Common	1	-4+000	0+000	4	7,443,003	29,772,011	
	1	0+000	65+000	65	7,443,003	483,795,173	
	3	65+000	148+500	83.5	5,676,453	473,983,849	
	SUB-TOTAL					**987,551,033**	
Port A	3	148+500	150+000	1.5	5,676,453	8,514,680	1,249,304,017
	1	150+000	160+000	10	7,443,003	74,430,027	
	3	160+000	191+500	31.5	5,676,453	178,808,278	
Port B	3	148+500	150+000	1.5	5,676,453	8,514,680	1,278,004,351
	1	150+000	165+000	15	7,443,003	111,645,040	
	3	165+000	195+000	30	5,676,453	170,293,598	
Port C	3	148+500	162+000	13.5	5,676,453	76,632,119	1,329,351,759
	1	162+000	190+000	28	7,443,003	208,404,075	
	3	190+000	200+000	10	5,676,453	56,764,533	
Port D (North Access)	3	148+500	150+000	1.5	5,676,453	8,514,680	1,346,121,790
	1	150+000	165+000	15	7,443,003	111,645,040	
	3	165+000	207+000	42	5,676,453	238,411,038	
Port D (South Access)	3	148+500	150+000	1.5	5,676,453	8,514,680	1,468,165,536
	1	150+000	165+000	15	7,443,003	111,645,040	
	3	165+000	228+500	63.5	5,676,453	360,454,783	
Port E	3	148+500	160+000	11.5	5,676,453	65,279,213	1,492,838,489
	1	160+000	197+000	37	7,443,003	275,391,099	
	3	197+000	226+000	29	5,676,453	164,617,145	
Port F	3	148+500	150+000	1.5	5,676,453	8,514,680	1,306,386,617
	1	150+000	165+000	15	7,443,003	111,645,040	
	3	165+000	200+000	35	5,676,453	198,675,865	
Port G	3	148+500	160+000	11.5	5,676,453	65,279,213	1,583,661,741
	1	160+000	197+000	37	7,443,003	275,391,099	
	3	197+000	242+000	45	5,676,453	255,440,398	

Table 3.2 – Comparison of Alternative Routes East

Port Site	Length (km)	Cost ($B)	Comments
A	192	1.25	- least expensive route - Quernbiter Fiord is the same width as southern Milne inlet and 25 km long; navigation safety issues will be worse than those at Milne Inlet - The last 30 km is in a very narrow valley, possibly prone to severe snow drifts
B	195	1.28	- Quernbiter Fiord is the same width as southern Milne inlet and 25 km long; navigation safety issues will be worse than those at Milne Inlet - The last 30 km is in a very narrow valley, possibly prone to severe snow drifts
C	200	1.33	- Approximately 15 km is in a very narrow valley, possibly prone to severe snow drifts -Cambridge Fiord is the same width as southern Milne inlet for 47 km; navigation safety issues will be significantly worse than those at Milne Inlet
D (North)	208	1.35	- 30 km is in a very narrow valley, possibly prone to severe snow drifts - May be exposed to glacial activity from the ice cap above Rannoch Arm - Cambridge Fiord is the same width as southern Milne inlet for 27 km; navigation safety issues will be worse than those at Milne Inlet
D (South)	229	1.47	- 15 km is in a very narrow valley, possibly prone to severe snow drifts - Cambridge Fiord is the same width as southern Milne inlet for 27 km; navigation safety issues will be worse than those at Milne Inlet
E	226	1.49	- at it lowest point the port site is over 160m above sea level, stockpiling and material handling for ship loading will be challenging. - Approximately 15 km is in a very narrow valley, possibly prone to severe snow drifts -Cambridge Fiord is the same width as southern Milne inlet for 30 km; navigation safety issues will be worse than those at Milne Inlet
F'	200	1.31	17 km is in a very narrow valley, possibly prone to severe snow drifts - Cambridge Fiord is the same width as southern Milne inlet for 23 km; navigation safety issues will be worse than those at Milne Inlet - There may no be adequate water depth close to the site and a kilometre or more of conveyors may be required between stockpile and ship loading.

All of the East coast sites have significant disadvantages in comparison with the Steensby Inlet option.

If an East Coast site is selected the better option would appear to be F'; It has the shortest sea route through a narrow fiord; the shortest section of railway exposed to snow drift problems, manageable stockpile and ship loading issues and is only 5% more expensive than the cheapest east coast route.

It should be noted that the costs developed for the Steensby route were based on the assumption that a large part of the material supply needed for the construction of the railway would be routed through the proposed Steensby Port. The scope of this study has not allowed for a re-evaluation of the costs if materials are supplied through other ports, in addition the impact of option F' on the total project cost has not been evaluated. The rail route to the F' port is 25% longer than the route to Steensby Port and would need a different railway operating plan, a bigger fleet of railway equipment, a larger team of operating personnel and consequently higher operating costs.

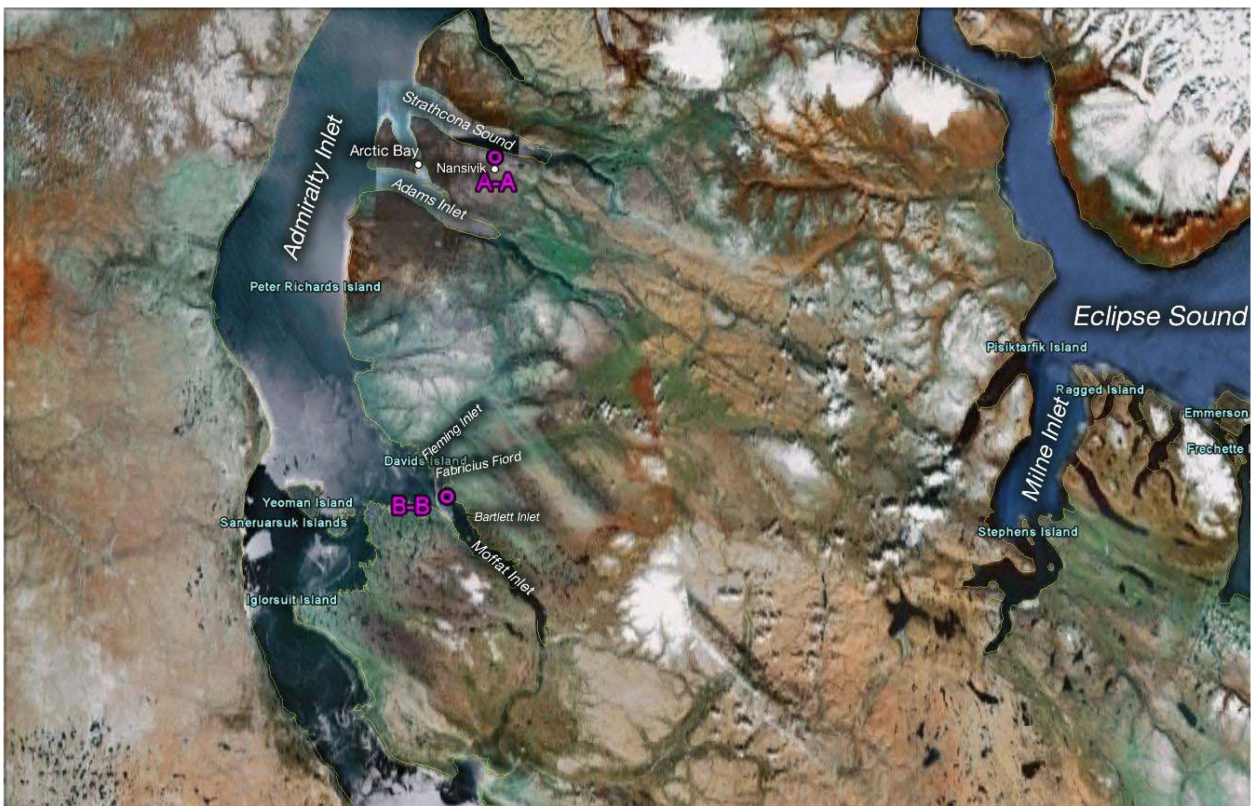
The viability of the identified port sites has not been considered in this evaluation. Based on feedback from shipping experts regarding the viability of Milne Inlet as a year round port operation, due to the challenge of navigating in ice conditions within the narrow fiord, it is likely that the same challenge would be present at all the East Coast Port sites.

4 WEST COST PORT SITES AND RAILWAY ROUTES

4.1 WEST COAST PORT SITES

Two (2) potential west coast port sites were initially identified on 1:250,000 scale national topographic maps Site A-A above the Nanisivik Port on Strathcona Sound and site B-B on the north coast of Moffat Inlet between David's Island and Bartlett Inlet.

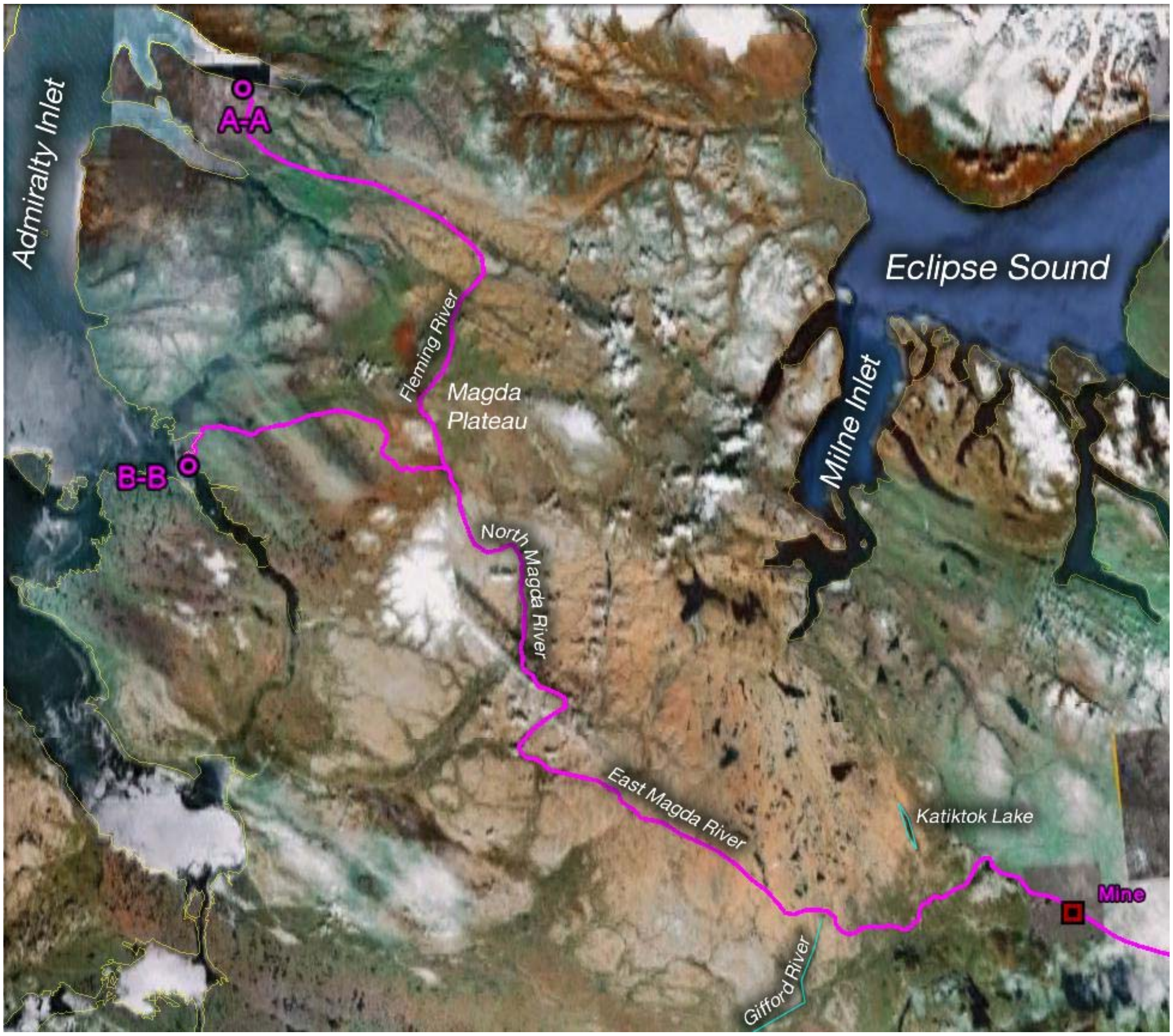
Figure 4.1 – Potential West Coast Port Sites



4.2 ROUTES TO WEST COAST PORT SITES

The assessed routes are shown in the Figure 4.2 which follows.

Figure 4.2 – Routes to West Coast Ports



All of the west coast routes follow an alignment to the north west from Mary River and then turn west to cross a tributary of the Ravn River about 15km south of Katiktok Lake. The route then drops a little to the south west, skirts the headwaters of the Gifford River and then turns northwest to enter the valley of the East Magda River which it follows, holding to the north side of the river valley.

About 20 km short of the junction of the East Magda and North Magda Rivers the route crosses northward into the valley of a river flowing parallel to the East Magda and enters the North Magda River valley about 30km north of the junction between the East and North Magda Rivers. It then follows the valley of the North Magda northwards and enters the valley of the Moffat River and follows it north until the valley turns to the west.

The route to Port Site A-A continues northward and crosses through the western arm of the Magda plateau to skirt the headwaters of the Fleming River and follow its higher reaches to the watershed divide between it and the Adams River. The route then turns west to more or less follow the line of the Adams River Valley, but retains elevation so that it passes along the divide between the Adams River and the rivers flowing north to arrive on the plateau above Nanisivik.

When the Moffat river turns westward from its northern path the route to Port Site B-B crosses the divide between the Moffat river and the river running into Fabricius Fiord and maintaining a relatively high elevation follows the line of the river valley westward, wraps around the western end of the Saw Tooth hills and arrives on the north coast of Moffat Inlet about 7km north west of Bartlett Inlet.

The costs derived for each of the routes based on typical zones is shown in Table 4.1. The routes are then compared in Table 4.2.

Table 4.1 – Segment Costs of Alternative Routes West

WEST COAST ROUTES							
Section	Typical Zone (Reach)	Chainage		Length (km)	Unit Cost (CAD/km)	Total Cost (CAD)	
		From KP	To KP			Section	Route
Common	1	0+000	55+000	55	7,443,003	409,365,146	
	2	55+000	115+000	60	5,306,051	318,363,071	
	1	115+000	230+000	115	7,443,003	855,945,306	
	2	230+000	237+500	7.5	5,306,051	39,795,384	
	SUB-TOTAL					**1,623,468,908**	
Port X	2	237+500	247+00	9.5	5,306,051	50,407,486	2,337,992,775
	3	247+000	255+000	8	5,676,453	45,411,626	
	2	255+000	275+000	20	5,306,051	106,121,024	
	3	275+000	365+300	90.3	5,676,453	512,583,731	
Port Z	2	237+500	265+000	27.5	5,306,051	145,916,408	2,047,531,526
	3	265+000	314+000	49	5,676,453	278,146,211	

Table 4.2 – Comparison of Alternative Routes West

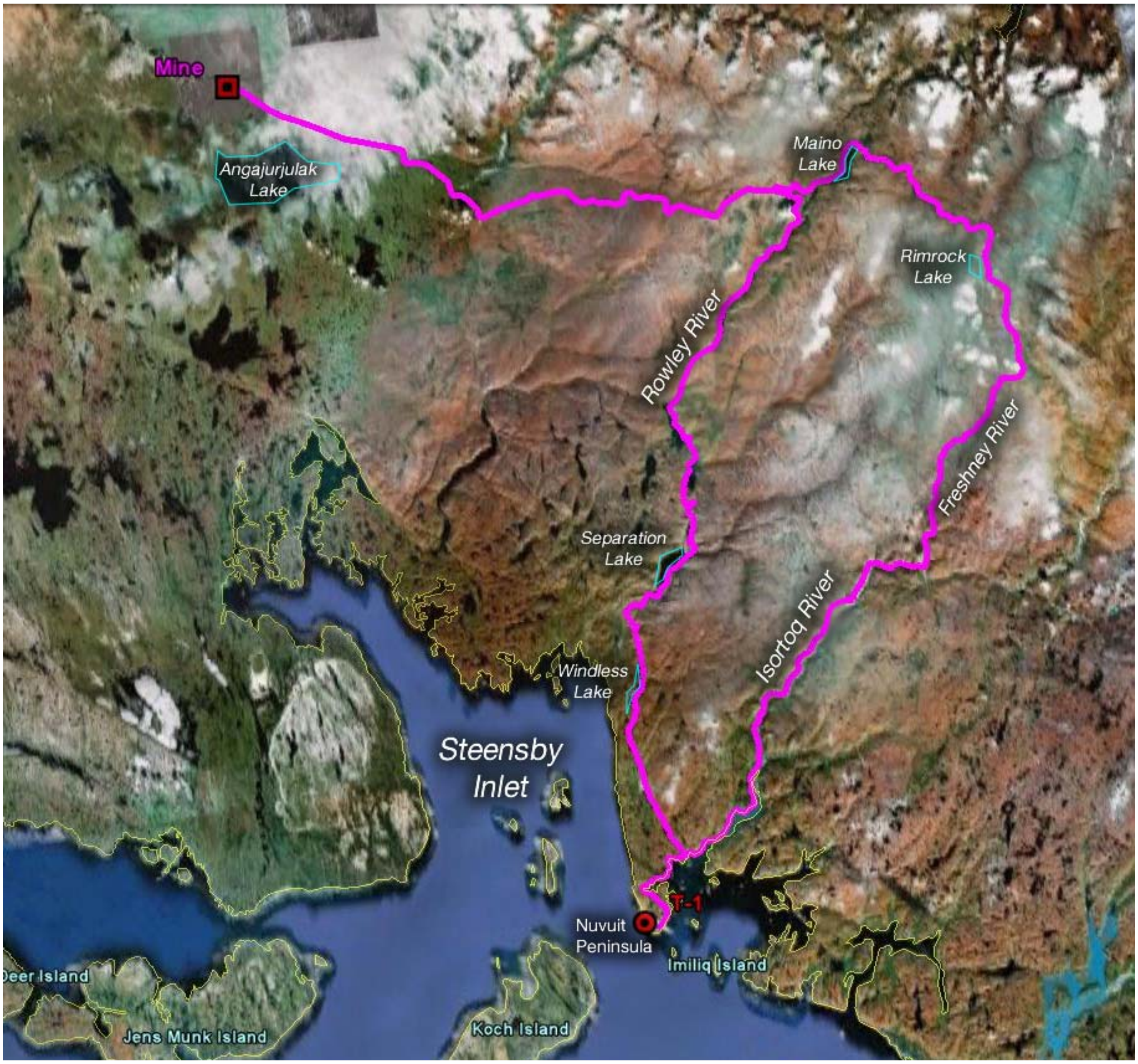
Port Site	Length (km)	Cost ($B)	Comments
A-A	366	2.34	- More than double the cost of the Steensby route - More than twice as long as the Steensby route; will have a significant impact on the fleet size and operating costs of the railway - There are 15 km in a very narrow valley, possibly prone to severe snow drifts
B-B	314	2.05	- More than double the cost of the Steensby route - More than twice as long as the Steensby route; will have a significant impact on the fleet size and operating costs of the railway - There are 15 km in a very narrow valley, possibly prone to severe snow drifts

Neither of the western port sites and railway routes would seem to provide a competitive economic alternative to the base case railway route to Steensby Port.

5 ROUTES TO NUVUIT PENINSULAR PORT SITE

The assessed routes are shown in the Figure 4.21 which follows.

Figure 5.1 – Routes to Nuvuit Peninsular Port Site



The selected port site on the Nuvuit Peninsular lies at the southern tip of the peninsular as shown in Figure 5.1 above

The route from the Mary River Mine to the Nuvuit Peninsular has a common section of approximately 148 km which follows the Steensby route to a crossing of the Ravn river and then rather than turning north to follow the Ravn River valley follows a tributary river valley eastward entering the Rowley River valley south of Maino Lake. Two potential routes diverge at this point, one to use the Rowley River valley and the other to use the Isortoq River Valley.

The divergent routes are shown in the Figure 3.35.2 which follows.

Figure 5.2 – Divergent Routes to Nuvuit Peninsular Port Site

The Rowley River route travels southwest from Maino Lake along the Rowley River through several lakes. West of Separation Lake, the alignment takes a more southerly heading, passes alongside Windless Lake and moves towards a port location on the southern end of the Nuvuit Peninsular

The Isortoq River route skirts around the north shore of Maino Lake and follows tributary river valleys east and then south to Rimrock Lake. The alignment then travels south along the Rimrock River valley and then crosses the watershed divide to follow the Freshney River in a south westerly direction. It then joins the Isortoq River valley and travels southwest to the coast and a port location on the southern end of the Nuvuit Peninsula

The costs derived for each of the routes based on typical zones is shown in Table 5.1. The routes are then compared in Table 5.2

Table 5.1 – Segment Costs of Alternative Routes to the Nuvuit Peninsula

ROUTES TO NUVUIT PENINSULAR							
Section	Reach	Chainage		Length (km)	Unit Cost (CAD/km)	Total Cost (CAD)	
		From KP	To KP			Section	Route
Common	1	-4+000	56+438	60.438	7,443,003	449,840,195	
	2	56+438	124+328	67.89	5,306,051	360,227,815	
Rowley River	2	124+328	180+486	56.158	5,306,051	297,977,223	2,031,240,013
	3	180+486	226+729	46.243	5,676,453	262,496,229	
	1	226+729	238+591	11.862	7,443,003	88,288,898	
	3	238+591	291+901	53.31	5,676,453	302,611,724	
	Tunnels			4.986		135,788,220	
Isortoq River	2	124+328	257+634	133.306	5,306,051	707,328,460	2,248,132,553
	3	257+634	356+231	98.597	5,676,453	559,681,264	
	Tunnels			1.293		37,045,110	
Common	3			23.608	5,676,453	134,009,709	
	COMMON SUB-TOTAL					**944,077,719**	

Table 5.2 – Comparison of Alternative Routes to the Nuvuit Peninsular

Route	Length (km)	Cost ($B)	Comments
Rowley River	316	2.0	- Requires three tunnels: on lake north of Separation Lake; at Separation Lake; and south of Windless Lake - More than twice as long as the Steensby route; will have a significant impact on the fleet size and operating costs of the railway - More than double the cost of the Steensby route
Isortoq River	380	2.2	- Requires one tunnel south of the mouth of the Isortoq River - More than twice as long as the Steensby route; will have a significant impact on the fleet size and operating costs of the railway - More than double the cost of the Steensby route

Neither of the routes to the Nuvuit Peninsular would seem to provide a competitive economic alternative to the base case railway route to Steensby Port.

6 CONCLUSION

The routes to the east are more expensive than that to Steensby, but not so much so that they should not bear consideration. The cost implications of these options on the overall project cost should be examined to truly test their viability. However, since they do not present a cost advantage the additional problems they present relating to exposure to snow drift situations and to the navigation issues in Cambridge and Quernbiter Fiords they do not present an attractive alternative to Steensby. Additionally the port sites, and shipping viability to these locations, have not been evaluated and may also present challenges or technical barriers that are not identified in this memorandum

The routes to the west and to the Nuvuit Peninsular are far longer and thus far more expensive than the railway to Steensby, when this is added to additional fleet and operating expenses for the railway the west coast also does not seem to be able to present an attractive alternative to Steensby, based on the railway alone and not considering port sites and shipping issues.