THE NORTHERN TRANSPORTATION SYSTEMS ASSESSMENT

Phase 2 Report

Infrastructure

Needs Assessment

January 2011

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Infrastructure Needs Assessment

Prepared for Transport Canada

Prepared by PROLOG Canada Inc.

In Association with EBA Engineering Consultants Ltd.

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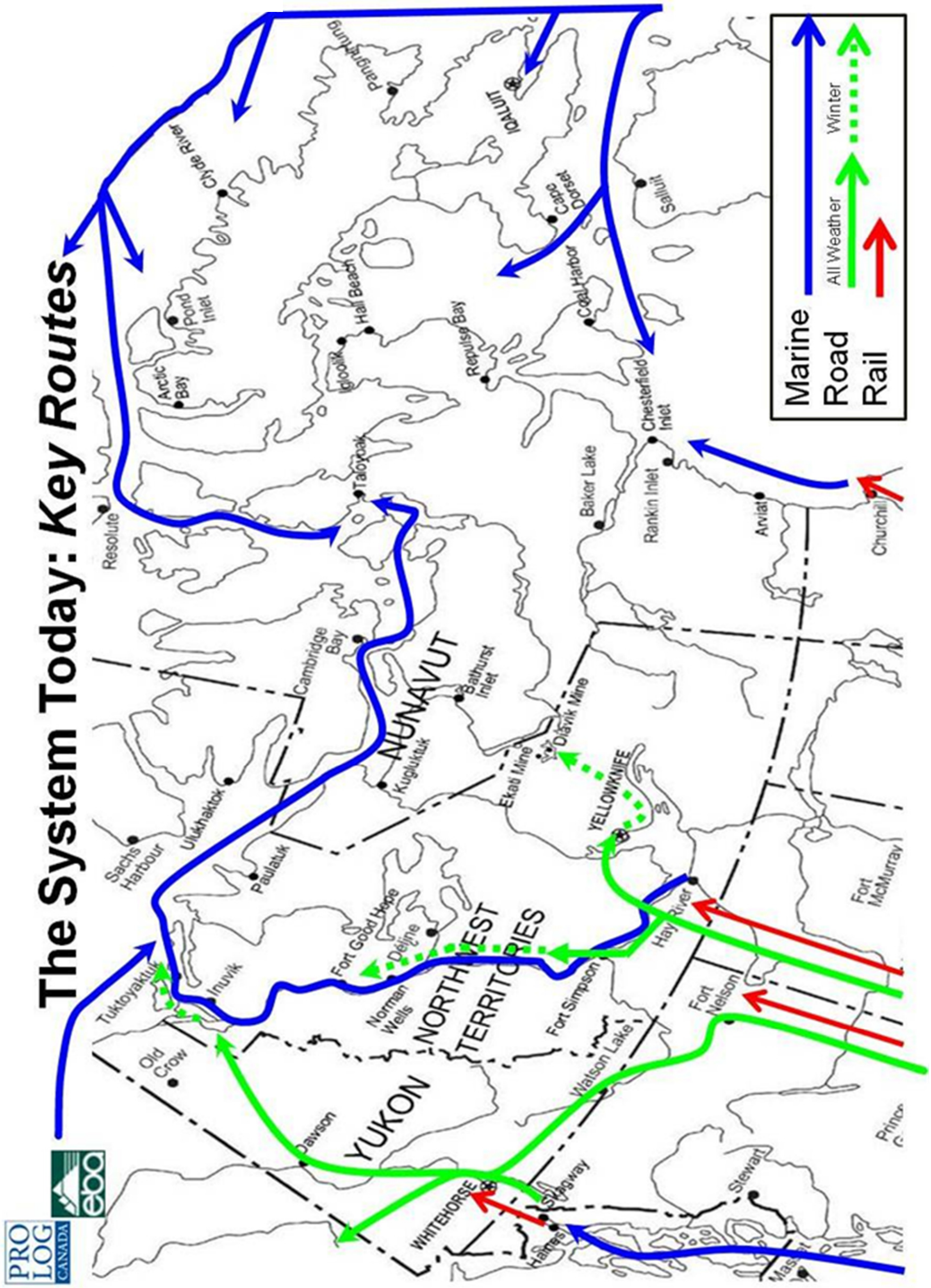
The System Today: Key Routes
Marine
Road
Rail
All Weather
Winter
PRO LOG CANADA
YUKON
NORTHWEST TERRITORIES
NUNAVUT
Resolute
Arctic Bay
Pond Inlet
Clyde River
Pangnirtung
IQALUIT
Cape Dorset
Salluit
Coral Harbor
Hall Beach
Igloolik
Repulse Bay
Chesterfield Inlet
Baker Lake
Rankin Inlet
Arviat
Churchill
Taloyoak
Cambridge Bay
Bathurst Inlet
Kugluktuk
Ulukhaktok
Sachs Harbour
Paulatuk
Tuktoyaktuk
Inuvik
Old Crow
Dawson
Fort Good Hope
Deline
Norman Wells
Fort Simpson
Hay River
Fort Nelson
Fort McMurray
YELLOWKNIFE
Ekati Mine
Diavik Mine
Watson Lake
WHITEHORSE
Skagway
Haines
Stewart

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Northern Transportation Systems Assessment

Phase 2 Report
Infrastructure Needs Assessment

1. Introduction

This is the Phase 2 Report of the Infrastructure Needs Assessment for the Northern Transportation Systems Assessment Study. Phase 2 builds on the Transportation Demand Assessment completed in Phase 1.

The objective of the Northern Transportation Systems Assessment is to determine what transportation infrastructure is required to support growing demand in the North over the next 20 years, and to determine what incremental improvements will build towards a transportation system that supports Canada's vision for northern development. To meet that objective this Phase 2 Northern Transportation Infrastructure Needs Assessment:

- Compares existing transportation capabilities and constraints with proposed infrastructure investments to determine potential performance changes in future cost, service or reliability;
- Applies potential performance changes to recast modal split projections, analyze transportation system reconfigurations, and monetize future infrastructure savings/benefits versus costs; and
- Screens future infrastructure savings/benefits versus costs to help set northern transportation system investment priorities over a 20 year planning horizon.

The scope of this assessment includes the principal roads, ports, rail and air infrastructure embraced by the map of Northern Canada below.

Phase 2 started with engagement of Northern Stakeholders to consider a changing climate with evolving regional and international challenges. Experts in arctic shipping, circumpolar ice regimes, northern socio-economic, military and geopolitical issues provided knowledge and advice important to transportation infrastructure investment decisions for the North.

A key conclusion of many stakeholders is that the high cost of northern infrastructure requires careful consideration of all opportunities for cost sharing partnerships where multiple needs can be met with the same facility. Toward that end, the Phase 2 Assessment looks at major infrastructure needs with an eye for potential or existing multi-use facilities that can share the required investment among multiple users. The study also looks for projects that can provide incremental transportation improvement with staged infrastructure investment.

Phase 2 provides a high-level financial feasibility assessment of major infrastructure projects based on shipper savings that can be reasonably quantified. Public interest requirements for remote transportation safety and resupply reliability, for isolated community access and development, and for protection of a fragile northern environment while not monetized in this assessment are equally, and sometime more, important to balance infrastructure investment decisions in the North.

The Phase 1 Report found that the majority of transportation demand in much of the North is for bulk fuel delivery. The prospect of many new mining projects expanding demand for diesel fired power generation and the consequent transportation impact of that demand on infrastructure needs has been a major focus for this assessment. The potential for hydro-electric power generation, and perhaps nuclear power, to replace transportation infrastructure with transmission infrastructure is a long term opportunity which should not be overlooked. The potential for that infrastructure substitution is outlined in an appendix to this report, however it is not considered likely within the current 20 year planning horizon.

2. Canadian Arctic Sealift System

This chapter of the report screens the Canadian Arctic Sealift System for potential performance changes and parallel infrastructure needs.

In the Eastern Arctic, where a sealift beach is the typical marine terminal facility, these include:

- The public sector opportunity to reduce sealift costs and increase sealift reliability with regional distribution as inter-community roads are developed in the Kivalliq Region; and with incremental investment in permanent port facilities at Iqaluit; and
- A private sector facilities investment proposed for northern Baffin Island at Steensby Inlet and Milne Inlet that will accommodate intensive year around import/export trade between Nunavut and Europe as well as summer sealift from Montreal, both with spin-off opportunities for Nunavut community resupply.

In the Western Arctic, this chapter previews emerging sealift reconfiguration as a competitive marketplace emerges in one of the most remote regions of Canada, characterized by:

- Eastern sealift cargo ships and product tankers entering the western arctic while Mackenzie River barges are superseded by ocean vessels from the west coast; and
- A shift from traditional use of river barges that can come alongside shallow draft community wharfs, to shallow draft barge shuttles from deep draft ocean vessels.

This chapter continues with screening sealift infrastructure issues at two Western Arctic port development locations:

- Tuktoyaktuk - the once and future supply base for Beaufort Sea/Mackenzie Delta oil and gas field development, and the only improved port in the Western Arctic with the depth of water to allow cargo transfers - but with access constrained by an undredged channel entrance.
- Coronation Gulf Port and Road - infrastructure investment that is required before Nunavut base metal mines can be developed. Existing diamond mines in the NWT could also use this infrastructure to reduce their cost of inbound fuel and other bulk resupply and to mitigate their risk of having to rely on the Tibbitt to Contwoyto Winter Road as their sole means of surface transportation. This would provide the project with an immediate return on investment.

While a Coronation Gulf Port and Road project is integral to future Nunavut base metal mining feasibility, this chapter shows how winter road risk and savings benefits for currently producing NWT diamond mines can offset advanced project investment on a stand-alone basis.

Over the next 20 years, the Canadian Arctic Sealift System is anticipated to encounter a warmer climate with an extended shipping season that will see:

- Increasing options for community resupply sealift
- Reduced risk for resource development sealift
- Greater international arctic activity, and
- Corresponding strategic national initiatives.

However, an extended sealift season will not create much commercial attraction for cargo ships to transit the Canadian Northwest Passage on a regular basis. The Russian Northern Sea Route is a shorter, more attractive passage between Europe and Asia – which is the major merchant marine market. Market economics will determine whether commercial ships will transit the Canadian Northwest Passage. A more relaxed ice regime will not make any difference without a market.

Ship owners see Canada's Arctic as a destination market, rather than part of an international trade route. However, the lack of permanent marine facilities at arctic coastal destinations can constrain progress for community and resource development that, short of air access, is otherwise stranded without sealift.

A warming climate and extended shipping season are fostering new sealift supply chains for coastal destinations:

- Eastern Arctic Sealift ship owners are expanding into the Western Arctic; and
- Western Arctic Sealift is shifting from Mackenzie River to Pacific Coast vessels.

Non-commercial Canadian initiatives are also adding marine activity with a High Arctic Research Station at Cambridge Bay and an Arctic Training Centre joining the Polar Continental Shelf Project at Resolute Bay. As well a new fleet of Navy Arctic/Offshore Patrol Vessels and Coast Guard ice breakers are to be supported from Nanisivik.

In this chapter assessment of sealift infrastructure needs seeks multifunctional, multi-user port development opportunities in both the Eastern and Western Arctic.

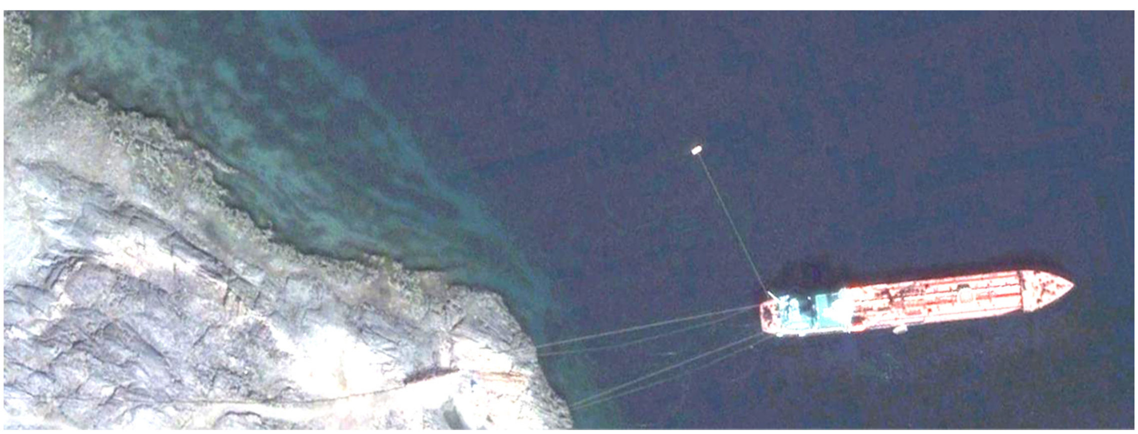
2.1 Eastern Sealift System

In the Eastern Arctic, permanent sealift facilities investment has in the past been, and is poised in the future to be, private sector driven by major mining projects.[1] The Polaris and Nanisivik lead/zinc mines both invested in deep draft docks and terminal storage facilities for mineral exports and mine supply using bulk ships in sealift service to and from Europe.

The Polaris facility has been completely removed with the closure and remediation of the mine. However, following closure of the Nanisivik mine, the deep water dock there has been retained as a fuelling facility for Canadian Navy and Coast Guard ships.

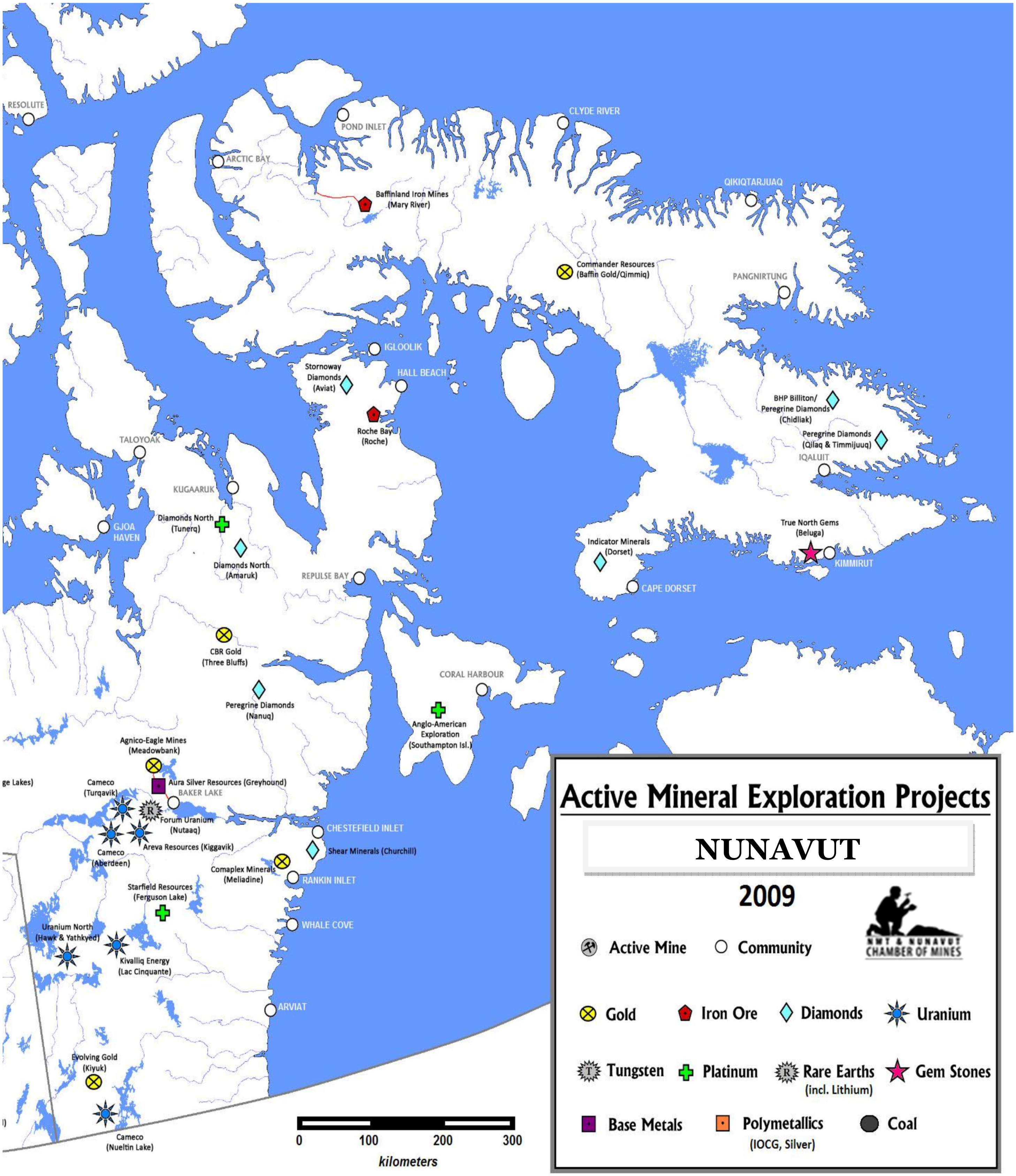
In the same northeast area of Baffin Island, future development of the Baffinland Mary River Iron Ore Mine includes investment in a preliminary port facility at Milne Inlet on the north coast and a production port facility at Steensby Inlet on the south coast in Foxe Basin.

The map on the following page shows Eastern Arctic mineral exploration projects and Nunavut communities, both of which rely on sealift for resupply.



Google Earth image of sealift tanker discharge at Iqaluit Inuit Head pipeline header.

[1] Future consideration is also possible for public sector investment in multi-functional facilities to provide logistics support at Resolute Bay for additional Canadian Forces, scientific projects, community and resource development to be based there.


Active Mineral Exploration Projects
NUNAVUT
2009
NWT & NUNAVUT CHAMBER OF MINES
Active Mine
Community
Gold
Iron Ore
Diamonds
Uranium
Tungsten
Platinum
Rare Earths (incl. Lithium)
Gem Stones
Base Metals
Polymetallics (IOCG, Silver)
Coal
0
100
200
300
kilometers
RESOLUTE
POND INLET
CLYDE RIVER
ARCTIC BAY
Baffinland Iron Mines (Mary River)
QIKIQTARJUAQ
Commander Resources (Baffin Gold/Qimmiq)
PANGNIRTUNG
IGLOOLIK
HALL BEACH
Stornoway Diamonds (Aviat)
Roche Bay (Roche)
BHP Billiton/ Peregrine Diamonds (Chidliak)
Peregrine Diamonds (Qilaq & Timmijuuq)
IQALUIT
TALOYOAK
KUGAARUK
Diamonds North (Tunerq)
GJOA HAVEN
Diamonds North (Amaruk)
REPULSE BAY
Indicator Minerals (Dorset)
CAPE DORSET
True North Gems (Beluga)
KIMMIRUT
CBR Gold (Three Bluffs)
CORAL HARBOUR
Peregrine Diamonds (Nanuq)
Anglo-American Exploration (Southampton Isl.)
Agnico-Eagle Mines (Meadowbank)
Aura Silver Resources (Greyhound)
BAKER LAKE
Cameco (Turqavik)
Forum Uranium (Nutaaq)
Areva Resources (Kiggavik)
Cameco (Aberdeen)
CHESTERFIELD INLET
Shear Minerals (Churchill)
Comaplex Minerals (Meliadine)
RANKIN INLET
Starfield Resources (Ferguson Lake)
WHALE COVE
Uranium North (Hawk & Yathkyed)
Kivalliq Energy (Lac Cinquante)
ARVIAT
Evolving Gold (Kiyuk)
Cameco (Nueltin Lake)

2.1.1 System Overview

This section of the report looks at sealift facilities development in three major areas:

- First Stage development of an Iqaluit port facility for more reliable dry cargo discharge during all tide conditions and to relieve a chronic sealift bottleneck.
- Consideration of the future deep water port cluster consisting of Steensby Inlet, Milne Inlet and Nanisivik for new sealift options including bulk fuel and cargo redistribution and container transport to and from Europe.
- Rankin Inlet hub port development for bulk fuel and dry cargo transfers to smaller vessels for Chesterfield Inlet transits to Baker Lake; and to planned community roads for distribution to Arviat and Whale Cove; and for empty marine container return via winter road to Winnipeg.

Recommended Approach for Eastern Sealift

Seek development of multifunctional facilities that can more cost-effectively serve emerging resource industry needs in combination with ongoing Nunavut resupply reliability requirements; and ensure community marine infrastructure capability for:

- ***Safe, secure landing and distribution of dry cargo; and***
- ***Environmentally secure fuel transfers with effective tanker systems.***

The closest fully developed deep draft port that can support Eastern Sealift operations is at Churchill, Manitoba. Without the permanent port facilities supporting conventional cargo handling at southern Canadian ports, the Eastern Sealift System has adapted unique cargo discharge operations to resupply coastal communities in Nunavut:

- Fuel supply transfers from petroleum product tankers rely on floater hoses deployed between ships at anchor and pipeline headers on the shore;
- Dry cargo resupply relies on lighter barges shuttling containers and loose stow cargo between ships at anchor and a sealift beach or sometimes a shallow draft dock; and
- Combination fuel and dry cargo tug/barges discharge direct to shore at barge push-outs or shallow draft docks.

These systems consistently meet most community resupply requirements each sealift season. Performance change has been ongoing with sealift ship owners investing heavily in new ice class vessels that are now able to provide a greater degree of seasonal flexibility and increased container capacity for large shippers while continuing traditional loose stow cargo lighterage for smaller shippers.

The two ships pictured below are typical of both Nunavut Sealift and Supply Inc. (NSSI) and Nunavut Eastern Arctic Shipping (NEAS) dry cargo resupply sealift fleet:

NSSI M/V Sedna Desgagnés
Speed: 15.5 knots
Deadweight: 12,612 tonnes
LOA: 139.00 m; Draught: 8.00 m
Equivalent to Lloyd's 100 A1 Ice Class 1A
Builders: Qingshan Shipyard, China, 2009
Containers: 665 TEU
Holds: 15,953 m^3
2 x180 mt cranes

NEAS M/V Qamutik
Speed: 16 knots
Deadweight: 12,754 tonnes
LOA: 137.16 m; Draught: 8.515 m
Lloyd's 100 A1 Ice Class 1A
Built: Netherlands 1994
Containers: 730 TEU
Bale: 14,870 m^3
3 x 600 mt cranes

Despite an ongoing record of sealift success, safety and reliability as well as efficiency remain somewhat at risk with the lack of port facilities in environmentally challenging conditions.

For the dry cargo sealift system:

- Weather delays can curtail discharge operations not just where they occur, but at subsequent discharge locations as well.
- Dry cargo discharge to above the high water mark substitutes for conventional marine terminal operations within a secure perimeter and with container freight station stripping and distribution facilities.
- Container operations are limited to larger shippers (i.e., Northern Stores and Arctic Cooperatives) with the storage facilities to offload and return containers within a single sailing window.
- Safety can be a concern with heavy equipment moving cargo on a sealift beach that is often in the centre of a community.

For the fuel supply sealift system, tanker operations in the Arctic are highly specialized. Floater hoses, containment booms and in some cases skimmers carried on board are deployed for fuel transfers and to mitigate the risk of spills. Two tankers in arctic sealift service from the Woodwards Group are shown below.

Double hulled *MT Nanny* 117m fuel tanker built 1993

Icebreaking tanker *MT Tuvaq* Finnish design built 1977

In the North, ship owners are left to inspect their own operations without any vetting by the Nunavut or NWT governments. This would not be acceptable in southern Canada where as a matter of policy, tankers in oil company service are rigorously monitored and must typically be no more than 10 years old. All tankers serving the Arctic are over 15 years old and most are over 20 years old. Tugs may be 40 years old and barges may be over 30 years old.[2]

No tanker is employed in the service of an oil company that is not inspected under the Ship Inspection Report program (SIRE), a unique tanker risk assessment tool for charterers, ship operators, terminal operators and government bodies concerned with ship safety; and any international tanker, bulk carrier, or container ship must be managed with the International Safety Management System. However, domestic Canadian coastwise operations are specifically exempted, raising concerns that hazard identification, risk management, and effective safety processes may be inadequate for the North.[3]

Spill response in the south is provided through co-operatives for different parts of the country. Transport Canada sets the standards for these organizations with Response Organizations and Oil Handling Facilities Regulations.

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[2] The Government of Canada recently waived the 25 percent tariff for all general cargo vessels and tankers, as well as ferries longer than 129 metres, that are imported into Canada after January 1, 2010. This will make it easier to replace aging ships with cleaner, safer and more efficient vessels.

[3] The risk is real as MT Nanny pictured here ran aground in 2010 near Gjoa Haven with a cargo of diesel fuel. However, the potential consequence of an arctic diesel fuel spill, while not to be minimized, is also not to be confused with the far more severe impact of a crude oil tanker spill. (MT Nanny did not spill any diesel fuel.)

In the Arctic, a Beaufort Sea Cooperative that was comprised of the major oil companies previously based at Tuktoyaktuk has long been disbanded. As there is no longer any response organization, the Canadian Coast Guard assumes that role for the entire Canadian Arctic.

Over the last 30 years caches of oil spill equipment have been established in Arctic communities in addition to the sizable store that was inherited from the Beaufort Sea Oil Spill Cooperative. Recently the government has announced that it will be sending additional equipment to 19 Arctic communities. The Coast Guard ships that operate in the Arctic also carry oil spill response supplies and equipment on board.

Over the next 20 years the extent of permanent port infrastructure investment in the Eastern Arctic will, in combination with strategic non-commercial initiatives, be dependent upon the prospects for:

- Mining industry project specific full port facilities development; and
- Public sector incremental improvement in local and regional sealift resupply facilities.

From the Phase 1 Demand Report, following traffic projections provide the context for Eastern Sealift infrastructure needs assessment.

Qikiqtaaluk Eastern Arctic Traffic Projections

(tonnes/year)

	2010	2015	2020	2025	2030
Baffinland Iron Ore Exports		**9,000,000**	**18,000,000**	**18,000,000**	**18,000,000**
Baffinland Mary River Mine Supply	1,000	107,000	10,000	10,000	10,000
Baffinland Mary River Mine Fuel	2,000	17,000	41,000	41,000	41,000
Total Resource Development	**3,000**	**124,000**	**51,000**	**51,000**	**51,000**
Community Fuel Supply	73,596	77,680	81,327	84,464	87,236
Community Resupply	15,145	15,985	16,736	17,381	17,951
Mining Induced Resupply*	600	24,800	10,200	10,200	10,200
Total Inbound Traffic	**92,341**	**242,465**	**159,263**	**163,045**	**166,387**

Kivalliq Hudson Bay Traffic Projections

(tonnes/year)

	2010	2015	2020	2025	2030
Kivalliq Region Mine Supply	23,000	38,000	68,000	68,000	68,000
Kivalliq Region Mine Fuel	17,000	52,000	78,000	78,000	78,000
Total Resource Development	**40,000**	**90,000**	**146,000**	**146,000**	**146,000**
Mining Induced Resupply*	8,000	18,000	29,200	29,200	29,200
Community Resupply	42,288	44,636	46,732	48,534	50,121
Total Inbound Traffic	**90,288**	**152,636**	**221,932**	**223,734**	**225,321**

* Induced traffic assumed as .2 x total resource development traffic.

2.1.2 Performance Change

The relatively small scale of Nunavut community resupply dictates modest incremental improvements in Eastern Sealift systems. The Nunavut Government has undertaken an inventory of community harbours with a view toward improving small craft harbours and complementary sealift capabilities according to the unique needs of each community. These include various combinations of:

- Breakwaters to mitigate open water/weather exposure;
- Shallow draft docks or ramps to accommodate extreme tidal conditions;
- Bollards, moorings and other tie-downs to secure sealift ships; and
- Relocation of awkward sealift landing locations.

There is also a common requirement in all communities for cargo staging safety and security improvements. As long as a loose stow cargo operation is required for smaller shippers, a more substantial cargo receiving area than current delivery to above the high water mark is warranted. Initially, this can be as simple as a fenced and lighted concrete hard stand for cargo receipt and distribution following sealift departure.

In the longer term, containerization offers an alternative to clear sealift beaches of loose stow cargo for smaller shippers, but requires the more substantial infrastructure investment in a warehouse where containers can be stripped and returned on the same sailing. Container conversion of loose stow cargo is a positive performance change already in practice by larger shippers (i.e., Northern Stores and Arctic Co-Operatives) with warehouse capacity to receive and return containers on the same sealift sailing.

Returning containers on the same sailing is a prerequisite for extending the lower cost packaging, handling and security advantages of containerization to smaller shippers, without imposing the higher cost of a container kept through the winter. A common-user container freight stripping station can help meet that pre-requisite for less than container load shipments.

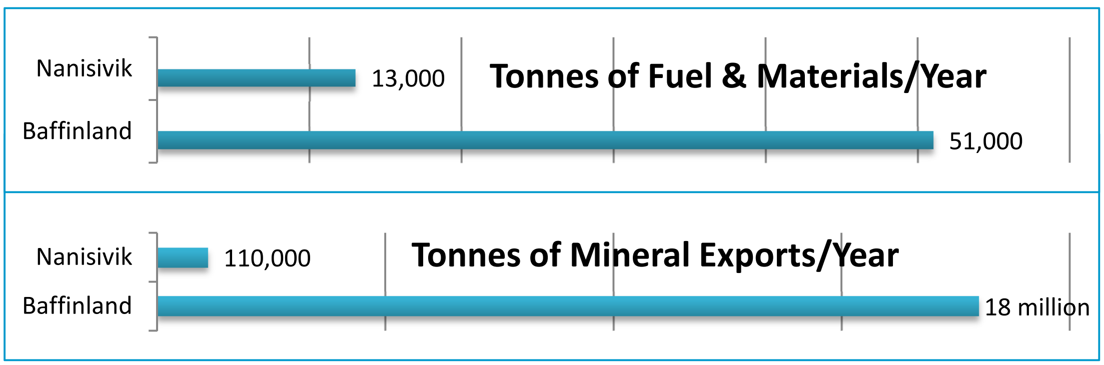
For community resupply, sealift operators have developed a reasonably adequate delivery system that can improve performance with small scale infrastructure investments uniquely targeted to each community. However, for resource development projects much larger scale infrastructure is anticipated. In particular the Baffinland Mary River Iron Mine Project could bring a huge order of magnitude shift to sealift operations and opportunities in Nunavut.

This section of the report looks at that potential for system performance change with (a) new northern Baffin Island infrastructure as well as for (b) incremental southern Baffin Island infrastructure development and (c) Hudson Bay infrastructure improvements.

a) Northern Baffin Island Infrastructure

A dramatic change in performance of resource sector sealift support in Nunavut is shown in the following table. It compares the previous level of sealift support for the Nanisivik lead/zinc mine to proposed support for the Mary River iron mine, both on North Baffin Island.

Sealift Cargo	Nanisivik Lead/Zinc Mine	Baffinland Iron Mine
Mine Resupply Material	2,500 tonnes/year	10,000 tonnes/year
Mine Fuel Supply	10,400 tonnes/year	41,000 tonnes/year
Mineral Exports	110,000 tonnes/year	18 million tonnes/year



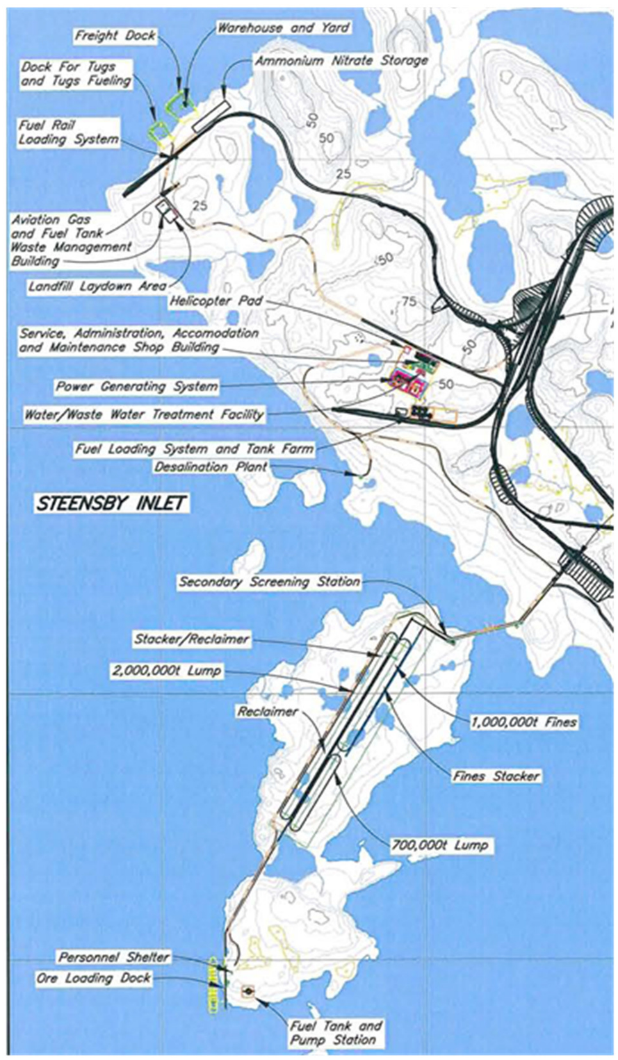
Compared to the modest Nanisivik docking and fuelling facility now used by the Canadian Navy and Coast Guard, the Mary River Project will be connected by a 143 km railway south to a deep water port complex at Steensby Inlet in Foxe Basin. To the North a tote road and deep water sealift connection at Milne Inlet are already in use.

The scale of transportation infrastructure investment that the Mary River project may bring to Nunavut would result in a number of changes to sealift cargo operations in the Eastern Arctic, including:

- Year around sealift transport for inbound fuel supply as well as outbound iron ore;
- Permanent deep water dock facilities for intermodal marine container transfer; and
- Overland rail/road connections with harbours on two coasts of Baffin Island.

Sealift facilities and operations planned for Steensby Inlet include:

- A sheet pile construction service dock and tug refuelling dock located in a protected bay with container handling equipment and adjacent warehouse and storage yard. The service dock will handle tankers and dry cargo supply ships during the open water season.



- A steel shell construction dock for cape-size ore carriers with a draft of 17.8 metres. Ore loading will average 12 ships per month (one every 2.5 days) year-round and up to 17 vessels per month in summer open-water season when non-icebreaking ships will bring additional materials and supplies. The resulting shipping schedule equates to a ship moving in and out of Foxe Basin roughly every 1.3 days (32 hours). This shipping frequency will increase during the open water season when sealifts will provide annual re-supply and supplemental market vessels to ship additional ore.

- A 45 million litre capacity tank farm and 3.3 km pipeline connection to the ore loading dock for diesel fuel discharge from incoming ore ships year around plus large tanker re-supply during summer. It is expected that at least one of the icebreaking ore carriers will be equipped with an additional fuel tank holding some 3 million litres of diesel fuel delivered upon arrival to load ore, thereby providing a year-round supply of diesel fuel to the Project. Some tanker deliveries during the open water season are also expected to fully supplement the annual fuel needs of the Project.

Milne Inlet is the current staging point for exploration and development in the northern region of Baffin Island. The Mary River mine site is connected to Milne Inlet by a 99km access road. There are plans to use the Milne Inlet sealift access point to load 2 to 5 million tonnes of early stage mine production per year onto cargo vessels during open water season.[4] This will require upgrades to the existing access road and marine facilities at Milne Inlet. Milne Inlet will also be used to unload oversized equipment from southern Canada via conventional sealift.

The infrastructure developments that will be required to support full production at the Mary River project can create new opportunities for reducing community resupply costs in Nunavut. The legacy of the Mary River project for Nunavut could include:

- Sharing the benefit of a marginal cost backhaul for bulk fuel delivery on empty ore ships from Rotterdam and strategic petroleum products storage with subsequent Nunavut distribution through the existing tanker delivery system.
- Creating combined community/mine resupply container traffic threshold for a Nunavut "load centre" potentially attracting liner services (e.g., Eimskip/Royal Arctic Lines Halifax-Greenland) with container distribution and return over an extended season.
- Cooperative private/public sector development of a permanent mine site community rather than temporary camp accommodations for a multi-generational project with transportation and utilities infrastructure, and corresponding lower cost of living, unavailable elsewhere in Nunavut.

The level of year around marine traffic that will result from the Mary River project may warrant the increased Canadian Coast Guard icebreaking support, improved Canadian Hydrographic Service support, and new polar satellite based weather and communications support that can benefit all arctic shipping. The increased level of traffic should also help to spread risks and reduce insurance rates for ship owners operating in the Arctic.

b) Southern Baffin Island Infrastructure

Public port infrastructure investment in Iqaluit might allow Nunavut to capitalize on the private infrastructure investment and increased traffic that will be created by the Mary River project. A permanent dock with container handling and storage facilities, combined with an extended open water season over the next twenty years could attract new container shipping services to call at Iqaluit as well as Steensby Inlet.

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[4] Three trial cargo shiploads of iron ore were loaded onto vessels at Milne Inlet in 2008.

Port improvements at Iqaluit would also save ship time consumed by over-the-water cargo discharge operations for current resupply ship owners. With the change in cargo handling and assuming:

- Dry cargo discharge time can be cut by 75% compared to current sealift beach lightering limited to half tide (6 hours) over a long distance to shore; and
- Bulk fuel discharge time can be reduced by 25% with direct connection of larger diameter hoses at higher pump-off pressure than floater hoses;

Then the following table shows the potential in-port ship time savings available from this sealift infrastructure investment.

In-Port Ship Time Savings Potential
Iqaluit Deep Water Dock Development

	Dry Cargo Vessel	Tanker	Total
Status Quo			
Assumed days to discharge cargo	5	4	
Assumed sailings per season	15	7	
Assumed in-port ship cost per day	$25,000	$25,000	
Annual Iqaluit in-port ship cost	$1,875,000	$700.000	$2,575,000
Deep Water Dock Option			
Reduction in ship discharge time	75%	25%	
New Annual Iqaluit in-port ship cost	$468,750	$525,000	$993,750
Resulting savings per year	$1,406,250	$175,000	$1,581,250

The most significant change in sealift performance from deep water dock development is elimination of tidal constrained dry cargo lighterage to a sealift beach[5].

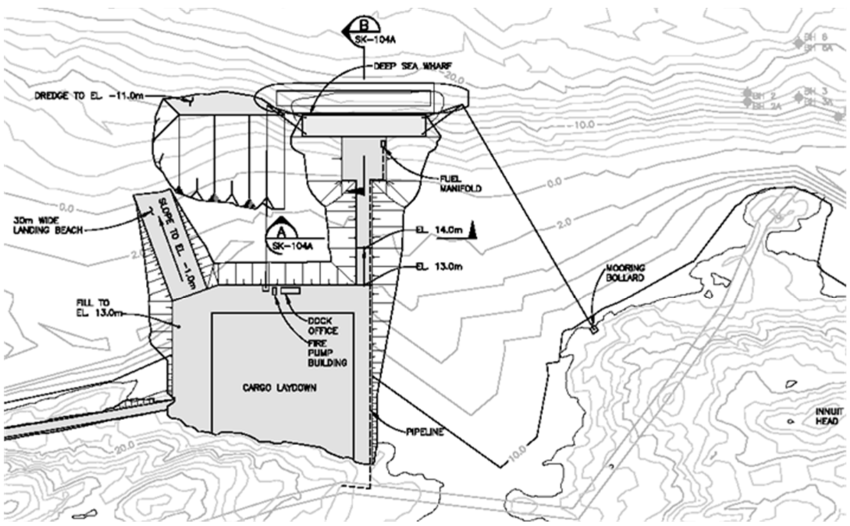
Elimination of floater hose connections for tanker discharge does not provide the same level of savings as for dry cargo vessels because tanker operations are not tidal constrained. Discharging alongside a dock is not that much faster than using a floater hose. Savings are also more limited because there are far fewer tanker sailings than dry cargo sailings per year into Iqaluit.

[5] Current in-port ship time/delay is assumed 50% due to tidal conditions limiting discharge to approximately 6 hours in every tide cycle and at least 25% for the lighterage distance to shore that can be avoided with new port development.

There are a number of advantages from Iqaluit deep water port development that while not so easily monetized would offer significant benefits to shippers, ship owners and the broader public interest. These include:

- Easing a chokepoint for subsequent sealift delivery to smaller Nunavut communities;
- More revenue cargo capacity where lighterage equipment is now carried on board;[6]
- Safer and secure handling/storage for loose stow and less than container load cargo;
- Reduced fuel spill risk with elimination of floater hose connections.

Some of these benefits may be achieved incrementally with initial investment to construct a sealift beach landing ramp at the port development site to accommodate continuous dry cargo lighterage in all tidal conditions (see following port development site plan).



c) Hudson Bay Infrastructure

Kivalliq region sealift performance along the Hudson Bay coast is already changing with the resource development demand driven by Agnico Eagle Meadowbank and Meliadine Gold Mines. The Meadowbank Mine near Baker Lake is now in production and the Meliadine Mine near Rankin Inlet is in development.

[6] Assuming Iqaluit is the first port of discharge where lighterage equipment can be seasonally staged and loaded for traditional sealift beach discharge at other Nunavut communities.

The following table shows that Kivalliq traffic in 2007 is forecast to increase fourfold for dry cargo and almost double for bulk fuel over the five year period to 2012.

Kivalliq Community and Mine Resupply

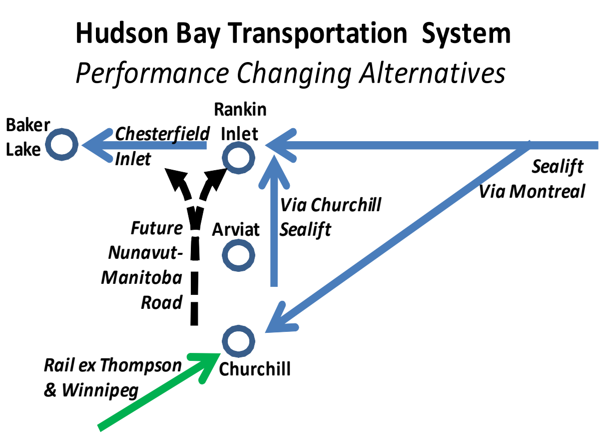
Combined Sealift Tonnes/Year

	2007	2012	Increase
Dry Cargo	13,000	66,000	4.1 times
Bulk Fuel	30,000	84,000	1.8 times
Total Sealift	43,000	150,000	2.5 times

The increase in transportation demand in the Kivaliq Region has followed and reinforced competition from Montreal based ship owners NSSI and NEAS that entered the Hudson Bay market in the late 1990's. Until then Northern Transportation Company Limited (NTCL) was from 1975 the sole service provider to the Kivalliq Region with combination bulk fuel and dry (deck) cargo barges connecting with the Hudson Bay Railway at Churchill from Winnipeg.

Direct tanker deliveries currently contracted to the Woodwards Group and a competitive market among the three dry cargo sealift operators has lead to intermittent NTCL service since 2001.

Among the ongoing changes in Kivalliq region sealift performance:



- Montreal based dry cargo ships (NSSI and NEAS) calling at the Hudson Bay Port of Churchill as well as directly in each Kivalliq community.
- Introduction of dry cargo lighterage to sealift beaches by NSSI and NEAS as well as traditional NTCL landings at barge pushouts.
- Transhipment of dry cargo and bulk fuel from deep draft ships to smaller vessels able to transit Chesterfield Inlet 320kms from Hudson Bay to Baker Lake.

The Port of Churchill provides existing deep water port infrastructure that can facilitate future Eastern sealift opportunities. It is a fully developed port facility offering access to communities and resource development projects in Nunavut - with deep water berths, cargo sheds, a bulk fuel tank farm, grain elevator and connection to the continental rail system. The Port of Churchill is a multi-functional facility requiring relatively minor infrastructure investment to serve multiple users.

In meeting future demand, and with an extended shipping season, the threshold for market critical mass may be met that can attract innovative new services (e.g., Royal Arctic Line North Atlantic container connections) to benefit both the Kivalliq region and Northern Manitoba. Churchill was once the hub for distribution of Winnipeg sourced goods to Kivalliq communities – and may in future redevelop that role for a broader spectrum of origins and destinations.

Nunavut sealift infrastructure investment for regional port development at a Kivalliq Community like Rankin Inlet may also be warranted given the amount of resource development traffic that is anticipated over the next 20 years. In conjunction with the prospect for initial development of a community road system ultimately linked to the Manitoba highway network, a Kivalliq regional port could provide highway distribution for containers discharged at a deep water port as well as facilitate cargo transfer to Baker Lake - first by water, later by road.

With full completion of the Nunavut-Manitoba road, empty containers could be returned by backhaul on the winter road and rail or ultimately by all-weather road to Winnipeg. The attraction of year around trucking, however, could also eclipse the need for a deep water dock.

2.1.3 Infrastructure Investment

The high cost of infrastructure in the Arctic demands careful consideration of all opportunities for cost sharing partnerships where multiple needs can be met with the same facility or where incremental investment has the potential to capture substantial benefits.

This section of the report screens Eastern Sealift infrastructure needs with a focus on incremental, multifunctional, and/or multi-user port development and prioritizes opportunities for:

(a) Southern Baffin Island Iqaluit Port Development;

(b) Northern Baffin Island Infrastructure, and

(c) Hudson Bay Hub Port Redistribution.

a) Southern Baffin Island Iqaluit Port Development

Investment in new port infrastructure for Iqaluit can start with initial development of a sealift landing beach ramp that later may be incorporated into full development of a deep water dock at the same site.

The estimated costs for the full development are provided below along with the estimated cost for initial investment in a sealift ramp.

Full Development – Iqaluit Deep Water Port	Cost Estimate
Mobilization/Demobilization	$5,150,000
Dredging	$3,383,000
Rock Excavation	$4,560,000
Fill (onshore and offshore)	$12,290,000
Deep Sea Wharf Structure (Concrete Caisson)	$16,650,000
Wharf Hardware, Utilities, and Equipment	$8,248,000
General Indirects	$14,930,000
Total Development – Full Dry Cargo and Tanker Facilities	**$65,211,000**
Initial Development – Dry Cargo Sealift Ramp/Staging Site	**$22,000,000**

Source: Nunavut Economic Development and Transportation Iqaluit Port Development Plan Option 4

With this investment, sealift system performance can improve significantly. In particular ship delays associated with dry cargo lighterage to a sealift beach and tanker discharge with floater hoses will be significantly reduced.

The investment impact of these savings has been incorporated in the summary level financial assessment on the following page. This assessment consists of a cursory life cycle analysis of initial capital cost and the discounted value of ship delay savings that increase with projected traffic growth.

Looking at just the ship delay savings, initial construction of a sealift ramp that can be accessed during all tidal conditions produces a positive net present value with discounted savings benefits that exceed the cost of this investment by 16%. (Note that this analysis considers maintenance costs to be no more or less than currently required at the present sealift beach)

The cost savings of reduced ship delay times alone do not support the construction of a permanent dry cargo dock with unloading arms for dockside bulk fuel discharge.

Full port development would improve the ability of Iqaluit to become a sealift distribution hub with potentially lower sealift costs from more fully containerized service and new market entrants (although for outlying communities without container freight stations Iqaluit redistribution transferring from container to loose stow cargo would likely increase costs).

Financial analysis suggests that full facility development is justified if the value of these and other benefits, including increased tanker safety and environmental security with reduced risk of spills, were to exceed the $34.5 million necessary to achieve a positive net present value (see table below).

Incremental Iqaluit Deep Water Port Development

Initial Development Sealift Ramp and Dry Cargo Site Construction
Full Development Dry Cargo and Tanker Facilities Construction

Calendar Year	Project Year	Initial Development Ship Delay Savings ($22 million investment over 2 construction years)	Tanker Delay Ship Savings (additional full development savings)	Full Development Ship Delay Savings ($65 million investment over 2 construction years)
2012	-1	-$11,000,000		-$32,000,000
2013	0	-$11,000,000		-$33,000,000
2014	1	$1,406,250	$175,000	$1,581,250
2015	2	$1,441,406	$179,375	$1,620,781
2016	3	$1,477,441	$183,859	$1,661,301
2017	4	$1,514,377	$188,456	$1,702,833
2018	5	$1,552,237	$193,167	$1,745,404
2019	6	$1,591,043	$197,996	$1,789,039
2020	7	$1,630,819	$202,946	$1,833,765
2021	8	$1,671,589	$208,020	$1,879,609
2022	9	$1,713,379	$213,221	$1,926,600
2023	10	$1,756,214	$218,551	$1,974,765
2024	11	$1,800,119	$224,015	$2,024,134
2025	12	$1,845,122	$229,615	$2,074,737
2026	13	$1,891,250	$235,356	$2,126,605
2027	14	$1,938,531	$241,239	$2,179,771
2028	15	$1,986,994	$247,270	$2,234,265
2029	16	$2,036,669	$253,452	$2,290,121
2030	17	$2,087,586	$259,788	$2,347,375
	18	$2,139,776	$266,283	$2,406,059
	19	$2,193,270	$272,940	$2,466,210
	20	$2,248,102	$279,764	$2,527,866
	21	$2,304,304	$286,758	$2,591,062
	22	$2,361,912	$293,927	$2,655,839
	23	$2,420,960	$301,275	$2,722,235
	24	$2,481,484	$308,807	$2,790,291
	25	$2,543,521	$316,527	$2,860,048
2.5% /yr Escalated Savings Benefit		$48,034,356	$5,977,609	$54,011,964
5.0% Discounted Present Value		$25,454,541		$28,622,217
Net Present Value of Investment		$2,634,504		-$34,446,969
Savings Benefits to Capital Cost		116%		44%
Internal Rate of Return		6.1%		-1.2%

This assessment concludes that Iqaluit could capture most of the benefits of building a fully developed deep water dock, at a third of the cost, through construction of a sealift ramp and development of a safe and secure area for cargo staging on shore adjacent to the future deep water dock site. Further investment decisions should carefully consider the extent to which regional transportation benefits from building the full deep water dock facility could be captured with little or no capital costs through the infrastructure being built to support the Mary River project.

b) Northern Baffin Island Infrastructure

There is a significant amount of port infrastructure being planned for northern Baffin Island. The Government of Canada is investing in a deep water port at Nanisivik. The proponents of the Mary River Project are planning to invest in port infrastructure at Steensby Inlet and Milne Inlet.

Baffinland Mary River Iron Mine, Port and Rail Infrastructure Investment
Capital Cost Estimates

Mary River Mine Site Facilities	$ 600 Million
Railway Construction Mine Site to Steensby Inlet (143 km)	$1,200 Million
Steensby Inlet Port Site Facilities	**$ 700 Million**
Direct Cost	$2.5 Billion
Indirect Cost	$1.5 Billion
Total Capital Cost	$4.1 Billion

Steensby Inlet Port Facilities Include

- An all-season dock for cape-size ore carriers with a draft of 17.8 m.
- A seasonal service dock with adjacent storage for fuel and dry cargo resupply
- A 45 million litre diesel tank farm for fuel shipments from ore carriers and summer tankers
- A conveyor linked island stockpile facility with 3.7 million tonnes total storage capacity.

Note: Milne Inlet Landing Beach, Laydown Area and 100km Tote Road to Mine Site in use now.

The magnitude of investment proposed to support the Mary River Project will create opportunities for improving community resupply in the Eastern Arctic. The port facilities being proposed for Steensby Inlet and Milne Inlet could potentially meet the needs of multiple users and opportunities for partnerships between the private and public sector should be investigated.

c) Development of a Hudson Bay hub port for dry cargo and fuel redistribution

The Hudson Bay Port of Churchill is a multi-use, fully developed, deep water international port that is currently available for dry cargo or fuel redistribution to the Kivalliq Region.

Pending development of a Kivalliq community interconnect road system as a first stage of the Nunavut-Manitoba Road, Rankin Inlet port development may be warranted as a hub for truck distribution of sealift cargo to Arviat and Whale Cove; and for cargo transhipment for shallow draft transit via Chesterfield Inlet to Baker Lake. However, unlike Churchill, the only purpose of this port would be for regional resupply, with no major resource export prospects or international trade opportunities providing future financial partners to share funding for a multi-use facility.

In summary, screening for priorities in an Eastern Sealift infrastructure investment plan leads to the following conclusions:

1) Traditional sealift operations are a proven strategy for Nunavut resupply that can be continually improved with an ongoing program of incremental community harbour improvements targeted to uniquely different tidal conditions, open water/weather exposure, and awkward landing locations as well as a common requirement for cargo staging safety and security – and a container freight station.

2) At Iqaluit initial development of a sealift landing beach ramp adjacent to a future deepwater dock site can substantially improve the current resupply system in terms of relieving a bottleneck by reducing in-port ship time/delay without risking the full cost of deep water port development on less tangible benefits.

3) Before considering full development of an Iqaluit Deep Water Port, the opportunity to achieve similar benefits with far less cost at the Northern Baffin Island cluster of deep water ports already under development (Nanisivik, Milne and Steensby) should be thoroughly considered.

4) Finally when a Kivalliq inter-community interconnect roads system can provide local container distribution in summer and a trucking connection to Manitoba can return empty containers in winter, then consideration could be given to container hub port development at Rankin Inlet. However, investment in a deep water dock may be precluded by investment in an all-weather Nunavut-Manitoba Road (see Chapter 4).

2.2 Western Sealift System

Sealift infrastructure in the Western Arctic is limited to a few shallow draft barge docks at Kitikmeot and NWT coastal communities. Until recently these communities were exclusively resupplied by Western Arctic Sealift extension of the Mackenzie River barge system from a cargo hub and transload terminal at Tuktoyaktuk (barges to Western Arctic communities topped up to full capacity following draft limited Mackenzie River sailings from Hay River).

From the West Coast over the last few years, deep draft ocean vessels have entered the Beaufort Sea and typically transferred community resupply bulk fuel or deck cargo to shallow draft Mackenzie River barges in:

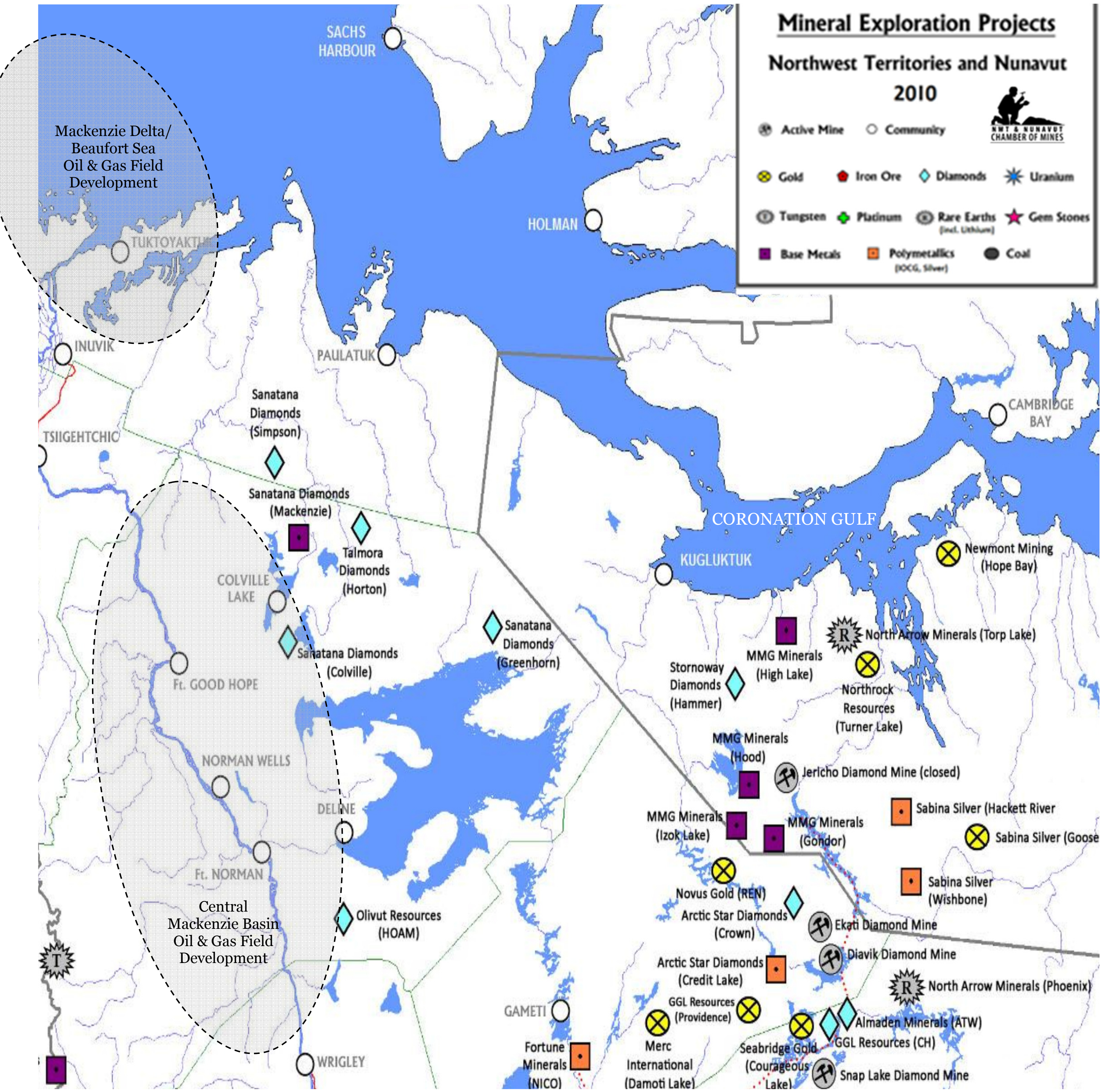
- the protected natural deep water harbour at Herschel Island, Yukon; or
- the unprotected open water offshore from Tuktoyaktuk, NWT; and
- at Cambridge Bay, Nunavut for Kitikmeot region resupply.

Over the last few years, sealift ships have begun resupplying Kitikmeot communities in the Western Arctic from the East Coast. Eastern Sealift ships resupply Kitikmeot communities from offshore anchorages using lighter barges for dry cargo and floater hoses for fuel.

There are no permanent deep water port facilities to ease these transfers or to provide shore based logistics support for any future deep draft marine activity in the Western Arctic. Over the next 20 years, resource development demand projected in the Phase 1 Report will be a major factor in planning port infrastructure for Western Arctic Sealift operations.

Sealift access to support resource development will focus on oil and gas field development in the Mackenzie Delta/Beaufort Sea Region and on mineral development in the Slave Geological Province south of Coronation Gulf (see map on following page).

Island Tug and Barge photograph of deep draft articulated tug barge tanker fuel transfer to shallow draft river and coastal barges in the Western Arctic.


Mineral Exploration Projects
Northwest Territories and Nunavut
2010
Active Mine
Community
Gold
Iron Ore
Diamonds
Uranium
Tungsten
Platinum
Rare Earths (incl. Lithium)
Gem Stones
Base Metals
Polymetallics (IOCG, Silver)
Coal
Mackenzie Delta/ Beaufort Sea Oil & Gas Field Development
Central Mackenzie Basin Oil & Gas Field Development
CORONATION GULF
SACHS HARBOUR
HOLMAN
TUKTOYAKTUK
INUVIK
PAULATUK
TSIIGEHTCHIC
CAMBRIDGE BAY
KUGLUKTUK
COLVILLE LAKE
Ft. GOOD HOPE
NORMAN WELLS
DELINE
Ft. NORMAN
GAMETI
WRIGLEY
Sanatana Diamonds (Simpson)
Sanatana Diamonds (Mackenzie)
Talmora Diamonds (Horton)
Sanatana Diamonds (Colville)
Sanatana Diamonds (Greenhorn)
Olivut Resources (HOAM)
Newmont Mining (Hope Bay)
North Arrow Minerals (Torp Lake)
MMG Minerals (High Lake)
Stornoway Diamonds (Hammer)
Northrock Resources (Turner Lake)
MMG Minerals (Hood)
Jericho Diamond Mine (closed)
Sabina Silver (Hackett River
MMG Minerals (Izok Lake)
MMG Minerals (Gondor)
Sabina Silver (Goose
Sabina Silver (Wishbone)
Novus Gold (REN)
Arctic Star Diamonds (Crown)
Ekati Diamond Mine
Diavik Diamond Mine
Arctic Star Diamonds (Credit Lake)
North Arrow Minerals (Phoenix)
GGL Resources (Providence)
Almaden Minerals (ATW)
GGL Resources (CH)
Merc International (Damoti Lake)
Seabridge Gold (Courageous Lake)
Snap Lake Diamond Mine
Fortune Minerals (NICO)

2.2.1 System Overview

This section of the report looks at both:

a) A Tuktoyaktuk Supply Base - Tuktoyaktuk already has the natural harbour, port facilities and southern connections to renew and expand its former position as a multi-functional trans-shipment point and Mackenzie Delta/Beaufort Sea logistics supply base; and

b) A Coronation Gulf Port and Road - Bathurst Inlet or Grays Bay can be developed as a new deep water port with a heavy haul trucking corridor into the Slave Geological Province to support multiple mines while potentially providing a regional cargo redistribution/logistics supply facility.

Recommended Approach for the Western Sealift System

Resource driven infrastructure investment in two multi-user, multi-functional Western Arctic Sealift hubs:

- ***Tuktoyaktuk for oil and gas field development; and***
- ***Bathurst Inlet or Grays Bay in Coronation Gulf for mining development.***

a) Tuktoyaktuk Offshore Supply Base

In an earlier era of intense Mackenzie Delta/Beaufort Sea oil and gas exploration starting in the mid 1970's and extending into the early 1990's, Esso Resources, Dome Petroleum and Gulf Canada Resources all developed extensive logistics supply bases at Tuktoyaktuk. A combination of shallow draft Mackenzie River barges (1500 tonnes capacity) and deep draft ocean barges (up to 24,000 tonnes capacity) converged at Tuktoyaktuk in the summer. Drilling tubulars, consumables and fuel were staged for redistribution by ice-breaking supply boats or were delivered directly to drill ships or land rigs drilling from artificial islands.

Tuktoyaktuk Harbour Summer 1979

Beaufort Offshore Supply Fleet wintering over at Tuktoyaktuk Harbour circa 1982

In 1980 completion of the Dempster Highway added all-weather road capability to Inuvik with a winter ice-road extension to Tuktoyaktuk. Ironically this highway infrastructure investment removed an element of schedule risk from the Western Arctic Sealift System since any shipments that missed the summer sealift or river shipping window could be rerouted by truck, albeit at greater expense.

A 32 km channel entrance historically limits access to the deeper water harbour at Tukoyaktuk[7]. Depth of water at docks within the harbour is 4 to 6 meters, while the depth of the harbour itself is up to 12 meters. When Canadian Marine Drilling (CanMar, a Dome Petroleum subsidiary) was operating in the Beaufort Sea, this channel was regularly dredged to approximately 5 meters which would allow loaded CanMar supply boats access to the harbour.

Deeper draft drilling and marine supply equipment was forced to find safe harbour elsewhere. Canmar would winter-over drill ships at McKinley Bay 100 kms east of Tuktoyaktuk. Gulf would winter over the conical drilling unit "Kulluk" at Herschel Island in Yukon near the U.S. border[8].

Herschel Island is now part of Ivvavik National Park and the only other potential for port development in the area is at King Point, Yukon just east of the park with deep water right up to the shore but without the protection of a natural harbour. Pauline Cove at Herschel Island in Yukon remains an active harbour for transhipment from deep draft ocean vessels to shallow draft barges resupplying river and coastal communities.

Pauline Cove may resume a more prominent role with the prospect of production modules moved into the Western Arctic from Asian assembly sites for transfer from deep draft to shallow draft vessels and river delivery to Athabasca Oil Sands projects. Asian fabricated modules for the Mackenzie Gas Project can also be transloaded at Pauline Cove[9]

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[7] The depth of the channel entrance is reported to be about 6 meters for 32 kms from Tuktoyaktuk to the outer buoy, but less than 4 meters for the first 8kms from Tuktoyaktuk.

[8] More recently Kulluk has been moored in McKinley Bay which has approximately 10 meters channel and basin depth. During summer 2010, Kulluk was towed to Dutch Harbour, Alaska in anticipation of a Chukchi Sea drilling program. Kulluk was the last of the Canadian Beaufort offshore drilling fleet to be stored at McKinley Bay. Still reported to be moored at Herschel Island in 2010 are a converted super tanker hull (the former Dome/Canmar Steel Drilling Caisson) and a number of concrete caissons.

[9] Water depth adjacent to the Shell Niglintgak Field is sufficient to allow deeper draft, barge mounted modules to be floated in and permanently grounded at the site. Shallow draft barge delivery for other Delta gas production modules, Inuvik gas plant modules and pipeline compressor station modules is planned from Hay River, but that could change if Asian fabrication becomes attractive as a cost cutting option.

Construction of the Mackenzie Valley pipeline would cause a resurgence of oil and gas development in the Mackenzie Delta/Beaufort Sea Region of the Western Arctic. This project received regulatory approval from the Government of Canada in January 2011. The approval is contingent upon a decision to proceed from the project proponent by 2013 and calls for construction to start no later than 2016.

From the Phase 1 Demand Study, the table below provides a forecast of NWT traffic in the Western Arctic. It includes NWT coastal community resupply traffic, resource development traffic, and additional "spin-off" resupply traffic that will be induced by oil & gas activity.

NWT Western Arctic Inbound Traffic Projections
(tonnes/year)

	2010	2015	2020	2025	2030
Mackenzie Gas Pipeline*		400,000	5,000	5,000	5,000
Oil&Gas Field Development**	6,000	69,000	73,000	102,000	142,000
Total Resource Development	**6,000**	**469,000**	**78,000**	**107,000**	**147,000**
Oil&Gas Induced Resupply***	1,200	93,800	15,600	21,400	29,400
Community Resupply	15,956	16,576	17,208	17,779	18,442
Total InboundTraffic	**23,156**	**579,376**	**110,808**	**146,179**	**194,842**

* Construction material and resupply traffic spread out along the full Mackenie Valley pipeline right-of-w ay.
** Includes Central Mackenzie Basin resupply from North or South pending proposed all-w eather road.
*** Induced traffic assumed as .2 x total resource development traffic.

b) Coronation Gulf Port and Road

Over the next 20 years development of the two prominent base metal mines in the Slave Geologic Province, Izok Lake and Hackett River, and perhaps others in the area will depend on construction of a Coronation Gulf deep water port and inland road connection. Several suitable locations have been studied in recent years, including Bathurst Inlet and Grays Bay (near Kugluktuk).[10]

A port and road from either of these locations could potentially link up with the Tibbitt to Contwoyto Winter Road (TCWR) which currently provides mine access from Yellowknife to the NWT portion of the Slave Geological Province and in some years to the Lupin Mine on Contwoyto Lake in Nunavut.

Bathurst Inlet Port and Road (BIPAR) is the most advanced proposal being considered for Coronation Gulf and this report uses BIPAR in its assessment. The high level assessment applied here is considered equally applicable to a Grays Bay Port and Road project.

[10] Newmont Mining's Doris Mine marine facilities and inland road expansion at Roberts Bay in Melville Sound may also be an option.

Any Coronation Gulf Port and Road project will provide:

- A central gateway to the Slave Geological Province for outbound base metal concentrates and inbound mine resupply for Izok Lake, Hackett River and possibly other area mines;
- A Western Arctic distribution hub for Kitikmeot communities, and other area resource development projects; and
- An Arctic sealift supply system alternative for inbound bulk commodity resupply to the three diamond mines now served by the TCWR from Yellowknife.

A Coronation Gulf Port and Road project would allow resource development projects in the Slave Geological Province to access the sealift from the East and West Coasts. Reduced ice coverage in the region has resulted in new sealift services from both the East and West Coasts with cargo rates falling by up to 50% compared to those for the traditional Mackenzie River barge supply program.

From the Phase 1 Demand Report, annual freight flow projections for mines in the Slave Geological Province are shown below:

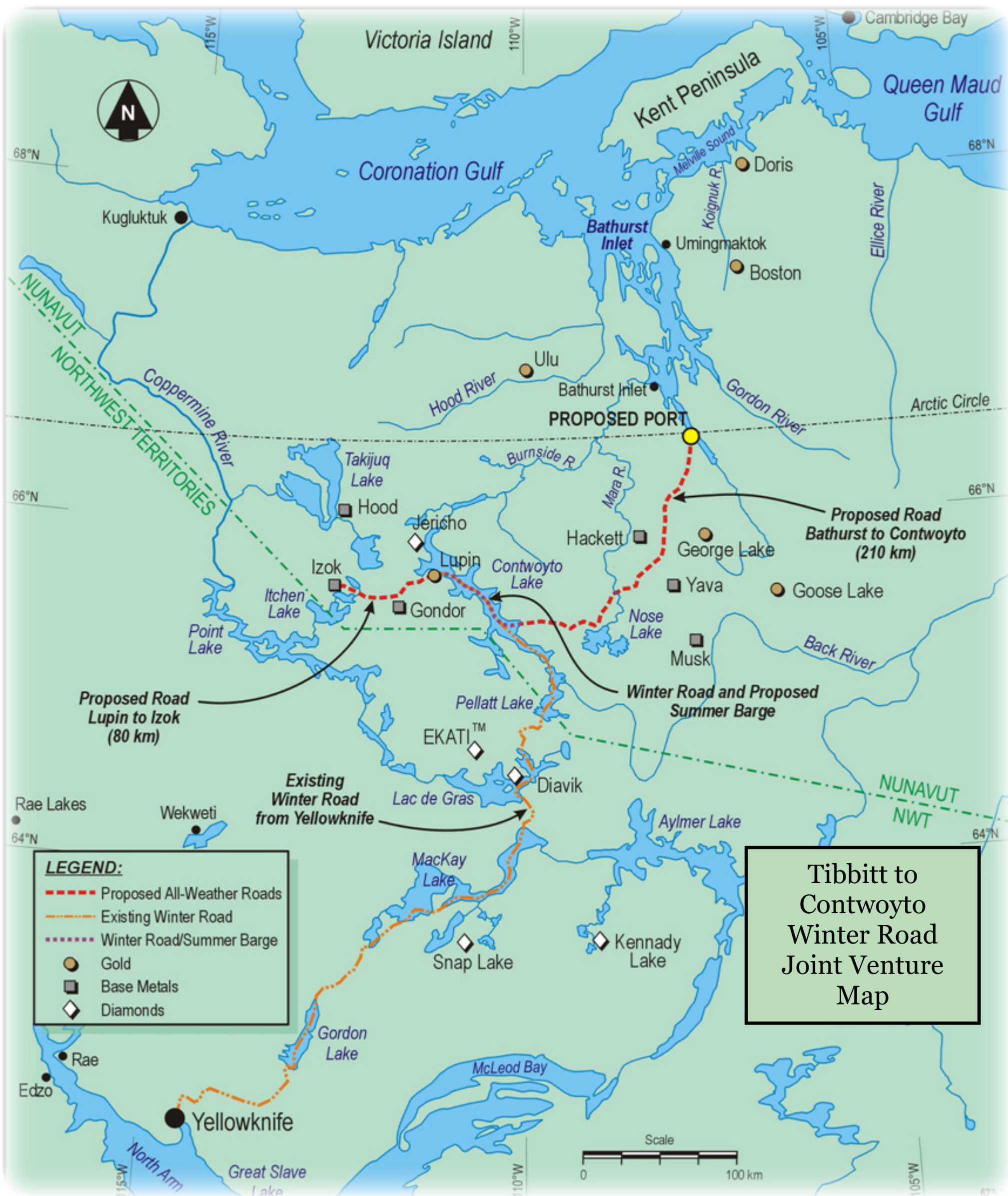
		FUTURE SLAVE GEOLOGIC PROVINCE MINING FORECAST VOLUMES					
			(tonnes/yr)				
MINE			**2010**	**2015**	**2020**	**2025**	**2030**
Base Metal Mines							
Izok Lake	Outbound			430,000	430,000	430,000	430,000
	Inbound	Fuel		28,000	28,000	28,000	28,000
		Other Bulk		4,000	4,000	4,000	4,000
Hackett R	Outbound			450,000	450,000	450,000	450,000
	Inbound	Fuel		30,000	58,000	58,000	58,000
		Other Bulk		34,000	76,000	76,000	76,000
		Total Inbound Bulk		96,000	166,000	166,000	166,000
Diamond Mines							
Diavik	Inbound	Fuel	18,000	69,000	69,000	69,000	
		Other Bulk	16,000	59,000	59,000	59,000	
Ekati	Inbound	Fuel	36,000	57,000	57,000		
		Other Bulk	5,000	7,000	7,000		
Snap Lake	Inbound	Fuel	26,000	29,000	29,000	29,000	29,000
		Other Bulk	2,000	6,000	6,000	6,000	6,000
Gahcho Kue	Inbound	Fuel		25,000	25,000	25,000	25,000
		Other Bulk		12,000	12,000	12,000	12,000
		Total Inbound Bulk	103,000	264,000	264,000	200,000	72,000
		Total BIPAR Throughput	**103,000**	**360,000**	**430,000**	**366,000**	**238,000**

Note: *Other Bulk* includes Portland Cement, Shotcrete and Ammonia Nitrate Prills. The current diamond mines ratio of *Other Bulk* shipments = 85% x Total Inbound - Inbound Fuel. Total Inbound and Bulk Fuel tonnes from Phase 1 Report Appendix "Resource Development Projects Detailed Demand Forecast".

Approximately 85% of all inbound mine supply for the NWT diamond mines are made up of bulk commodities - Portland Cement, Shot-Crete; Ammonia Nitrate Prills, Diesel and Jet Fuel. All of these bulk commodities could be shipped from international or domestic coastal supply points to BIPAR by summer sealift and stockpiled at the port for winter road transport to the mines.

The BIPAR project is a 50/50 Joint Venture between Nuna Logistics Limited and Kitikmeot Corporation (the Bathurst Inlet Port and Road Joint Venture Ltd.). The BIPAR project would lie almost entirely within the Kitikmeot region of Nunavut and would include the development of a port on Bathurst Inlet connected to the mines and mineral deposits in Nunavut and Northwest Territories. There will be a 211 km all-weather road (AWR) to Contwoyto Lake connecting to the existing TCWR winter ice road.

The following map shows port location, AWR and TCWR routes, and mine sites.



Tibbitt to Contwoyto Winter Road Joint Venture Map

2.2.2 Performance Change

Resource development in the Mackenzie Delta/Beaufort Sea region and in the Slave Geological Province will create a steady demand for Arctic Sealift over the next 20 years.

Dry cargo and bulk fuel sealift in the Western Arctic are in transition from traditional reliance on Mackenzie River barge operations extended through Tuktoyaktuk to Western Arctic communities. Sealift cargo is shifting to deep draft ships from the East Coast and deep draft barges or tankers from the West Coast. Market competition from both coasts is lowering sealift cargo rates in the Western Arctic.

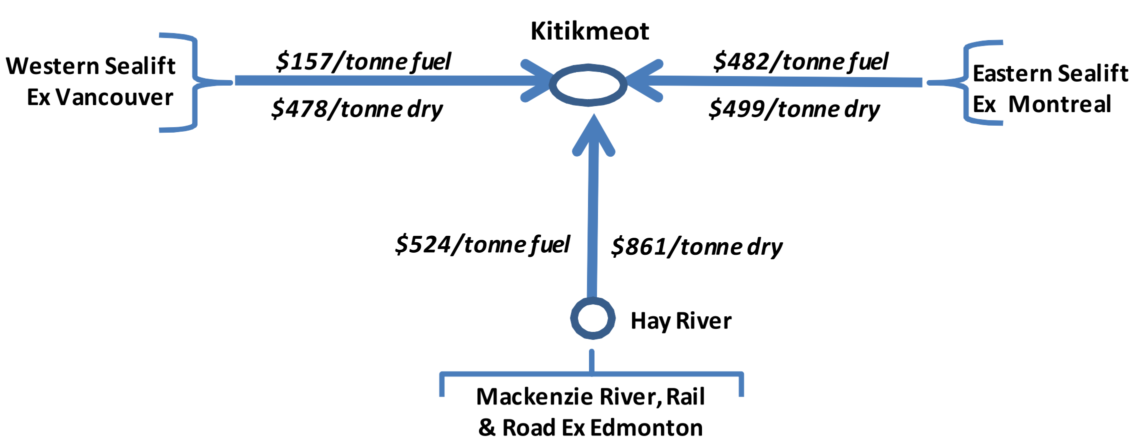
The following table shows how sealift performance has been changing Western Arctic resupply rates since the initial introduction of East Coast Sealift savings to the Western Arctic in 2008, followed by the introduction of West Coast Sealift providing additional savings.

Sealift System Performance Changes in the Western Arctic

($/tonne)

	To Kitikmeot Region		To NWT Coast (Tuk)	
	Dry Cargo	Bulk Fuel	Dry Cargo	Bulk Fuel
Edmonton-Hay River	*$184*	*$78*	*$184*	*$78*
Hay River-Tuktoyaktuk	*$677*	*$446*	*$422*	*$361*
Mackenzie River Ex Edmonton*	$861	$524	$606	$439
East Coast Sealift Ex Montreal**	$499	$482	*(not now served from east)*	
Initial Savings from East Coast Sealift	**$362**	**$42**		
West Coast Sealift Ex Vancouver	$478	$157	$412	$120
Additional Savings from West Coast	**$21**	**$325**	**$194**	**$319**
Total Sealift Savings	**$383**	**$367**	**$194**	**$319**

* Lowest dry cargo rate NTCL Tariff for Containers (20,000 lb. min.). Kitikmeot avg. for 4 Communities.
** Lowest dry cargo rate NSSI Tariff for Containers (20,000 lb. min.). Diesel source price 90 cents/litre.



The sealift competition is not just between coasts. It is also with Mackenzie River barges and Dempster Highway trucks to the Mackenzie Delta; and with Tibbitt to Contwoyto Winter Road operations to the Slave Geological Province.

There is the potential to reduce transportation costs for NWT Diamond Mines through the utilization of BIPAR rather than TCWR.

The three producing diamond mines (Diavik, Ekati and Snap Lake) and the Gahcho Kue diamond mine scheduled for production in 2014, have and will continue to rely on the annually-constructed Tibbitt to Contwoyto Winter Road. As detailed in Chapter 4 of this report, the TCWR is built and funded annually by a consortium of the diamond mines and other users operating and/or exploring in the area. TCWR traffic has ranged from a low of 120,000 tonnes (3,500 loaded inbound trucks) in 2010; to 340,000 tonnes (11,000 loaded inbound trucks) in 2007.

However, the recent warming trend in the north associated with climate change patterns can mean warmer than usual winters in the future that can curtail the TCWR season. For example, the unusually warm winter of 2006 forced an early closure of the southern portion of TCWR, which crosses many lakes with its operational integrity correspondingly more susceptible to warmer winters. As a result, nearly a quarter of the 2006 diamond mine freight had to be airlifted at much greater cost. More recently during the latter part of the 2010 season, trucks were forced to travel at night only, due to warm daytime temperatures.

The existence of BIPAR would provide a significantly extended transportation season to NWT diamond mines.[11] (See Chapter 4 for assessment of a Seasonal Overland Road alternative via Yellowknife that can also extend the transportation season.)

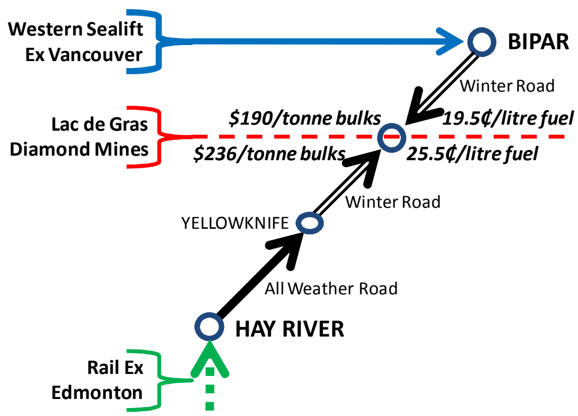
Assuming a Coronation Gulf Port and Road can be in operation by 2015, system performance changes which this investment can provide will reduce resupply costs for existing diamond mines from two perspectives:

1) Procurement and delivery savings using low cost marine transport from Vancouver or offshore supply points vs. Edmonton as the source of supply; and
2) Winter road construction and operations savings with a Coronation Gulf bulk marine terminal and truck transfer facility vs. the existing 400 km TCWR system via Yellowknife.

Resupply Transport Cost Savings – Approximately 85% of TCWR total inbound traffic is bulk commodities that can be shifted to West Coast Sealift at significant savings. The following table shows the extent of savings potentially realized from BIPAR investment.

[11] The Grays Bay option for a Coronation Gulf port would add another 115 kms for truck trips to the NWT diamond mines, which would still provide a similarly extended supply season without appreciably impacting the transportation savings.

Western Sealift System Savings Potential With Bathurst Inlet Port & Road Investment



OVER HAY RIVER	Bulk Fuel ¢/litre*	Other Bulks $/tonne
Ex Edmonton		
Rail to Hay River	5.0	$50
Hay River Handling	1.5	$10
Truck to Yellowknife	6.5	$56
Yellowknife Handling	1.5	$10
Truck to Lac de Gras	11.0	$110
Total to Mine	**25.5 ¢/litre**	**$236 /tonne**
OVER BIPAR		
Ex Vancouver		
Marine to BIPAR	7.0	$70
Handling at BIPAR	1.5	$10
Truck to Lac de Gras	11.0	$110
Total to Mine	**19.5 ¢/litre**	**$190 /tonne**
Potential Savings	**6¢/litre ($72/tonne)**	**$46 /tonne**

* Edmonton and Vancouver wholesale rack price equalized at 90¢/litre

This analysis assumes domestic Canadian sourcing at Vancouver. Savings may actually be greater than indicated as international sourcing and procurement of fuel, cement and ammonium nitrate could offer pricing improvements - as has been experienced in the past.

Winter Road Construction and Operations Savings – With up to 85% of TCWR traffic diverted to Western Sealift over BIPAR, a substantially shorter operating season is possible for the southern section of the TCWR. Much lower TCWR traffic volumes will reduce the current requirement for extra winter road expenditures to extend operations through a full season. After allowance for the additional 180 km of winter road construction to the TCWR/BIPAR junction at Contwoyto Lake, winter road construction and operating savings of an estimated $5.5 million/year should be available.[12]

TCWR System Construction and Operations Cost Adjustments

Current Annual Cost to build/operate TCWR (3 rest camps):		$17,000,000
Future cost to build/operate southern TCWR only at reduced vols:	$7,000,000	
Future cost to build/operate northern TCWR to BIPAR Jct. (1 rest camp):	$4,500,000	
		$11,500,000
	Annual Savings	**$ 5,500,000**
	System Life Cycle	**15 years**
	Life Cycle System Savings	**$82,500,000**

[12] This does not include BIPAR winter road user fees which should be no more than TCWR user fees currently applied to the same traffic.

2.2.3 Infrastructure Investment

a) Tuktoyaktuk

While incremental improvements to rebuild previous capacity at Tuktoyaktuk may be required, the basic port facilities (docks, terminals and tanks) are already there. The oil and gas industry and private transportation firms invested heavily in Tuktoyaktuk port infrastructure in the 1970's and 1980's oil and gas exploration boom. Most of that infrastructure is still in place and available for sealift support.[13]

Tuktoyaktuk requires no major investment in new port infrastructure to become a logistics hub for the Mackenzie River/Western Arctic Sealift System. The system has been underutilized since 1972 when approximately 400,000 tonnes of bulk fuel and deck cargo used the Mackenzie River/Western Arctic Sealift System.

Over the past few years, the major change in Arctic shipping is a tentative shift from Hay River based Mackenzie River shallow draft barging to West Coast based deep draft ocean shipping. To allow deeper draft cargo vessels to enter Tuktoyaktuk Harbour either:

- Some cargo must be lightered off to clear the channel entrance; or
- Annual dredging of the channel to a deeper draft will be required.

b) Bathurst Inlet Port and Road Project

Substantial investment is required to provide mines in the Slave Geological Province with access to tidewater. A project like the Bathurst Inlet Port and Road Project (BIPAR) would help to open up access to resources for development in the Western Arctic. The most recent BIPAR development program indicates the following for the project (2009 dollars):

	Full Investment	Initial Investment
Port (dock, storage, 120 man camp & 1,200 m air strip)	$63,000,000	$63,000,000
Tank Farm (220 million litres-may require more capy.)	$64,000,000	$64,000,000
All Weather Road – (211 km @ $1.7 million/km)	$360,000,000	winter road option
Total Investment Capital Cost	**$487,000,000**	**$127,000,000**

[13] Exceptions are former Esso Resources facilities which have been completely dismantled and remediated and the NTCL Camp which was destroyed by fire.

BIPAR will accommodate 50,000 deadweight tonne ice-class vessels carrying outbound mineral concentrates and inbound fuel, bulk commodities and general supplies, potentially for distribution to Kitikmeot communities by barge, as well as to Slave Geological Province mines by truck.

The picture below illustrates the port conceptual layout within the general Bathurst Inlet location for the proposed project.

Port schematic courtesy Kitikmeot Corporation

BIPAR's main purpose will be to facilitate the development of the Izok Lake and Hackett River base metal mines. BIPAR will include a 72 km all-weather road from Contwotyo Lake to Izok Lake ($122 million) and a shorter road link to Hackett River. BIPAR would require a barge operation to ferry trucks over Contwoyto Lake in the summer.

There are a number of options for using BIPAR to facilitate the development of Izok Lake. One scenario is to truck a full year's production of concentrates from Izok Lake to the Bathurst Inlet port in the winter months (January to April) and then to load the concentrates on to 50,000 DWT vessels in the summer months (July to October). The costs of an all-weather road and a summer barge operation would not be required under this scenario.

Most of the benefits for BIPAR could be captured with properly constructed winter roads and some additional storage capacity at the port. The costs of building the extra storage capacity at the port would be relatively small compared to the costs of building an all-weather road.

Constructing a 211 km high quality winter road between the Port and Contwoyto Lake offers an option to save the $360 million investment proposed for the (seasonally-operated only) all-weather road.

The operating season of BIPAR with a winter road would be approximately 120 days long an*d would coincide with the operating season of the TCWR. This system would provide Izok Lake and Hackett River with four months of road access. This system could also link up to the TCWR north of Lac de Gras which would provide a winter road link from Yellowknife and the intermediate Diamond Mines to a Bathurst Inlet Port.

The distance from the Contwoyto Lake TCWR/BIPAR junction to Lac de Gras mines is approximately 180 km. The annual cost to construct this portion of the TCWR is estimated to be $4.5 million and includes a rest camp for tucks running another 211 km through to the port at Bathurst Inlet. This cost could be recovered with winter road user fees which should be about the same whether for trucking via Yellowknife or from Coronation Gulf.

A high quality winter road over tundra should allow heavy commercial trucks of "B Train" Gross Vehicle Weight (64,000 kgs) to operate at speeds averaging 50 km/h. Using as a cost proxy the Colville Lake heavy haul winter access road constructed in recent years for the NWT oil and gas industry, over similar terrain and at about the same latitude, the 211 km winter road leg to the TCWR/BIPAR junction is estimated as follows:

Colville Lake Winter Road Cost Proxy*	**$2,500/km**
Maintain/Rebuild to Max Capacity*	$1,250/km
Contingency Allowance @ 100%	$3,750/km
Annual Winter Road Total Cost	$7,500/km
BIPAR Winter Road Distance	211 km
BIPAR Winter Road Cost Estimate	**$1,582,000**
BIPAR Winter Road Life Cycle**	15 years
BIPAR Winter Road Life Cycle Cost	**$23,737,500**

* Estimates provided by Northwest Territories Department of Transportation
**Assumes in 15 years an all-weather road built or diamond mines out of production

This suggests that a fully functional winter road could be constructed and operated for $1.6 million annually or on the order of $24 million over a 15 year period.

The investment assessment for BIPAR becomes much more attractive with a substantially lower capital cost and financing focused on the port alone. From a project financing perspective, $360 million All Weather Road capital cost can be converted to an annual Winter Road expense of $1.6 million.

Following is a summary level BIPAR investment assessment based solely on the savings opportunity for currently producing NWT Diamond Mines, prior to Nunavut Base Metal Mining requirements for the project.

Initial BIPAR/TCWR Sealift Access System Development

BIPAR Port Investment ($129 million) with Winter Road Operations

In Lieu of All-Weather Road Investment ($360 million)

Calendar Year	Project Year	TCWR Diverted 85% Tonnes/Year	Sealift Savings @ $59/ tonne*	TCWR Savings w/Shorter Season	BIPAR Winter Road Cost/Year	Net Savings Benefit
2014	-1		*($127 million investment over 2 construction years)*			-$63,500,000
2015	0					-$63,500,000
2016	1	224,400	$13,239,600	$5,500,000	-$1,600,000	$17,139,600
2017	2	224,400	$13,570,590	$5,637,500	-$1,640,000	$17,568,090
2018	3	224,400	$13,901,580	$5,778,438	-$1,681,000	$17,999,018
2019	4	224,400	$14,232,570	$5,922,898	-$1,723,025	$18,432,443
2020	5	224,400	$14,563,560	$6,070,971	-$1,766,101	$18,868,430
2021	6	224,400	$14,894,550	$6,222,745	-$1,810,253	$19,307,042
2022	7	224,400	$15,225,540	$6,378,314	-$1,855,509	$19,748,344
2023	8	224,400	$15,556,530	$6,537,772	-$1,901,897	$20,192,404
2024	9	224,400	$15,887,520	$6,701,216	-$1,949,445	$20,639,291
2025	10	170,000	$12,286,750	$6,868,746	-$1,998,181	$17,157,316
2026	11	170,000	$12,537,500	$7,040,465	-$2,048,135	$17,529,830
2027	12	170,000	$12,788,250	$7,216,477	-$2,099,339	$17,905,388
2028	13	170,000	$13,039,000	$7,396,889	-$2,151,822	$18,284,066
2029	14	170,000	$13,289,750	$7,581,811	-$2,205,618	$18,665,943
2030	15	61,200	$4,874,580	$7,771,356	-$2,260,758	$10,385,178
					2.5% /yr Escalated Net Savings Benefit	$269,822,384
					5.0% Discounted Present Value Savings	$188,040,305
					Infrastructure Investment Capital Cost	$127,000,000
					Net Present Value of Investment	$52,485,538
					Savings Benfits to Capital Cost	148%
					Internal Rate of Return	10.6%

* Average of $72/tonne (6¢/litre) fuel and $46/tonne other bulks.

Shipper savings for the NWT diamond mines alone justify the costs of building BIPAR with the winter road option. The present value of shipper savings for the NWT diamond mines would exceed $188 million over a 15 year period. The internal rate of return for this project would exceed 10% and savings benefits are almost 1.5 times capital costs.

The ability to meet the needs of the NWT diamond mines represents a unique opportunity for an otherwise high risk investment to yield immediate benefits. Northern transportation infrastructure projects are often hard to justify based on existing traffic levels and there is often an element of risk where transportation infrastructure projects are only justified if resource development occurs. Faced with the "chicken or egg" dilemma where resource projects need infrastructure and infrastructure projects need resource traffic – neither may go ahead because the other is at risk. In this case, traffic from the NWT diamond mines already exists and could be shifted from the TCWR.

There is a limited window of opportunity to use the NWT diamond mines as a catalyst to build BIPAR. This window starts to close as diamond mine production starts to fall after 2025.

Although not so easily monetized, other economic benefits of BIPAR for resource development projects and northern communities are significant:

- BIPAR investment provides a marine gateway to lower the costs for more extensive mineral exploration and development in NWT and Nunavut.
- BIPAR could act as a distribution hub for Kitikmeot communities. The price of consumer goods would be reduced with large ships accessing the port directly from major supply centres. A re-distribution industry using smaller vessels could be developed to serve other coastal mines (e.g. Hope Bay, George and Goose Lake gold mines), as well as Kitikmeot and NWT Western Arctic communities.
- BIPAR could serve as a military asset in providing Canada with a Central Arctic servicing and re-supply base to support new Navy and Coast Guard vessel operations planned for the North.
- BIPAR bulk terminal, tank farm and trucking systems with global tanker access could reduce the costs of diesel fired power generation for mining projects in the Slave Geological Province as a competitive alternative to hydro power generation proposals.
- BIPAR would allow bulk fuel delivery from international sources, which would mitigate the risk that Alberta refineries may no longer be able to supply low pour point winter diesel fuel to the North.

3. Yukon Resource Access Systems

This chapter of the report screens infrastructure needs for Yukon Resource Access Systems that include:

- Skagway, Alaska port development to overcome capacity shortfalls constraining Yukon mine feasibility and production decisions and that can provide up to 70% transportation savings benefits by avoiding distant port alternatives;
- CANOL Resource Corridor development between Ross River, Yukon and Skagway, Alaska to cut 20% of the trucking distance and to double truck payloads that in combination can provide up to 65% transportation savings;
- KLONDIKE Resource Corridor to Skagway with initial rail rehabilitation between Carcross and Whitehorse providing a 50% savings below truck costs; and
- Subsequent standard gauge conversion and extension to Carmacks which can save 73% of truck cost – but which is mutually exclusive with CANOL Resource Corridor development that would divert rail traffic threshold density away from Carmacks.

This chapter provides the investment decision making information that will be useful in crafting a strategic infrastructure development plan to avoid the very real possibility of conflicting outcomes.

Over the next 20 Years, growth in Yukon transportation demand will be driven primarily by resource development - principally base metal mineral development.

The Phase 1 Demand Assessment documents annual Yukon base metal mineral exports and inbound resource development supply at 3 levels over the next 20 years:

- MINimum 448,000 tonnes (410,000 tonnes export) for currently producing mines (2010-15);
- MID Level 680,000 tonnes (556,000 tonnes export) adding probable mines (2015-20); and
- MAXimum 1.4 mm tonnes (1 mm tonnes export) adding resource projects possible (2020-25).

Longer range potential for additional resource development traffic is projected to approach 2 million tonnes/year in the 2020-2030+ time period.

Precious metal mines will also have significant inbound, if not outbound, mine transportation requirements. However, the focus for the Yukon infrastructure needs assessment is on the base metal mining that creates overwhelming demand for mine haul transportation in the near term.

Base metal mining transportation demand is subject to constraints from two perspectives:

- First - ore terminal storage, berthing and loading capabilities at Skagway, Alaska will constrain tidewater access as Yukon mineral exports increase; and
- Second – the remote inland location of Yukon mines means that long distance transportation costs to tidewater can constrain mineral production feasibility.

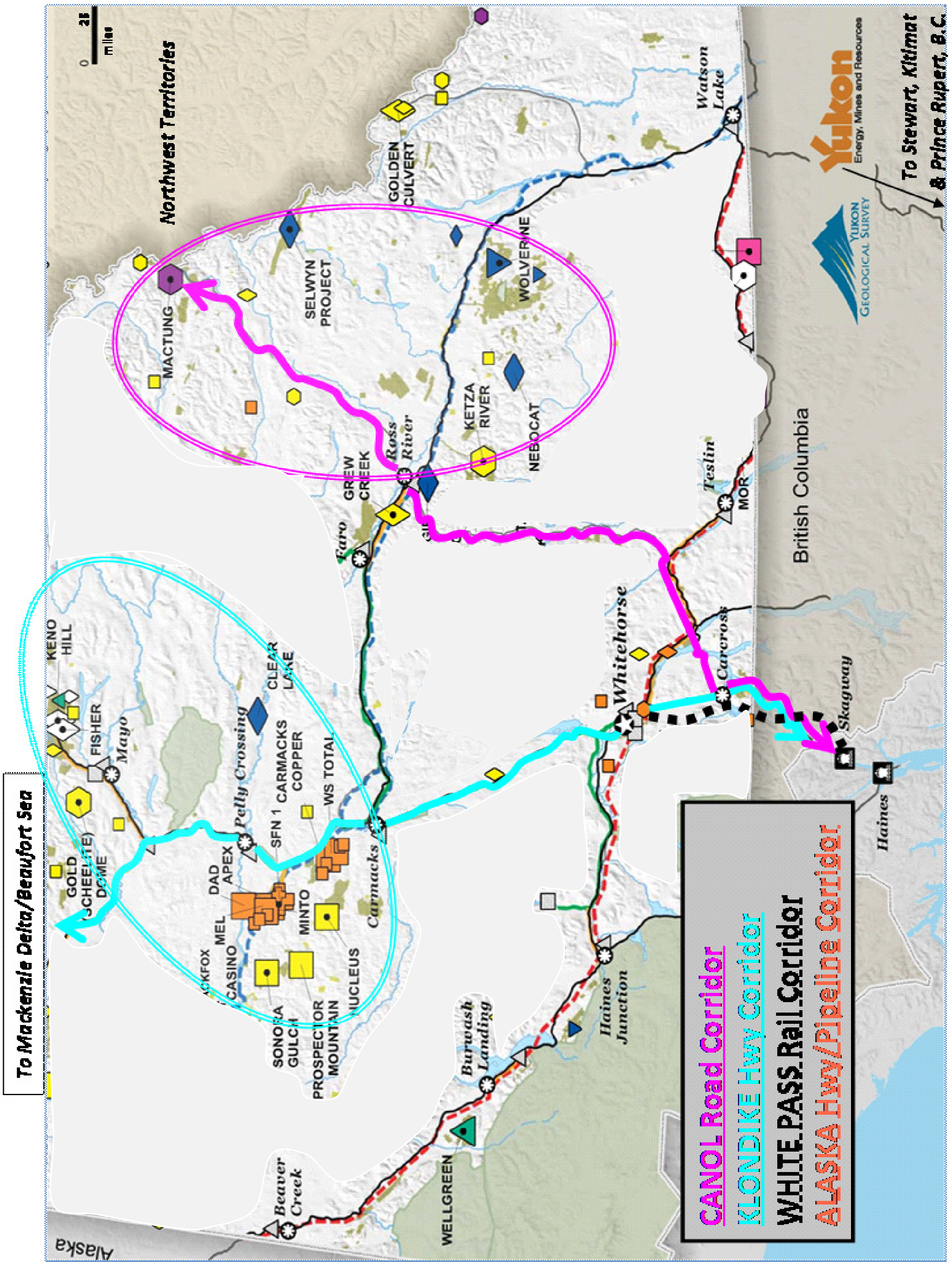
These constraints can be relieved with:

- SKAGWAY Port investment to increase capacity up to 2 million tonnes/year of outbound base metal concentrates and inbound resource development supply;
- CANOL Corridor investment in a Super Heavy Haul Truck route to cut concentrate transportation costs by up to 60% from Ross River to Skagway; and/or
- KLONDIKE Corridor investment in extension of the White Pass & Yukon Route railway to cut concentrate transportation costs by over 70% between Carmacks and Skagway.

This transportation system development can be realized with public and/or private, incrementally staged infrastructure investment as located on the following map and analyzed in the balance of this chapter.

Yukon Mineral Concentrates Loading for Export at Skagway, Alaska

Yukon Ports, Base Metal Mines and Resource Access Corridors



3.1 Alaska Inside Passage Ports

Alaska Inside Passage Ports link Canada's resource development industry in Yukon to Pacific Rim markets. The Alaska Inside Passage Ports of Haines and Skagway are a key part of Canada's present and future northern transportation system.

Haines and Skagway offer the closest access to ice-free ports for Yukon and Mackenzie Delta/Beaufort Sea resource development projects. The Port of Skagway is located just 24 kms from the Canadian border while the Port of Haines is only 72 kms from the border.

Canadian transportation infrastructure provides Alaska Inside Passage port access via:

- The Haines/Alaska Highway from the Port of Haines;
- The Klondike/Dempster Highway from the Port of Skagway; and
- The White Pass railway through British Columbia to Yukon from Skagway.

Unique geographical circumstances which find the United States separated by Canada from Alaska; and Canada separated from the Alaska Inside Passage by a few kilometres in the United States, have historically fostered mutually beneficial bilateral cooperation:

- The U.S. has built and Canada now maintains the Alaska Highway in B.C. and Yukon;
- Canada has maintained the Klondike Highway in Alaska (Curragh Mine Haul); and
- The U.S. has reconstructed Yukon's Haines and Alaska Highways (Shakwak Project).

The long term strategic significance of Alaska Inside Passage ports to Yukon economic development has lead previous Yukon governments to secure options on port lands and to provide financing for port development.[14]

The adjacent map shows the current concentration of mineral development activity in Southern Yukon centered on the KLONDIKE Corridor through Carmacks and the CANOL Corridor through Ross River. Both corridors provide direct access to tidewater at Skagway.

This map also shows the close proximity of the Alaska Highway Pipeline Route to both Haines and Skagway. These ports will be important for pipe, fuel, and equipment delivery during construction of the Alaska Highway Gas Pipeline and may serve an important role in construction of the Mackenzie Valley Pipeline as well as providing key support for ongoing oil and gas field exploration and development which those two projects will stimulate.

[14] Options previously placed on property at Tayia Inlet near Skagway and Lutak Inlet near Haines to protect Yukon tidewater access; and at Haines, financing was provided for marine bulk terminal development for Yukon fuel supply.

3.1.1 System Overview

Inside Passage port access is particularly critical to Canadian mineral resource development in Yukon. If Alaska Inside Passage ports are not available for Yukon mineral exports and inbound mine supply, the next closest ports are Prince Rupert and Kitimat (over 1500 kms by highway from Whitehorse) or the less developed bulk terminal at Stewart (over 1000 kms by highway from Whitehorse).

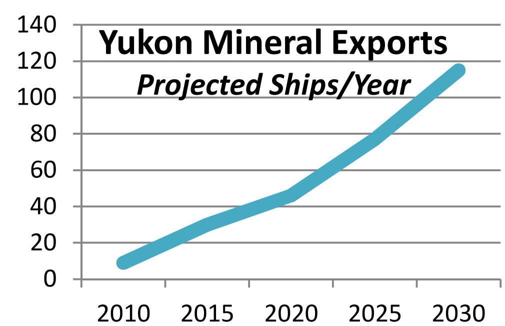
Recommended Approach for Inside Passage Ports

Facilitate cost effective Pacific port access in Alaska for Canadian resource development in Yukon with infrastructure investment at Skagway to:

- ***Expand ore terminal capacity for an impending influx of Yukon mineral exports;***
- ***Load ore ships without disrupting a seasonally intense cruise ship market; and***
- ***Provide seamless transfer of Canadian container and general cargo.***

Yukon mineral exports in currently average 13,000 tonne ocean shipments will require[15]:

- A ship every 12 days by 2015
  (30 ships at about 400,000 tonnes/year);
- A ship every 8 days by 2020
  (46 ships at about 600,000 tonnes/year);
- A ship every 5 days by 2025
  (77 ships at about 1 million tonnes/year); and
- A ship every 3 days beyond 2030
  (115 ships at about 1.5 million tonnes/year).



Inside Passage port capacity constraints on mineral exports at Skagway or Haines, Alaska include:

- Competition with cruise ships for summer berthing at Skagway, but not at Haines;
- Lack of any bulk ore terminaling capability at Haines, but not at Skagway; and
- At Skagway, inadequate existing ore terminal capacity.

These constraints can be eliminated with an infrastructure investment program that increases Alaska Inside Passage port capacity for Yukon mineral resource development over a 20 year

[15] Future shipment size may increase up to full shiploads of 25,000 to 35,000 tonnes. However, staging full shiploads will require much greater ore terminal storage capacity, especially to segregate storage for multiple mines.

planning horizon. Skagway is the preferred port both because it is closer than Haines by 222 kms to Whitehorse and because it already has the basic ore terminal facilities that can be incrementally expanded while Haines has none.

However, Skagway has no more port capacity without incremental investment to meet emerging resource project requirements in Yukon. Port redevelopment is required to:

- Reconstruct the original, and build new, ore terminal facilities incrementally scaled to major new Canadian base metal mines in Yukon.
- Reconfigure ore ship loader equipment that currently blocks cruise ship berthing to avoid disrupting the seasonally intense Alaska cruise ship market; and
- Rebuild a deteriorating dock as a multi-use transfer facility for container, bulk and general cargo operations required for Canadian resource development and Yukon community resupply.

In the short term, this infrastructure investment will eliminate ore ship berthing, ore shed storage and ore ship loader constraints at Skagway. In the longer term, this infrastructure investment will leverage the port proximity to Yukon mines and provide significant positive support to production decisions for high volume, remote mineral prospects.


Cruise and Ore Ship Berthing Conflict at Skagway Ore Dock

The consequence of not eliminating these constraints is expensive highway diversion to Stewart Bulk Terminals or to a closer greenfield site at Haines where completely new facilities would have to be built:

- Whitehorse to Haines is an extra $20/tonne or $1000/truck or $260,000/ship
- Whitehorse to Stewart is an extra $78/tonne or $4000/truck or $1 million/ship

Note: Above based on 51 tonne truckloads and 13,000 tonne ocean shipment parcels.

The anticipated surge of outbound mineral exports from Yukon is shown in the following table of Phase 1 traffic demand projections. This table also summarizes the corresponding Phase 1 forecast for inbound resource development traffic. These projections are recast in the next two sections of this report to analyze the extent, timing and viability of incremental infrastructure investments to achieve significant system performance improvements.

Phase 1 Mineral Export & Inbound Supply Recap

Inside Passage Ports Demand Forecast

A) Short Range Mining Projects (Start-Up within 10 years)

Producing Mines		*Outbound Tonnes/Year*			
Mine	Concentrates	2010-15	2015-20	2020-25	2025-30+
Minto	Copper	65,000	65,000	65,000	
Wolverine	Lead/Zinc	45,000	135,000	135,000	
Whitehorse	Magnitite	300,000			
Total MIN Scenario (Total Producing)		**410,000**	200,000	200,000	
Probable Mines					
Bellekeno	Lead/Zinc	20,000	20,000	20,000	
Carmacks	Copper (cathodic)		16,000	16,000	
Selwyn	Lead/Zinc		320,000	500,000	500,000
Total MID Scenario (Producing+Probable)			**556,000**	736,000	500,000
Possible Mnes					
Casino	Copper/Moly			300,000	300,000
MacTung	Tungsten			15,000	15,000
Total MAX Scenario (Producing+Probable+Possible)				**1,051,000**	815,000

B) Longer Range Mining Projects (Start-Up Within 20 Years)

Potential Additional Mineral Exports		
Marg	Zinc/Copper	135,000
Andrew	Lead/Zinc	50,000
Kud Ze Kyah	Lead/Zinc	170,000
Tom & Jason	Lead/Zinc	290,000
Longer Range Total		**1,460,000**

C) Very Long Range Mining Projects (Start-Up Beyond 20 Years)

Crest	Iron Ore	28,000,000

All Projects	*Inbound Tonnes/Year*			
Inbound Traffic	2010-15	2015-20	2020-25	2025-30+
Mine Fuel	31,000	95,000	228,000	173,000
Mine Supply	7,000	29,000	99,000	80,000
Total Mining Inbound	**38,000**	**124,000**	**327,000**	**253,000**
Alaska Gas Pipeline (peak year & ongoing supply)			786,500	3,000
Oil & Gas Exploration/Development			______	6,000
			1,113,500	**262,000**

Note that since the Phase 1 Mining Projections were compiled, Bellekeno has made an early production decision, starting 20,000 tonnes/year concentrate shipments in late 2010. As well, while not a mine, Eagle Minerals now plans to reprocess Whitehorse Copper mine tailings already produced. 250,000 to 300,000 tonnes of magnetite for export through Skagway will be produced over a 6-7 year period starting in 2012.

3.1.2 Performance Change

The lack of adequate ore terminal capacity at the Port of Skagway is an issue for Yukon's mining industry. The only alternative port currently capable of handling mineral ore/concentrates from Yukon is the much more distant Port of Stewart, B.C. with an operating ore terminal. Haines while closer than Stewart, has no ore terminal at all.

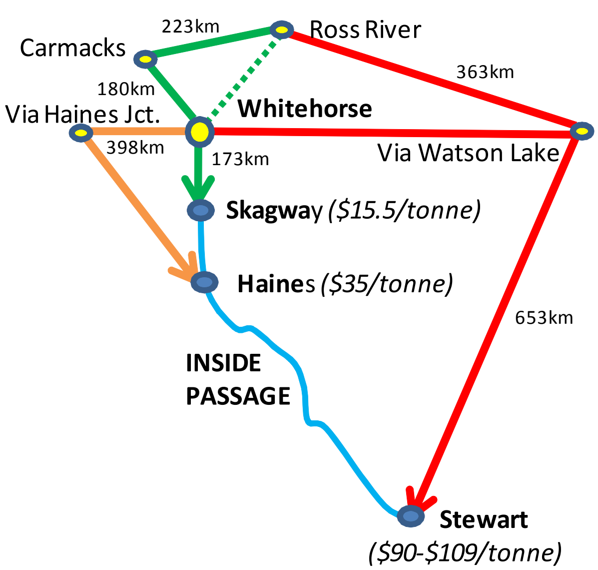
Additional trucking distance from Whitehorse as a common point that most mine traffic will move through is 225 kilometres further to Haines than to Skagway. Additional trucking distance to Stewart is 875 kms from Carmacks via the Klondike Highway through Whitehorse and 440 kms via the Campbell Highway through Ross River.

The Port of Stewart currently handles mineral concentrate from the Yukon Zinc Wolverine mine and does have some additional capacity. However, Stewart Bulk Terminals would require a significant investment in ore terminal capacity to accommodate traffic from an additional large mine (e.g., Selwyn lead/zinc prospect at 300,000-500,000 tonnes per year).

In fact, the level of investment needed at the Port of Stewart to accommodate a significant amount of additional mine traffic is similar to what would be required at the Port of Skagway. At Haines much greater marine terminal investment would be required as there are no concentrate storage or ship loading facilities at present.

Accordingly, while the undeveloped port of Haines is closer, Stewart with an operating bulk concentrate terminal is the relevant alternate port for the Phase 2 - 20 year planning horizon.

The following map and table show the distance and cost penalty that will be imposed on Yukon mineral exports without investment to remove port capacity constraints at Skagway



Skagway Port Access System Savings Potential

Highway Access Savings to Skagway vs. Stewart or Haines

From Ross River	**To Stewart**	**To Skagway**	**Skagway Savings**	
Distance (kms)	1016	576	440	
Cost ($/tonne)	$90.42	$51.26	**$39.16**	43%
From Carmacks	**To Stewart**	**To Skagway**	**Skagway Savings**	
Distance (kms)	1228	353	875	
Cost ($/tonne)	$109.29	$31.42	**$77.88**	71%
From Whitehorse	**To Haines**	**To Skagway**	**Skagway Savings**	
Distance (kms)	398	173	225	
Cost ($/tonne)	$35.42	$15.40	**$20.03**	57%

Skagway versus Stewart port access savings/tonne above are applied to Current, Near Term and Long Term tonnes/year to determine for each time period, the total savings/year below:[16]

- Current actual and potential Skagway savings of $35 million/year for mines in production over the next 5 years;
- Near Term Skagway additional savings potential of $36 million/year for probable mineral production within the next 10 years;
- Long Term Skagway savings potential of a further $30 million/year for possible mineral production within the next 20 years.

Savings from Skagway Port Development for Yukon Mineral Exports

Remove Cruise Berthing Constraint and Expand Ore Shed Capacity

To Save Cost of Truck Diversion to More Distant Port of Stewart

(Current and Additional Savings per Year)

	Tonnes/Year	Current	Near Term	Long Term
	Skagway Versus	2010-2015	2015-2020	2020-2030
	Stewart Trucking	Min Level	Mid Level	Max level
$78 /Tonne Savings				
From Carmacks via Whitehorse				
Mine	Tonnes			
Minto	65,000	$5,061,875		
Bellekeno	20,000	$1,557,500		
*Whitehorse**	*300,000*	$23,362,500		
Casino	300,000		$23,362,500	
Marg	135,000			$10,513,125
$39 /Tonne Savings				
From Ross River via Watson Lake				
Mine	Tonnes			
Wolverine**	135,000	$5,286,600		
Mactung	15,000		$587,400	
Selwyn	320,000		$12,531,200	
Andrew	50,000			$1,958,000
Kud Ze Kyah	170,000			$6,657,200
Tom & Jason	290,000			$11,356,400
Total Skagway Savings/Year		$35,268,475	$36,481,100	$30,484,725

*Whitehorse Copper tailings processing for 6-7 years added to Phase 1 Resource Projects Demand Forecast and assumed complete coincident with Casino start with similiar tonnage requirement.

** Wolverine 45,000 tonnes start-up production currently routed through Stewart.

[16] Note some deviations from Phase 1 Resource Demand Forecast reflecting more recent outlook.

3.1.3 Infrastructure Investment.

The potential for system performance savings identified in the previous section can be achieved with the port capacity investments analyzed in this section. These are incremental infrastructure investment planning options to support the long term vision for Inside Passage Ports as outlined in the first section of this chapter. They must be prioritized along with counterpart investment options associated with all Northern Transportation Systems in this Phase 2 Infrastructure Needs Assessment.

As an objective tool for prioritizing these investment options, a high level financial feasibility assessment is provided. This assessment consists of a cursory investment life cycle discounted cash flow analysis that looks only at initial capital costs and ongoing savings that benefit Yukon mineral development. The savings benefit is assumed as a proxy for net revenue after all operating costs including interest, depreciation and residual value.

The savings benefit, as calculated in the previous performance changes section, recognizes the existing Stewart Bulk Terminals as the only viable alternate to relieve impending capacity shortfalls at Skagway. It is assumed that the operating and maintenance costs associated with new investments at Skagway would be the same as for similar capacity investments that would be required at Stewart. The only relevant difference is the distance – 891 kms further to Stewart from Whitehorse.

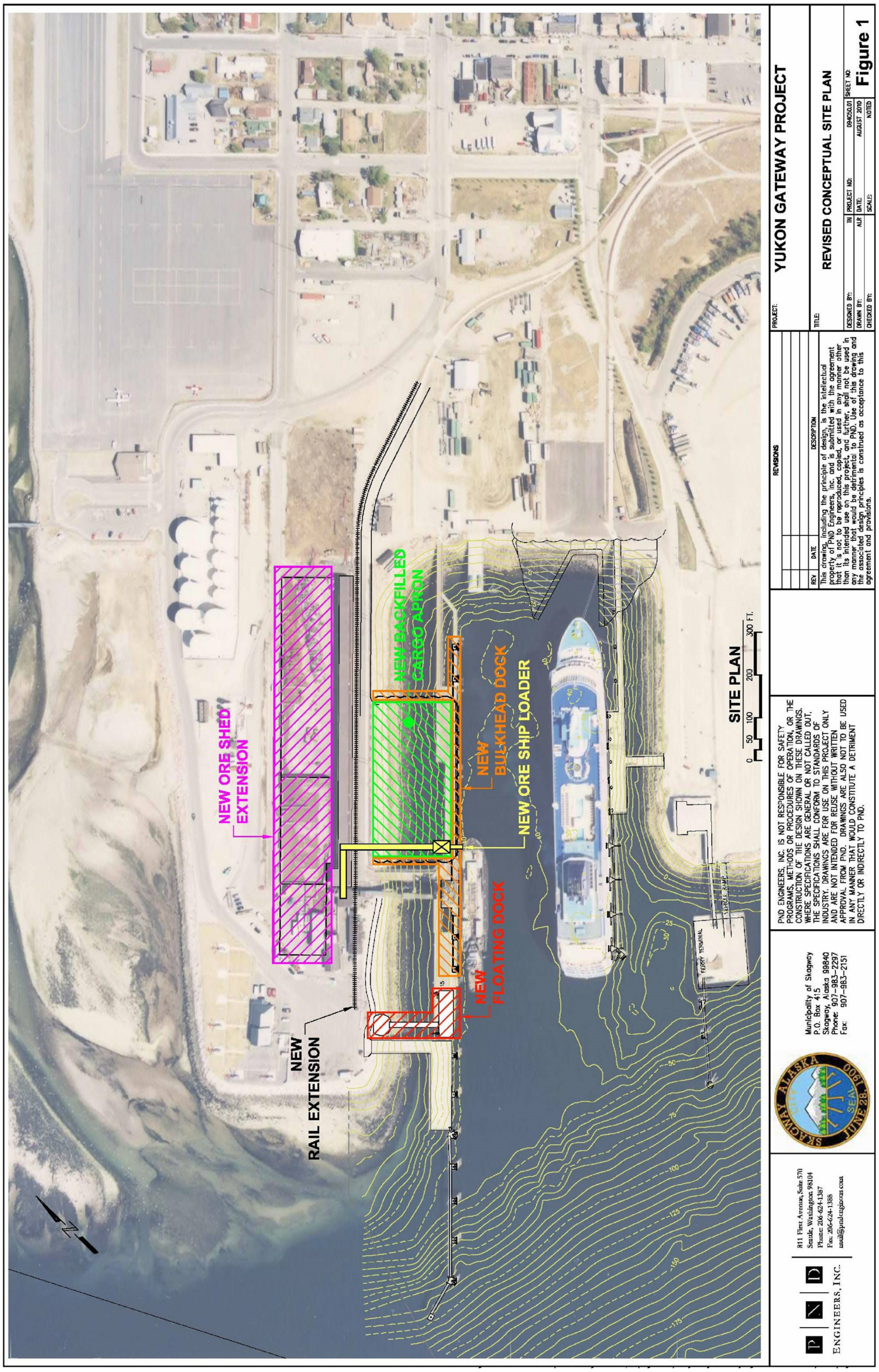
A commercial, private sector investment assessment requires a much more rigorous analysis of detailed revenue and expense streams. However, higher level reference to savings benefit coverage of capital costs used here is considered appropriate for public sector screening of infrastructure options and prioritizing an investment plan.

Proposed Skagway port infrastructure investment in two increments is estimated as follows and illustrated in the conceptual design layout on the following page:

Initial Skagway Port Investment ***(Ref: Skagway Gateway Project)***		***Estimated Cost***
Reconstruct Ore Dock with Cargo Apron		$16 million
New/Reconfigured Ore Ship Loader to Clear Cruise Ship Berth		$15 million
Ore Terminal Build Out, Dust Suppression & Conveyor Upgrade/Expansion		$50 million
	Subtotal	**$81 million**
Additional Skagway Port Investment #2 ***(Ref: Skagway Port Development Plan B2)***		
Second Ore Terminal Building to Double Former Capacity		$50 million
Site Work Allowance (construction beyond current site)		$10 million
	Subtotal	**$60 million**
	Skagway Port Investments Total	$141 million

Note that both the initial Ore Terminal Expansion and Second Ore Terminal Building can be phased in as Yukon mining demand is manifested.

Skagway Ore Terminal Capacity Investment Conceptual Design Layout



Incremental Investment Cost and Savings Benefits to provide simultaneous cruise and cargo operations, with increased Ore Terminal Capacity are shown in the following table.

In the near term, a demand phased initial investment of $81 million will be required within 5 years to expand existing ore shed storage capacity and to avoid interference from cruise ship operations. Otherwise any new mineral traffic from Yukon will be diverted with long truck hauls to more distant ports.

Truck costs saved can pay back this investment in a little over one year. Over a 20 year life cycle, the present value of the savings benefit at a 5% discount rate is over half a billion dollars with a net present value of $431 million. The internal rate of return based on trucking savings is a highly attractive 40% with a 7:1 benefit/cost ratio and investment payback within three years.

In the longer term, within 10 years, another similar phased $60 million expansion program may be required for a second, separate ore terminal building.

Skagway Port Capacity Investment

Ore Dock Rehab, Ore Ship Loader Reconfiguration & Ore Shed Expansion

	Calendar Year	Project Year	Tonnes ThruPut Capacity Required	Initial Investment Savings Benefit	Second Investment Savings Benefit	
Current	2010		385,000	($81 million		
	2011		385,000	investment		
	2012		385,000	over 2 years)		
	2013	-1	385,000	-$40,500,000		
	2014	0	385,000	-$40,500,000		
Near Term	2015	1	405,000	$36,481,100	($60 million	
	2016	2	405,000	$37,393,128	investment	
	2017	3	405,000	$38,327,956	over 2 years)	
	2018	4	405,000	$39,286,155	-$30,000,000	
	2019	5	405,000	$40,268,308	-$30,000,000	
Longer Term	2020	6	1,460,000	$41,275,016	$30,484,725	
	2021	7	1,460,000	$42,306,892	$31,246,843	
	2022	8	1,460,000	$43,364,564	$32,028,014	
	2023	9	1,460,000	$44,448,678	$32,828,715	
	2024	10	1,460,000	$45,559,895	$33,649,432	
	2025	11	1,460,000	$46,698,892	$34,490,668	
	2026	12	1,460,000	$47,866,365	$35,352,935	
	2027	13	1,460,000	$49,063,024	$36,236,758	
	2028	14	1,460,000	$50,289,599	$37,142,677	
	2029	15	1,460,000	$51,546,839	$38,071,244	
	2030	16	1,460,000	$52,835,510	$39,023,025	
		17		$54,156,398	$39,998,601	
		18	*Initial Investment*	$55,510,308	$40,998,566	
		19	*to uprade & expand*	$56,898,066	$42,023,530	
		20	*the current ore terminal*	$58,320,517	$43,074,118	
		21	2.5% Escalated Savings Benefit	$931,897,209	$44,150,971	
		22	5% Discounted Present Value	$558,048,026	$45,254,746	
		23	Infrastructure Capital Investment	$81,000,000	$46,386,114	*Added Investment*
		24	Net Present Value of Investment	$430,859,888	$47,545,767	*for second expansion*
		25	Savings Benefits to Capital Cost	7 : 1	$48,734,411	*of original ore terminal*
			Internal Rate of Return	40.0%	$778,721,863	Savings Benefit Escalated at 2.5%
			Pay Back (years)	3	$466,322,030	Savings Present Value Discounted at 5%
					$60,000,000	Infrastructure Investment Capital Cost
					$367,185,515	Net Present Value of Investment
					8 : 1	Savings Benefits to Capital Cost
					44.1%	Internal Rate of Return
					3	Pay Back (years)

Note: Skagway capacity demand adjusted for 135,000 tonnes Wolverine to Stewart

The present value of truck cost savings for this additional port capacity investment is $466 million at a 5% discount rate with a net present value of $367 million. Repeating the commercially attractive financial performance of the initial investment, the internal rate of return is 44% with an 8:1 benefit/cost ratio.

The financial viability of these investments should attract funding from private as well as public sector investors on both sides of the border. Both of these investments can be paid back by mine haul savings benefits in three years.

If these investments in Skagway port capacity are not made, development of Yukon resources may become stranded by the distance to alternate ports. The additional cost for mineral shipments through Carmacks to reach Stewart Bulk Terminals will exceed $1 million per typical 13,000 tonne ocean shipment – and Stewart would likely require the equivalent of Skagway's second capacity expansion at $60 million investment to handle the additional traffic.

Haines is much closer but with no bulk terminal facilities would require at least the equivalent of the initial proposed Skagway port capacity investment ($81 million) as well as purchase of a suitable terminal development site (e.g., the former sawmill dock for some $25 million) to handle diverted Yukon mineral exports.

In addition to providing increased export capacity for new mines in Yukon, Skagway port infrastructure investment will support the less certain timing of the Alaska Pipeline Project, Mackenzie Gas Project or other resource development projects, with a general cargo apron built in conjunction with reconstruction of the ore dock.

In summary, financially attractive infrastructure investment in Skagway port development can unblock current port capacity constraints that will otherwise increasingly impede Yukon resource development.

3.2 Yukon Heavy Haul Transportation System

Yukon has the most extensive highway system in Northern Canada embracing Alaska Highway, Klondike Highway and Dempster Highway connections to both Inside Passage and Arctic Ports. This system links most mineral production areas in the territory to tidewater at the Alaska Inside Passage Ports of Haines and Skagway. It also provides direct trucking access from Watson Lake via Cassiar Highway 37 in British Columbia to the B.C. Inside Passage Ports of Stewart, Kitimat and Prince Rupert.

To help overcome the high cost of inland mine haul truck transport to and from Inside Passage Ports, the Yukon bulk haul permitting system allows a 21.4% gross vehicle weight overload for the nominal fee of a penny per tonne-kilometre (charged only against the overload). This is the heavy haul trucking system that provides Klondike Highway access to Yukon's closest port at Skagway.

The State of Alaska has established a counterpart industrial toll road for the short 24 km distance between the Canadian border and Skagway. As well, British Columbia has recently implemented a similar system that now allows bulk haul overloads from Yukon mines to Stewart Bulk Terminals.

The CANOL Corridor is an unimproved, summer only, single lane route through Ross River that connects to the Klondike Highway at Whitehorse or Carcross. It offers the opportunity to combine a new short-cut to Skagway with "super load" mine haul trailers that can substantially increase productivity of the Yukon heavy haul trucking system.

The KLONDIKE Corridor is the principal port access route and running through it parallel to the heavy haul highway is the White Pass and Yukon Route railway, a legacy from an earlier period of intense mining activity and intermodal mine haul transportation in Yukon. The narrow gauge White Pass & Yukon Route is currently active between Skagway and Carcross, but only for passenger trains operated during the summer tourist season. Rail track is in place, but not in service between Carcross and Whitehorse.

The Phase 1 Demand Report forecasts Yukon mine haul activity to surge past previous peaks of around 600,000 tonnes/year within the next 5 to 10 years and to exceed 1 million tonnes/year within the next 10 to 15 years. As traffic density increases, so will the attraction of building on existing, underutilized rail infrastructure to achieve lower transportation rates with rail costs that decline as volumes increase.

At the same time a parallel rail alternative can relieve the public highway impacts from rapidly growing mine haul truck traffic. These include increased highway maintenance requirements, increased greenhouse gas emissions, reduced public safety and reduced tourism attraction. This last impact is especially significant for the spectacularly scenic portion of the Klondike Highway mine haul between Whitehorse and Skagway.

3.2.1 System Overview

While Yukon has the most extensive all-weather, heavy haul highway system of the three territories, the long trucking distance to tidewater export position still means that transportation cost can constrain resource development financial feasibility. This section of the report looks at potential investment in two complementary port access corridors that can alleviate that constraint:

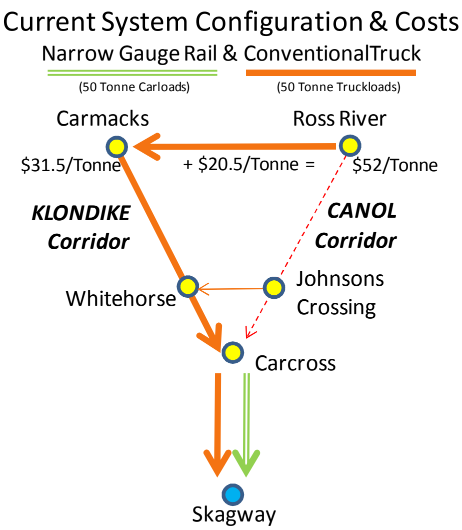
- KLONDIKE Corridor investment in rail service to Carmacks and/or Whitehorse that can cut concentrate and mine resupply transportation costs up to 73% between Carmacks and Skagway while reducing public highway impacts by shifting truck traffic to trains; and

- CANOL Corridor investment to double truck payloads over a shorter route from Ross River that can cut concentrate and mine resupply costs up to 65% between Ross River and Skagway while reducing public highway impacts by splitting traffic otherwise converging on the North Klondike Highway.

<u>Recommended Approach for the Yukon Heavy Haul Transportation System</u>

Incremental rail and/or road investment where relatively high density mining traffic can support new modal systems to:

- ***significantly improve cost performance; and***
- ***reduce resource development public impacts.***



At present the Yukon Heavy Haul Highway System provides mine access to the Port of Skagway via the Klondike Corridor through Carmacks. Mine haul traffic between Skagway and Ross River must use the Robert Campbell Highway via Carmacks. (Alternatively the Robert Campbell via Watson Lake and the Cassiar Highway provide access to the more distant Port of Stewart, B.C.)

From Carmacks, current 50 tonne truckload costs are estimated at $31.50/tonne. From Ross River an estimated additional $20.50/tonne totals $52/tonne.

Relevant Phase 1 mine haul traffic projections shown in the following table are applied to system performance savings in the next section to forecast the level and timing of annual savings potential from investment in each of the KLONDIKE and CANOL Corridors.

Phase 1 Mineral Export & Inbound Supply Recap

KLONDIKE & CANOL Corridor Demand Forecast

A) Short Range Resource Projects (Start-Up within 10 years)

Corridor	Mine	Traffic	2010-15	2015-20	2020-25	2025-30+
Producing Mines				*(Tonnes/Year)*		
KLONDIKE	Minto	Lead/Zinc	65,000	65,000	65,000	
		Inbound Fuel	23,000	23,000	23,000	
		Inbound Supply	4,000	4,000	4,000	
	Whitehorse	Copper Tailings/Magnetite	300,000	_____	_____	
		SubTotal MIN Scenario (Total Producing)	**392,000**	92,000	92,000	
CANOL	Wolverine	Lead/Zinc	45,000	135,000	135,000	
		Inbound Fuel	8,000	21,000	21,000	
		Inbound Supply	3,000	10,000	10,000	
		SubTotal MIN Scenario (Total Producing)	**56,000**	166,000	166,000	
		Total MIN Scenario (Total Producing)	**448,000**	258,000	258,000	
Probable Mines						
KLONDIKE	Bellekeno	Lead/Zinc		20,000	20,000	
		Inbound Fuel		3,000	3,000	
		Inbound Supply		2,000	2,000	
	Carmacks	Cathodic Copper		16,000	16,000	
		Inbound Fuel		8,000	8,000	
		Inbound Supply		3,000	3,000	
		SubtoalMID Scenario (Producing+Probable)		**144,000**	144,000	
CANOL	Selwyn	Lead/Zinc		320,000	500,000	500,000
		Inbound Fuel		40,000	60,000	60,000
		Inbound Supply		10,000	15,000	15,000
		Subtotal MID Scenario (Producing+Probable)		**536,000**	741,000	575,000
		Total MID Scenario (Producing+Probable)		**680,000**	885,000	
Possible Mnes						
KLONDIKE	Casino	Copper/Gold			300,000	300,000
		Inbound Fuel			100,000	100,000
		Inbound Supply			60,000	60,000
		Subtotal MAX Scenario (Producing+Probable+Possible)			**604,000**	460,000
CANOL	MacTung	Tungsten			15,000	15,000
		Inbound Fuel			13,000	13,000
		Inbound Supply			5,000	5,000
		Subtotal MAX Scenario (Producing+Probable+Possible)			**774,000**	608,000
		Total MAX Scenario (Producing+Probable+Possible)			1,378,000	
B) Longer Range Resource Projects (Start-Up Within 20 Years)						
Potential Additional Mineral Exports						
KLONDIKE	Marg	Zinc/Moly				135,000
	Oil & Gas Exp/Dev	Ongoing Resupply				6,000
	Alaska Gas Pipeline	Construction Supply (1,187,200 tonnes/5 years)			237,440	
		Ongoing Resupply				3,000
		Longer Range Total KLONDIKE Corrider				**604,000**
CANOL	Andrew	Lead/Zinc				40,000
	Kud Ze Kyah	Lead/Zinc				170,000
	Tom & Jason	Lead/Zinc				290,000
		Longer Range Total CANOL Corrider				**1,108,000**
		Longer Range Total Both Corridors				**1,712,000**
C) Very Long Range - Crest Iron Ore Project (Start-up beyond 20 years)						**28,000,000**

Note reprocessing Whitehorse Copper mine tailings included under producing mines and not included in Phase 1 Demand Assessment.

3.2.2 Performance Change.

In this section pro-forma transportation cost reductions with strategic infrastructure investments are compared to current system configurations and "no change" truck costs identified in the previous section, to determine potential system performance savings. These savings are then applied to the relevant tonnage projections, taken from the preceding table, to determine total savings per year for incremental, initial and full system, infrastructure development in both the KLONDIKE and CANOL Corridors.[17]

a) Partial System Savings - will come with initial infrastructure investment in:

- Rehabilitation of narrow gauge tracks for an intermodal truck/rail alternative from Whitehorse in the KLONDIKE corridor; and
- Development of 100 tonne SuperLoad capability to double truck payloads over a 20% shorter dedicated mine haul route from Ross River in the CANOL Corridor.

Partial system investments complement each other in both corridors. From Ross River in the CANOL Corridor, reconstruction of the South Canol Road as a dedicated SuperLoad route can be integrated with truck/rail transfer at Whitehorse or Carcross, reintroducing intermodal bulk mineral transportation on the White Pass & Yukon Route to Skagway.

From Carmacks in the KLONDIKE Corridor similar truck to rail transfer can take place at Utah Yard in Whitehorse. The White Pass & Yukon Route narrow gauge system has already been rebuilt for summer tour train service between Skagway and Carcross. The track structure and roadbed is in place, but out-of-service between Carcross and Whitehorse, and would be rehabilitated to the same heavy haul standard to which it was previously rebuilt for the lead/zinc concentrate haul from Faro.

Railway Rebuilt to Carcross, Yukon

The CANOL Corridor shortcuts distance by up to 20% with 100 tonne SuperLoads that together will vastly improve trucking productivity between Ross River and the Alaska Highway junction at Johnsons Crossing. A Super B-Train truckload configuration is envisioned with two trailers each carrying two 25 tonne concentrate containers that can be transferred to 50 tonne railway flat cars. Upon leaving a dedicated South Canol mine haul road at Johnsons Crossing, the two trailers would be split into "legal" 50 tonne highway loads (77.1 tonnes GVW) for conventional highway travel.

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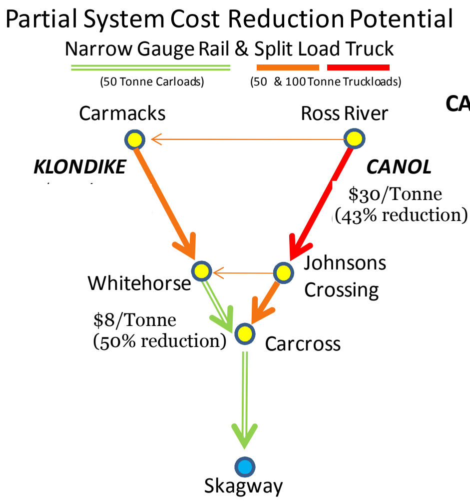
[17] Note that significant resource access requirements associated with - but not considered part of - the strategic corridor opportunities addressed here include North Canol Road upgrade 237 km to the Northwest Territories boundary to access the MacTung, Andrew and potentially Selwyn base metal properties (anticipated $75 million funded by Yukon); and Freegold Road 130 km to the Casino copper/gold property (anticipated $100 million financed by Western Copper).

Partial system cost performance changes and potential savings from initial infrastructure investment in both Yukon Heavy Haul Corridors are shown on the following map and table.



Partial System Infrastructure Investment

KLONDIKE Corridor Narrow Gauge Rail Rehab to Whitehorse

CANOL Corridor SuperLoad Trucking System from Ross River to Johnsons Cross

To Skagway ($/Tonne) **Via KLONDIKE Corridor**	*Narrow Gauge Rail 50 Tonne Carloads*	NO Change Truck *50 Tonne Loads*	Potential *Savings*	
From: Carcross	$5.41	$9.43	-$4.02	-43%
Whitehorse	$7.87	$15.74	-$7.87	-50%
VIA CANOL Corridor **From:** Ross River **Split at:** Johnsons Crossing	*Dedicated Road 100/50 Tonne Truckloads*	*Campbell Hwy 50 Tonne Loads via Carmacks*	*Potential Savings*	
And Thru to: Skagway	$29.82	$52.21	-$22.39 (-43%)	

Trucking operations in both the KLONDIKE and CANOL Corridors can feed into a rehabilitated White Pass rail route with the prospect of minimizing public highway impacts by shifting mine haul traffic to trains between Whitehorse and Skagway where scenic travel safety and tourism attraction are most at risk. Mining companies seeking to mitigate public impacts of heavy mine haul traffic by shifting from trucks to trains in the KLONDIKE Corridor can actually to do so at an estimated 50% savings of approximately $8/tonne.

Trucking operations in the CANOL Corridor from Ross River can realize 43% ($22/tonne) savings with 100 tonne SuperLoads that split into 50 tonne conventional loads at Johnsons Crossing on the Alaska Highway. Trucking operations on a reconstructed South Canol Road will also disperse the public impact of mine haul trucking otherwise concentrated on the North Klondike Highway from Carmacks.

b) Full System Savings - will come from subsequent infrastructure investment in:

- KLONDIKE Corridor Standard Gauge Conversion and Carmacks Rail Extension; or
- CANOL Corridor super load southbound lanes extended onto main highway system.

While initial partial systems investments can complement each other, full systems investments may not. Without CANOL Corridor investment, almost all Yukon mineral traffic will be routed through Carmacks via the KLONDIKE Corridor to Skagway. Traffic concentration on the KLONDIKE Corridor from Carmacks will create the higher density that can help make a rail extension to Carmacks viable. The higher traffic density would warrant standard gauge conversion from Skagway along with the extension to Carmacks.[18]

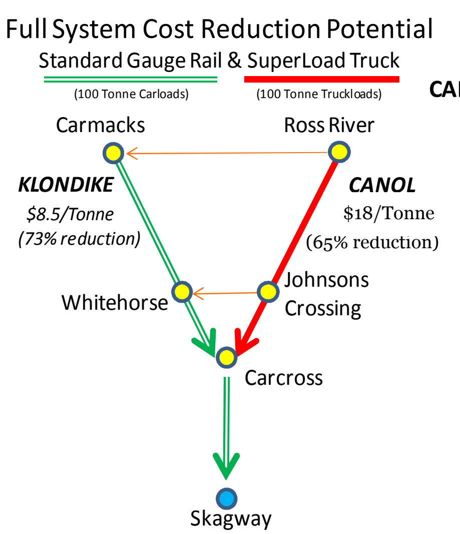
[18] To preserve the tourism appeal of historical narrow gauge passenger operations with heritage equipment, dual gauge trackage can be incorporated in the full system development.

Extending rail operations to Carmacks with standard gauge conversion also makes it possible to use 100 tonne cars. This full system rail investment offers the opportunity for an order of magnitude change in Yukon Heavy Haul Transportation performance: potential 73% mine haul savings, reducing costs by an estimated \$23/tonne to just \$8.60/tonne between Carmacks and Skagway.

Conversely investment in all or part of CANOL Corridor development can divert the traffic that is necessary for a viable rail extension to Carmacks. However extension of the CANOL Corridor super load system beyond Johnsons Crossing with a third lane on conventional public highways for Super B-Train 100 tonne truck loads could increase savings up to 65%, reducing full system costs by an estimated \$34/tonne to \$18/tonne from Ross River direct to Carcross en route to Skagway. Although this is a shorter alternative, the only truck route now authorized is via Whitehorse and accordingly that forms the investment assessment basis.

The current Yukon heavy haul trucking system would also be enhanced and public impacts minimized with build out of super load truck lanes in the loaded direction, effectively providing a passing lane for light vehicles.

Cost performance changes for both rail and highway infrastructure investment in KLONDIKE and CANOL Corridor full system development are shown on the following map and table.



Full System Infrastructure Investment

KLONDIKE Corridor Standard Gauge Rail Conversion & Extended to Carmacks

CANOL Corridor SuperLoad Trucking System from Ross River & Extended to Carcross

To Skagway (\$/Tonne) Via KLONDIKE Corridor	*Standard Gauge Rail 100 Tonne Carloads*	NO Change Truck *50 Tonne Loads*	Potential *Savings*	
From: Carcross	\$3.40	\$9.43	-\$6.02	-64%
Whitehorse	\$4.75	\$15.74	-\$11.00	-70%
Carmacks	\$8.60	\$31.48	-\$22.89	-73%
Ross River*	\$29.32	\$52.21	-\$22.89	-44%

*includes Campbell Hwy 50 tonne truckloads to Carmacks railhead

Via CANOL Corridor From: Ross River	*100 Tonne Truckloads*	*50 Tonne Truckloads*	*Potential Savings*
Split at Johnsons Crossing	\$29.82	\$52.21	-\$22 (-43%)
Thru. to Whitehorse (Utah Yard)*	\$6.79	\$11.94	-\$5
And Extended Thru to Skagway*	\$9.39	\$16.57	-\$7
Full System Direct to Carcross	\$18	\$52	-\$34 (-65%)

* Added cost/savings with build-out of Alaska and Klondike Highways relative to initial South Canol upgrade and operations.

From full and partial system performance changes developed above, potential savings/tonne are applied to various levels of Near Term and Long Term resource development traffic to determine the total savings per year. These are shown in the tables following for initial and full system development in both the KLONDIKE and CANOL Corridors.

Total annual system performance savings for KLONDIKE Corridor investment in an intermodal truck/rail system range up to:

- $14 million/year savings for Initial Narrow Gauge Rail Rehab to Whitehorse; and
- $39 million/year savings for Standard Gauge Conversion and Carmacks Extension.

Note that these savings are based on the operating costs of trains and trucks. Rail and road infrastructure cost are not included.

Initial Intermodal Truck/Rail System Development

KLONDIKE Corridor Narrow Gauge Rail Rehab to Whitehorse

With Utah Railhead Transfer for Truck Traffic from Carmacks and Ross River

	Annual Forecast Tonnes/Year and Potential Savings/Year			
$8 /Tonne	Near Term Resource Development			Long Term
Rail Savings	2010	2015	2020	2020-2030
Between: Skagway	Min Level	Mid Level	Max Level	Total
And: Whitehorse	300,000		237,440	
Carmacks	92,000	144,000	604,000	604,000
Ross River	56,000	536,000	774,000	1,108,000
Total Tonnes To Rail	448,000	680,000	1,615,440	1,712,000
Total Savings By Rail	**$3,584,000**	**$5,440,000**	**$12,923,520**	**$13,696,000**

Notes: At Whitehorse 300,000 tonnes/year reprocesssing copper tailings anticipated to start in 2012 and last 6-7 years and Max Level 2020 traffic includes 1,187,200 tonnes pipeline construction traffic averaged over 5 years.

Via Whitehorse $8/Tonne Rail Savings(50%) = $15.74/Tonne Truck Operating Cost - $7.90/Tonne Rail Operating Cost

If Via Carcross $4/Tonne Rail Savings (43%) = $9.43/Tonne Truck Operating Cost - $5.41/Tonne Rail Operating Cost

Full Intermodal Truck/Rail System Development

KLONDIKE Corridor Standard Gauge Rail Conversion & Extended to Carmacks

With Campbell Highway Connection to Carmacks Railhead for Ross River Truck Traffic

	Annual Forecast Tonnes/Year and Potential Savings/Year			
$23 /Tonne	Near Term Resource Development			Long Term
Rail Savings	2010	2015	2020	2020-2030
Between: Skagway	Min Level	Mid Level	Max Level	Total
And: Carmacks	92,000	144,000	841,440	604,000
Ross River	76,000	536,000	774,000	1,108,000
Total Tonnes To Rail	168,000	680,000	1,615,440	1,712,000
Total Savings By Rail	**$3,843,840**	**$15,558,400**	**$36,961,267**	**$39,170,560**

Notes: 50 tonne truck loads on Campbell Highway connection to Carmacks railhead @ $20.72/tonne

From Carmacks $23/Tonne Rail Savings (73%) = $31.48/Tonne Truck Operating Cost - $8.60/Tonne Rail Operating Cost

Total annual system performance savings projected at various levels of resource development traffic over a 20 year planning horizon – for CANOL Corridor investment in a "SuperLoad" Mine Haul Trucking System range up to:

- $25 million/year savings for Initial South Canol Road short-cut upgraded to 100 tonne SuperLoad standard; and
- $37 million/year savings for Full CANOL Corridor to Skagway upgraded with Special SuperLoad lanes.

SuperLoad Mine Haul Highway System Development

Initial South Canol Road reconstruction for dedicated 100 tonne SuperLoad operations
With subsequent construction of truck lanes to extend 100 tonne SuperLoad operations.

		Annual Forecast Tonnes/Year and Potential Savings/Year			
		Near Term Resource Development			Long Term
		2010	2015	2020	2020-2030
		Min Level	Mid Level	Max Level	Total
Total Tonnes/Year	From Ross River	56,000	536,000	774,000	1,108,000
$22 /Tonne Savings	To Johnsons Crossing	$1,259,440	$12,054,640	$17,407,260	**$24,918,920**
$5 /Tonne Savings	To Whitehorse	$252,000	$2,412,000	$3,483,000	$4,986,000
$7 /Tonne Savings	To Skagway	$369,600	$3,537,600	$5,108,400	$7,312,800
$34 /Tonne Savings	Full System Savings				**$37,217,720**

Notes: $22/Tonne Savings(43%) = $52.21/Tonne Conventional 50 Tonne Truckload via Carmacks - $29.82/Tonne 100 Tonne Load split at Johnsons Crossing
$5/Tonne Additional Savings(10%) = $11.94/tonne conventional truckload - $6.79/tonne SuperLoad between Johnson's Crossing and Whitehorse
$7/Tonne Additional Savings(14%) = $16.57/tonne conventional truckload - $9.39/tonne SuperLoad between Whitehorse and Skagway

3.2.3 Infrastructure Investment

This section screens for transportation system investment options that can be incrementally developed in part or in full. Assessment of these investment options is from a pro-forma savings and benefits perspective compared to current system performance.

System performance savings identified in the previous section are incorporated in a high level life cycle assessment as an objective tool for prioritizing options for a Northern Transportation Infrastructure Investment Plan. Estimated shipment savings are truck operating costs less rail operating costs and inclusive of depreciation.

In addition to transportation savings that benefit mineral shippers, highway and railway maintenance costs and savings have been included in a cursory discounted cash flow analysis that provides an indication of financial feasibility from a public sector perspective.

Incremental investment in both rail and road infrastructure can be staged to coincide with an anticipated influx of Yukon mine haul traffic. For partial and full system development scenarios outlined in the previous section, capital cost and relevant maintenance estimates are provided on the following pages.

KLONDIKE CORRIDOR RAIL SYSTEM DEVELOPMENT COST ESTIMATE

Narrow Gauge Freight Rail Rehab to Whitehorse

Between	And	Rail Miles	Investment	Capital Cost	
Skagway	Carcross	67.5	**Reactivate for Winter/Freight Ops**		
			fix icing areas, open cuts & fills, snow prep	$10,000,000	
			open Canadian Shed cut & realign	$2,000,000	
Carcross	Whitehorse	38.5	**Rehab Out of Service Track**		
			rebuild track & roadbed	$40,000,000	
			rebuild Utah Transfer Yard	$2,000,000	
			Mangement, Contingency & Escalation		
			project management & engineering	$2,000,000	
			other freight rail contingenciees	$5,000,000	
			escalation from 2006 costs (10%)	$6,039,000	
			PARTIAL SYSTEM INCREMENTAL COST		**$67,039,000**

Standard Guage Conversion & Extension to Carmacks

Between	And	Rail Miles	Investment	Capital Cost	
Carmacks	Utah Yard	109	**Construct New Rail Extension**		
			subgrade, roadbed & yards	$145,000,000	
			main track structure & sidings	$148,000,000	
			highway & water crossings	$71,000,000	
Utah Yard	Skagway	106	**Conversion to Standard Gauge**		
			standard/dual gauge track & facilities	$56,000,000	
			narrow gauge bridge upgrades	$17,000,000	
			Management, Contingency & Escalation		
			project management & engineering	$30,000,000	
			environmental assessment	$12,000,000	
			construction contingency	$45,000,000	
			escalation from 2006 costs (10%)	$51,876,000	
			FULL SYSTEM INCREMENTAL COST		**$575,876,000**

Standard Gauge to Carmacks Full System Total Cost **$642,915,000**

Source: HDR Engineering/Pacific Contracting Company for Alaska Canada Rail Link Feasibility Study (2006 costs)
Note: $20 million of rail installation cost White Pass to Carcross assumed reduced by 50% account ongoing rail replacement program; and continued narrow gauge tourist train operations assumed with dual gauge 3 rail system.

KLONDIKE CORRIDOR RAIL SYSTEM HIGHWAY MAINTENANCE SAVINGS ESTIMATE

Highway Maintenance Savings for Truck Traffic Diverted to Rail

Between Whitehorse and Skagway	**177 km @ $.02/tonne-km**	**$3.54/tonne**
Between Carmacks and Skagway	**354 km @ $.02/tonne-km**	**$7.08/tonne**

Notes: Highway maintenance savings = $.024/tone-km less 16% for truck fees and fuel taxes.

Railway shipper savings = truck operating costs less rail operating costs inclusive of depreciation and maintenance.

CANOL CORRIDOR SUPERLOAD SYSTEM DEVELOPMENT COST ESTIMATE

South Canol Road Reconstruction for 100 Tonne Superload Trucks

Between	And	Hwy Kms	Investment	Capital Cost	
Ross River	Johnsons Cross	226	**Rebuild S.Canol Rd for 100 tonne Superloads**		
			construct granular sub-base	$21,244,000	
			construct crushed granular surfacing	$6,563,000	
			turnouts, alignment & sightline impovements	$11,300,000	
			highway maint camp & equipment acquisition	$7,330,000	
			planning, management & contingency allowance	5,866,000	
			PARTIAL SYSTEM INITIAL COST		**52,303,000**

Alaska & Klondike Hwy Upgrades to Extend Superload Trucking

Between	And	Hwy Kms	Investment	Capital Cost	
			Upgrade Hwys with Special Superload Lanes		
Johnsons Cross	Whitehorse	121	add Alaska Hwy shoulder/surface lane	$35,761,713	
Whitehorse	Carcross	71	add S.Klondike Hwy shoulder/surface lane	$12,758,713	
Carcross	Skagway	106	add S.Klondike Hwy shoulder/surface lane	$33,516,000	
			FULL SYSTEM INCREMENTAL COST		**$82,036,426**

CANOL Corridor Full System Total Cost **$134,339,426**

CANOL CORRIDOR HIGHWAY MAINTENANCE COST ESTIMATE

Annual Maintenance Cost for 226 km South Canol Road	**$1,350,000/year**
Incremental Maintenance Cost	*$6,000/km*
above nominal 700,000 tonnes/year	*$.0086/tonne-km*
less 16% recovery from truck fees and fuel taxes	*$.0072/tonne-km*

Source: *CANOL Resource Corridor Preliminary Feasibility Study* (June 2009) PROLOG Canada Inc.
Note: Alternate CANOL Corridor routing via a Tagish Road shortcut reduces capital cost of superload lane upgrades by $24 million.
Shipment savings = Conventional Ops cost via Carmacks - SuperLoad ops cost via Canol Road inclusive of depreciation for 50 tonne loads via Carmacks vs. 100 tonne SuperLoads continuing through or split at Johnsons Crossing.

Economic viability for each of the above infrastructure development investments is screened against the life-cycle assessment of benefits from transportation savings, together with relevant maintenance cost and savings, presented on the following pages. This quantitative analysis can aid in the following sequence of investment decisions:

- Looking first at initial investment in:

  (a) South Canol Road Reconstruction; and

  (b) White Pass Rail Rehabilitation to Whitehorse.

- Followed by full system development of

  (c) A SuperLoad Highway System; or

  (d) An Extended Standard Gauge White Pass Rail System.

a) Initial CANOL Corridor SuperLoad Mine Haul System - Invest $52.3 million in reconstruction of the South Canol Road to a 100 Tonne SuperLoad standard. Completion of this short-cut to the Selwyn Mine within 5 years can capture the surge of lead/zinc concentrate traffic projected for 2015.

Initial CANOL Corridor reconstruction of the South Canol Road can complement initial KLONDIKE Corridor reconstruction of the narrow gauge railway to Whitehorse with the prospect of truck to rail transfers at Utah Yard or Carcross. Both projects are similarly attractive in meeting infrastructure investment decision criteria. However, opening up the South Canol Road will divert from Carmacks the traffic density needed to make subsequent full development of an extended standard gauge rail system viable in the Klondike Corridor.

Initial CANOL Corridor Investment provides a net benefit from the combination of a 20% shorter route with a doubling of truck payloads that totals almost $600 million in undiscounted savings.[19] At 5% discount rate over a 25 year project life cycle, the resulting Net Present Value is $209 million with a Benefit to Cost ratio exceeding 5:1 and an attractive 20% Internal Rate of Return, substantially exceeding a 10% discount rate hurdle.

After allowing for highway maintenance cost, the net benefit from mine shipment savings over this new truck route will pay back the value of the investment in seven years.

	Initial South Canol Road Reconstruction				
	CANOL Corridor Dedicated Mine Haul SuperLoad System				
Built to 100 Tonne SuperLoad Standard Ross River to Johnsons Crossing					
Calendar Year	Project Year	Cumulative Total Tonnes	Truck Shipment Savings	Hwy Maintenance Cost	Net Savings Benefit
2010					
2011	-1	($52 million investment over 2 construction years)			-$26,150,000
2012	0				-$26,150,000
2013	1	56,000	$1,259,440	-$91,108	$1,168,332
2014	2	56,000	$1,290,926	-$93,386	$1,197,540
2015	3	536,000	$12,657,372	-$915,636	$11,741,736
2016	4	536,000	$12,958,738	-$937,436	$12,021,302
2017	5	536,000	$13,260,104	-$959,237	$12,300,867
2018	6	536,000	$13,561,470	-$981,038	$12,580,432
2019	7	536,000	$13,862,836	-$1,002,839	$12,859,997
2020	8	774,000	$20,453,531	-$1,479,610	$18,973,920
2021	9	774,000	$20,888,712	-$1,511,091	$19,377,621
2022	10	774,000	$21,323,894	-$1,542,573	$19,781,321
2023	11	774,000	$21,759,075	-$1,574,054	$20,185,021
2024	12	774,000	$22,194,257	-$1,605,535	$20,588,722
2025	13	1,108,000	$32,394,596	-$2,343,428	$30,051,168
2026	14	1,108,000	$33,017,569	-$2,388,494	$30,629,075
2027	15	1,108,000	$33,640,542	-$2,433,560	$31,206,982
2028	16	1,108,000	$34,263,515	-$2,478,626	$31,784,889
2029	17	1,108,000	$34,886,488	-$2,523,692	$32,362,796
2030	18	1,108,000	$35,509,461	-$2,568,758	$32,940,703
	19	1,108,000	$36,132,434	-$2,613,824	$33,518,610
	20	1,108,000	$36,755,407	-$2,658,890	$34,096,517
	21	1,108,000	$37,378,380	-$2,703,956	$34,674,424
	22	1,108,000	$38,001,353	-$2,749,022	$35,252,331
	23	1,108,000	$38,624,326	-$2,794,088	$35,830,238
	24	1,108,000	$39,247,299	-$2,839,153	$36,408,146
	25	1,108,000	$39,870,272	-$2,884,219	$36,986,053
2.5%	**yr Escalated Savings&Maint.**		$645,191,996	-$46,673,252	$598,518,743
5.0%	**Discounted Present Value of Savings Benefit from Investment**				$284,415,119
				Net Present Value of Investment	$209,349,314
				Savings Benefits to Capital Cost	544%
				Internal Rate of Return	20.5%
				Pay Back (years)	7

19 Shipment savings equal conventional truckload operating cost via Carmacks less SuperLoad operating cost via South Canol Road, inclusive of depreciation for 50 tonne loads via Carmacks vs. 100/50 tonne SuperLoads that split at Johnsons Crossing. Canol Maintenance costs equal $1,350,000 for 226 km with nominal 700,000 tonnes per year or $.0085 per tonne-km less 16% of total as offset for government revenue from truck fees and fuel taxes.

b) Initial KLONDIKE Corridor Intermodal Truck/Rail System - Invest $67 million in narrow gauge rail rehabilitation between Carcross and Whitehorse. This project is essentially repair of an inactive railway that is "shovel ready" to start now with anticipation of an early traffic influx from reprocessing of Whitehorse Copper tailings that requires rail completion and readiness in 2012.

This project provides a combined benefit of reduced shipment costs ($375 million undiscounted savings) and reduced highway maintenance ($164 million undiscounted savings) that exceed half a billion dollars undiscounted savings total.[20] Over a 25 year project life cycle at a 5% discount rate, the resulting Net Present Value is $174 million with a Benefit to Cost ratio of almost 4:1. There is an attractive 17% Internal Rate of Return that substantially exceeds a 10% discount rate hurdle.

The direct economic benefits of this infrastructure development are rail shipment and highway maintenance savings which should pay back the value of the investment within 8 years.

Initial Intermodal Truck/Rail System Development

KLONDIKE Corridor Narrow Gauge Rail Rehab to Whitehorse

With Utah Yard Rail Transfer for Truck Traffic from Carmacks and Ross River

Calendar Year	Project Year	Tonnes Per Year	Rail Shipment Savings	Hwy Maintenance Savings	Total Savings Benefit
2010	-2				
2011	-1	($67 million investment over 2 construction years)			-$34,000,000
2012	0				-$33,000,000
2013	1	448,000	$3,584,000	$1,565,303	$5,149,303
2014	2	448,000	$3,673,600	$1,604,436	$5,278,036
2015	3	680,000	$5,712,000	$2,494,702	$8,206,702
2016	4	680,000	$5,848,000	$2,554,099	$8,402,099
2017	5	680,000	$5,984,000	$2,613,497	$8,597,497
2018	6	680,000	$6,120,000	$2,672,895	$8,792,895
2019	7	680,000	$6,256,000	$2,732,292	$8,988,292
2020	8	1,615,440	$15,185,136	$6,632,070	$21,817,206
2021	9	1,615,440	$15,508,224	$6,773,178	$22,281,402
2022	10	1,615,440	$15,831,312	$6,914,286	$22,745,598
2023	11	1,615,440	$16,154,400	$7,055,394	$23,209,794
2024	12	1,615,440	$16,477,488	$7,196,502	$23,673,990
2025	13	1,712,000	$17,804,800	$7,776,202	$25,581,002
2026	14	1,712,000	$18,147,200	$7,925,744	$26,072,944
2027	15	1,712,000	$18,489,600	$8,075,287	$26,564,887
2028	16	1,712,000	$18,832,000	$8,224,829	$27,056,829
2029	17	1,712,000	$19,174,400	$8,374,371	$27,548,771
2030	18	1,712,000	$19,516,800	$8,523,914	$28,040,714
	19	1,712,000	$19,859,200	$8,673,456	$28,532,656
	20	1,712,000	$20,201,600	$8,822,998	$29,024,598
	21	1,712,000	$20,544,000	$8,972,541	$29,516,541
	22	1,712,000	$20,886,400	$9,122,083	$30,008,483
	23	1,712,000	$21,228,800	$9,271,625	$30,500,425
	24	1,712,000	$21,571,200	$9,421,168	$30,992,368
	25	1,712,000	$21,913,600	$9,570,710	$31,484,310
2.5%	**yr Escalated Savings Benefit**		$374,503,760	$163,563,581	$538,067,341
5.0%	**Discounted Present Value of Savings Benefit from Investment**				$260,724,543
				Net Present Value of Investment	$174,171,921
				Savings Benefits to Capital Cost	389%
				Internal Rate of Return	17.1%
				Pay Back (years)	8

[20] Shipment savings equal truck operating costs less rail operating costs inclusive of maintenance and depreciation. Highway maintenance savings equal rail tonnes x $.024 per tonne-km x 177 kms Whitehorse to Skagway less 16% of total to account for government revenue from truck fees and fuel taxes.

c) Full CANOL Corridor SuperLoad System Extension – Invest an additional $82 million to extend the SuperLoad Mine Haul System throughout the CANOL Corridor with construction of special truck lanes along Alaska Highway 1 and Klondike Highway 2 between Johnsons Crossing and Skagway.

This project should target completion to accommodate the anticipated expansion of Selwyn Mine production in 2020. This project is mutually exclusive with full development of the KLONDIKE Corridor Intermodal Truck/Rail System as it would divert traffic away from a Carmacks railhead.

This project provides additional benefit from extending 100 tonne SuperLoads with special truck lanes that totals over $300 million undiscounted savings.[21] Discounted at 5% over a 25 year project life cycle, the resulting Net Present Value is $72 million with a 4:1 Benefit to Cost ratio and an 11% Internal Rate of Return that clears a 10% discount rate hurdle.

The economic benefits from this development will pay back the investment value in 10 years.

Additional Highway 1 and 2 Truck Lane Construction

CANOL Corridor Mine Haul System Extended with Special Truck Lanes

Built to 100 Tonne SuperLoad Standard Johnsons Crossing to Skagway

Calendar Year	Project Year	Cumulative Total Tonnes	Truck Shipment Savings	Hwy Maintenance Cost	Net Savings Benefit
2017					
2018	-1	($82 million investment over 2 construction years)			-$41,000,000
2019	0				-$41,000,000
2020	1	774,000	$8,591,400	-$1,493,261	$7,098,139
2021	2	774,000	$8,806,185	-$1,530,593	$7,275,592
2022	3	774,000	$9,020,970	-$1,567,925	$7,453,045
2023	4	774,000	$9,235,755	-$1,605,256	$7,630,499
2024	5	774,000	$9,450,540	-$1,642,588	$7,807,952
2025	6	1,108,000	$13,836,150	-$2,404,846	$11,431,304
2026	7	1,108,000	$14,143,620	-$2,458,287	$11,685,333
2027	8	1,108,000	$14,451,090	-$2,511,728	$11,939,362
2028	9	1,108,000	$14,758,560	-$2,565,169	$12,193,391
2029	10	1,108,000	$15,066,030	-$2,618,610	$12,447,420
2030	11	1,108,000	$15,373,500	-$2,672,051	$12,701,449
	12	1,108,000	$15,680,970	-$2,725,492	$12,955,478
	13	1,108,000	$15,988,440	-$2,778,933	$13,209,507
	14	1,108,000	$16,295,910	-$2,832,374	$13,463,536
	15	1,108,000	$16,603,380	-$2,885,815	$13,717,565
	16	1,108,000	$16,910,850	-$2,939,256	$13,971,594
	17	1,108,000	$17,218,320	-$2,992,697	$14,225,623
	18	1,108,000	$17,525,790	-$3,046,138	$14,479,652
	19	1,108,000	$17,833,260	-$3,099,579	$14,733,681
	20	1,108,000	$18,140,730	-$3,153,020	$14,987,710
	21	1,108,000	$18,448,200	-$3,206,461	$15,241,739
	22	1,108,000	$18,755,670	-$3,259,902	$15,495,768
	23	1,108,000	$19,063,140	-$3,313,343	$15,749,797
	24	1,108,000	$19,370,610	-$3,366,784	$16,003,826
	25	1,108,000	$19,678,080	-$3,420,225	$16,257,855
2.5%	**r Escalated Savings&Maint.**		$380,247,150	-$66,090,326	$314,156,824
5.0%	**Discounted Present Value of Savings Benefit from Investment**				$163,416,472
			Net Present Value of Investment		$71,987,730
			Savings Benefits to Capital Cost		399%
			Internal Rate of Return		11.3%
				Pay Back (years)	10

Unlike the initial CANOL Corridor investment which achieves both distance and payload savings, the additional CANOL Corridor investment can only extend payload savings over existing highway routes that are no shorter. Nevertheless the full system investment can achieve up to 65% savings for mine haul operations to and from Ross River.

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[21] Shipment savings inclusive of depreciation equal conventional 50 tonne truckload operating cost via Carmacks less 100 tonne SuperLoad operating cost via Canol Road continuing beyond Johnsons Crossing. Canol Road maintenance cost extended to highway truck lanes equals $1,350,000 for 226 kms or $6,000 per km for a nominal 700,000 tonnes per year or $.0085 per tonne-km, less 16% of total as offset for government revenue from truck fees and fuel taxes.

d) Full KLONDIKE Corridor Intermodal Truck/Rail System – Invest an additional $576 million in standard gauge rail conversion and extension to Carmacks. This project is an alternative to South Canol Road reconstruction and becomes viable with the combination of mine haul traffic from Ross River as well as Carmacks at approximately 2 million tonnes/year projected for 2020 and beyond.

This project provides a huge shipment savings benefit with an undiscounted value of $1.2 billion. The additional benefit of reduced highway maintenance has an undiscounted value of $385 million.[22] The combined Savings Benefit approaches a billion dollars over a 25 year project life cycle at a 5% discount rate and the Net Present Value is $237 million. Benefits exceed the high capital cost by 50% and indicate an Internal Rate of Return exceeding 8%.

The sheer magnitude of discounted savings benefits approaching $1 billion offers a powerful performance change in Yukon mine haul systems that far exceeds the potential of any other investment to meet future constraints on moving minerals to tidewater export position. This full system investment achieves 73% shipment savings at a Carmacks railhead.

Full Intermodal Truck/Rail System Development

KLONDIKE Corridor Standard Gauge Rail Conversion & Extended to Carmacks

With Campbell Hwy Connection to Carmacks Railhead for Ross River Truck Traffic

Calendar Year	Project Year	Tonnes Per Year	Rail Shipment Savings	Hwy Maintenance Savings	Total Savings Benefit
2017	-2				-$192,000,000
2018	-1	($576 million investment over 3 construction years)			-$192,000,000
2019	0				-$192,000,000
2020	1	1,615,440	$36,961,267	$11,288,630	$48,249,897
2021	2	1,615,440	$37,885,299	$11,570,846	$49,456,145
2022	3	1,615,440	$38,809,331	$11,853,062	$50,662,392
2023	4	1,615,440	$40,657,394	$12,135,277	$52,792,671
2024	5	1,615,440	$40,657,394	$12,417,493	$53,074,887
2025	6	1,712,000	$44,066,880	$13,458,811	$57,525,691
2026	7	1,712,123	$45,046,144	$13,758,884	$58,805,028
2027	8	1,712,123	$46,025,408	$14,057,990	$60,083,398
2028	9	1,712,123	$47,004,672	$14,357,096	$61,361,768
2029	10	1,712,123	$47,983,936	$14,656,203	$62,640,139
2030	11	1,712,123	$48,963,200	$14,955,309	$63,918,509
	12	1,712,123	$49,942,464	$15,254,415	$65,196,879
	13	1,712,123	$50,921,728	$15,553,521	$66,475,249
	14	1,712,123	$51,900,992	$15,852,627	$67,753,619
	15	1,712,123	$52,880,256	$16,151,734	$69,031,990
	16	1,712,123	$53,859,520	$16,450,840	$70,310,360
	17	1,712,123	$54,838,784	$16,749,946	$71,588,730
	18	1,712,123	$55,818,048	$17,049,052	$72,867,100
	19	1,712,123	$56,797,312	$17,348,158	$74,145,470
	20	1,712,123	$57,776,576	$17,647,264	$75,423,840
	21	1,712,123	$58,755,840	$17,946,371	$76,702,211
	22	1,712,123	$59,735,104	$18,245,477	$77,980,581
	23	1,712,123	$60,714,368	$18,544,583	$79,258,951
	24	1,712,123	$61,693,632	$18,843,689	$80,537,321
	25	1,712,123	$62,672,896	$19,142,795	$81,815,691
2.5%	**yr Escalated Savings Benefit**		$1,262,368,444	$385,290,073	$1,647,658,517
5.0%	**Discounted Present Value of Savings Benefit from Investment**				$879,958,839
				Net Present Value of Investment	$237,277,908
				Savings Benefit to Capital Cost	153%
				Internal Rate of Return	8.4%
				Pay Back (years)	12

The project would be an incentive to additional mine development that in turn could create the mineral traffic necessary to reach a more economical rail freight threshold that can:

- *Reduce tourism conflicts* as truck traffic currently competing with diverse passenger modes on a twisting mountain road shifts to rail in the Klondike Corridor to Skagway.
- *Improve energy efficiency, reduce oil dependence and cut greenhouse gas emissions* with lower fuel consumption for environmentally attractive rail operations.
- *Avoid accidents* as truck traffic shifts to an almost entirely grade separated railway with only one highway crossing between Skagway, Alaska and Carcross, Yukon.

[22] Shipment savings equal truck less rail operating costs inclusive of depreciation and maintenance. Highway maintenance savings equal rail tonnes x $.024/tonne-km x 354 kms to Skagway from Whitehorse or 177 kms from Carmacks less 16% truck fees and fuel tax.

From the foregoing investment assessment, the following financial characteristics provide a summary set of objective criteria as one tool for Yukon infrastructure development decision making:

Infrastructure Development Investment Options	Initial System Partial Investment		Full System Additional Investment	
	CANOL Corridor *SuperLoad Hwy*	KLONDIKE Corridor *Intermodal Rail*	CANOL Corridor *SuperLoad Hwy*	KLONDIKE Corridor *Intermodal Rail*
Financial Criteria				
Capital Cost	$52 million	$67 million	$82 million	$576 million
Internal Rate of Return	20.5%	17.1%	11.3%	8.4%
Net Present Value	$209 million	$174 million	$72 million	$237 million
Benefit/Cost Ratio	5 : 1	4 : 1	2 : 1	1.5 : 1
Payback	7 years	8 years	10 years	12 years

5% discount rate and escalation at 2.5%/year.

A Yukon Heavy Haul infrastructure investment plan should move first to capture the greatest economic value at the least cost that is almost equally available from either or both of:

- CANOL Corridor *SuperLoad* Mine Haul reconstruction of South Canol Road; and
- KLONDIKE Corridor *Shovel Ready* Intermodal Rail reconstruction to Whitehorse.

Later, within about 10 years projected traffic increases will require additional investment decisions to realize the full potential for a paradigm shift in Yukon Heavy Haul transportation system performance through:

- CANOL Corridor extension with construction of *SuperLoad* truck lanes; or
- KLONDIKE Corridor Intermodal Rail gauge conversion and Carmacks extension.

An initial investment decision for partial development of the CANOL Highway corridor to Johnsons Crossing can complement an initial investment decision for partial development of the KLONDIKE Rail corridor to Whitehorse. However, it will divert traffic from a potential Carmacks railhead, precluding the option of subsequent full rail system development. Conversely, if no investment is made in the CANOL Corridor, resulting traffic density converging at Carmacks will favour full rail system investment in the KLONDIKE Corridor.

In summary, all of these investments appear financially attractive from a narrow economic benefits focus on transportation and maintenance costs. However, strategic choices are required to avoid conflicting outcomes.

4. NWT/Nunavut New Road Systems

Many communities in the Northwest Territories and all communities in Nunavut have no all-weather road connections to the southern Canadian highway system. Public investment proposals for the Mackenzie Valley Highway and for the Nunavut-Manitoba Road would start to close that infrastructure gap.

While resource access roads will connect to these highways, the principal purpose is a public highway to connect communities – with a public interest in public investment. The Tibbitt to Contwoyto Winter Road, on the other hand, is exclusively a resource access road which is constructed each year at private sector expense.

This chapter of the report develops a summary level assessment for each of those key new road systems in NWT and Nunavut:[23]

- A Mackenzie Valley All-Weather Highway between Wrigley and Inuvik and between Inuvik and Tuktoyaktuk that in part or in full will benefit increased community and resource development access – and provide Canada's only southern highway connection to an arctic port at Tuktoyaktuk. The assessment identifies surface and air transportation savings for people and cargo that are compelling, exceeding annual highway maintenance costs, with a residual net benefit that just matches 16% of the capital cost of construction.
- A Seasonal Overland Road that can extend the operating season for the Tibbitt to Contwoyto Winter Road that serves NWT and Nunavut mineral properties in the Slave Geological Province. The assessment considers the risk that a warming climate will repeat the 100,000 tonne capacity shortfall of 2006 and the trade off of a large SOR investment with a short life versus a smaller BIPAR investment with a long life.
- A Nunavut-Manitoba All-Weather Road Investment that with an initial inter-community regional distribution system could improve sealift cargo delivery via a single Kivalliq hub. The assessment identifies the full investment impact of year around just-in-time trucking to reduce inventories and reorder lead times at no more cost than summer-only sealift. It also considers large air passenger and air cargo savings that in combination with sealift dry cargo diverted to trucks, exceed anticipated highway maintenance costs but are insufficient to significantly offset the capital cost of construction.

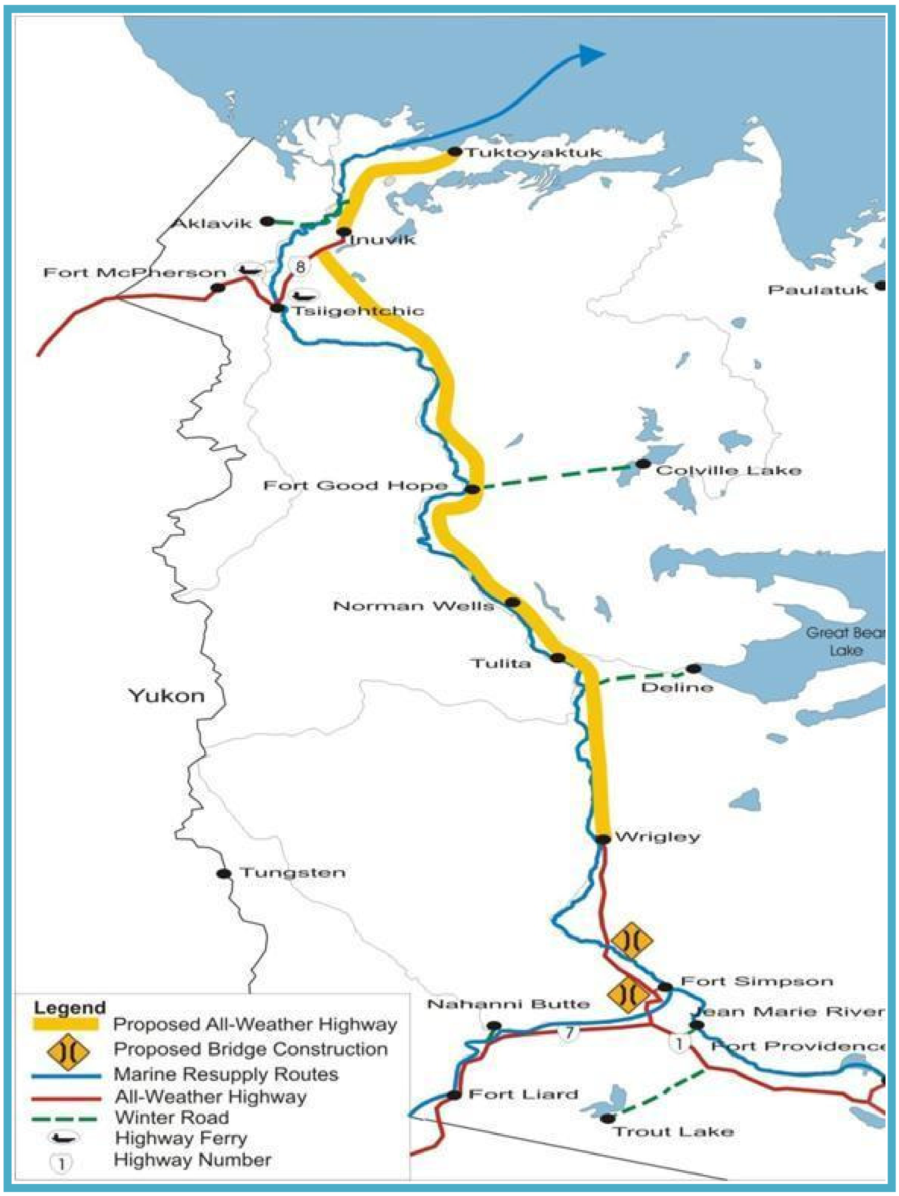
This chapter provides the investment decision making information for strategic highway infrastructure choices that may duplicate existing or potential transportation systems in the Mackenzie Delta, in the Slave Geological Province and in the Kivalliq Region.

[23] Among other significant resource access requirements not addressed here is the 122 km all-weather road from Highway 3 at Behchoko through the community of Wha Ti to the NICO mine site, estimated to cost $183 million where only a winter road is now available.

4.1 Mackenzie Valley Highway System

This section deals with the proposed Mackenzie Valley Highway all-weather road and the potential modal shifts and transportation savings which it could provide. This project is being pursued in two segments (see map below): Wrigley to Inuvik and Inuvik to Tuktoyaktuk.

The first segment is an 816 km all-weather highway from Wrigley to Dempster Highway 8 near Campbell Lake, 20 km south of Inuvik. The second segment is a 142 km all-weather highway from Inuvik to Tuktoyaktuk.



4.1.1 System Overview

The Mackenzie Valley Highway System is an extension of the existing all-weather and winter road system comprised of:

- The All-Weather Mackenzie Highway from Alberta to Wrigley, NWT;
- The Mackenzie Winter Road from Wrigley to Norman Wells/Fort Good Hope; and
- The Inuvik-Tuktoyaktuk Winter Ice Road along the Mackenzie River East Channel.

At present the all-weather NWT Mackenzie Highway No. 1 ends at Wrigley. A seasonal winter road connects Wrigley to Fort Good Hope via Tulita and Norman Wells. There is no road (winter or all-weather) between Fort Good Hope and Inuvik. A winter ice road along the Mackenzie East Channel connects Inuvik to Aklavik and Tuktoyaktuk

Recommended Approach for the Mackenzie Valley Highway System

Incrementally replace winter road segments, as compromised by warmer weather, with corresponding extension of the all-weather road system from the south to provide increasingly better access for:

- ***Mackenzie Valley and Delta communities;***
- ***Mackenzie Gas Pipeline Project construction; and***
- ***Mackenzie Valley and Western Arctic Oil & Gas Development.***

Mackenzie River East Channel Winter Ice Road

a) Inuvik to Tuktoyaktuk All-Weather Road

Currently a 194 km seasonal winter (ice) road connects Inuvik and Tuktoyaktuk. With federal and GNWT funding, a 20 km all-weather community access road from the Hamlet of Tuktoyaktuk south to Granular Source 177 is nearing completion.


Arctic Road Construction South from Tuktoyaktuk

This road, after upgrading to highway standards, will form the northern most portion of the future 142 km Inuvik to Tuktoyaktuk all-weather highway, for which a project description report (prepared for the Inuvialuit Land Claim group by consulting engineers with funding from the Federal and NWT governments) was submitted in early 2010 to the Inuvialuit Environmental Impact Review Steering Committee (EISC). The EISC recommended a full environmental review for the project. That process involves additional studies, submissions and hearings, and is expected to be completed sometime in 2012.

Assuming continued funding by the Federal and NWT governments, construction will take 3 to 4 years, with completion in 2016 or 2017. Most recently, the 2011 Federal Budget included $150 million allocated to construction of the Inuvik to Tuktoyaktuk All-Weather Road.

b) Wrigley to Inuvik All-Weather Highway

The 816 km all-weather highway from Wrigley to the Dempster Highway straddles three Land Claim groups: Deh Cho (who are negotiating a Land Claim with the federal government) from Wrigley to south of Tulita; Sahtu (who have a settled Land Claim, and have two of their "Districts" straddling the highway location) from south of Tulita to north of Fort Good Hope via Norman Wells; and Gwich'in from north of Fort Good Hope to Inuvik.

The GNWT Department of Transportation, along with the Town of Inuvik and Hamlet of Tuktoyaktuk signed a Memorandum of Understanding in September 2009 to complete work on a Project Description Report (PDR) for the Inuvik-Tuktoyaktuk road. The PDR has now been completed and submitted to the Environmental Impact Review Board (EIRB). The EIRB is expected to commence public hearings by late summer 2011.

Subject to funding availability, the proposed schedule for the completion of the 816 km all-weather highway from Wrigley to the Dempster Highway just south of Inuvik is as follows:

- Completion and submission of Project Description Report(s) — November 2011
- Regulatory screening(s) — 2012
- Environmental review and approval — 2013 and 2014
- Construction (depending upon government funding approvals) — 2015 to 2019

Infrastructure investment in a Mackenzie Valley Highway System will attract traffic from two season Mackenzie River and Winter Road operations; from the longer Dempster Highway route and from Air Cargo and Passenger services. This traffic potential is shown in the following recap of the Phase 1 Mackenzie Valley and Delta/Beaufort Traffic Forecast.

Recap of Phase 1 Mackenzie Valley & Delta/Beaufort Sea Traffic Forecast

(Tonnes/Year)

Mackenzie Valley	2009/10	2015	2020	2025	2030
Barge Deck Cargo	7,844				
Winter Road Truck	1,300				
Community Resupply	9,144	9,583	9,949	10,305	10,662
Mackenzie Basin Oil & Gas	6,000	27,000	27,000	40,000	54,000
Mackenzie Delta/Beaufort Sea					
Dempster Hwy Truck	22,000	23,056	23,936	24,794	25,652
Beaufort Sea Oil & Gas		4,000	8,000	8,000	12,000
Mackenzie Delta Oil & Gas		38,000	38,000	54,000	76,000
Mackenzie Valley/Delta Air Traffic					
Cargo Tonnes per Year	1,700	2027	2,353	2758	3,162
Passengers per Year	119,193	136,953	151,136	166,870	184,273

4.1.2 Performance Change

Proposed all-weather road investment in the Mackenzie Valley would alter system performance from the current two season summer barge and winter road operations to conventional year around highway operations. It would also provide a much shorter alternative to the Alaska/Dempster Highway routing for Mackenzie Delta/Beaufort truck traffic.

In the Mackenzie Valley, traffic shift from winter road will save an average of $56/tonne from an 8 hour reduction in return trip time to Norman Wells. [24] Winter road truck rates are approximately 25% higher than summer barge rates, and it is assumed that reduction in inventory costs with "just-in-time" 2 day trucking year around from Edmonton will divert barge deck cargo at a lower rate differential for all-weather road trucking. However, as long as the river system continues to operate, it is assumed that bulk fuel will continue to move by barge. (Note that Inuvik bulk fuel delivery for power generation has been largely replaced by regionally sourced natural gas.)

[24] Approximately 666 kms return trip at 75 km/h on gravel road – 40 km/h on winter road = 8 hour saving x $165/hour operating cost for average 23.5 tonne payload.

To the Mackenzie Delta, the Alaska/Dempster Highway route is over 1200 kms longer and traffic shift will save approximately $229/tonne from a 32 hour reduction in return trip time.[25]

Mackenzie Valley/Delta air cargo and passenger traffic will be attracted to much lower cost highway transport. A projected 95% of air cargo traffic is assumed diverted to a new highway with estimated $1,995/tonne savings based on the difference between air cargo rates and truck costs to Norman Wells.[26] A projected 10% air passenger traffic diversion assumes that the family vehicle will be favoured for annual southern shopping trips at estimated savings of $425/passenger based on the difference between current air fares to Edmonton and the cost for driving from Norman Wells.[27]

This potential for transport savings from full development of an all-weather highway extension between Wrigley and Tuktoyaktuk is shown in the following table.

Mackenzie Valley All-Weather Road Development
Full System Savings Potential

	No Change	All-Weather Road	Potential Savings
Winter Road	$119/tonne	$63/tonne	$56/tonne
Dempster Hwy	$619/tonne	$390/tonne	$229/tonne
Air Freight	$2,150/tonne	$155/tonne	$1,995/tonne
Air Passengers	$675/person	$250/person	$425/person

[25] Approximately 2,440 kms shorter return trip at 75 kph = 32.5 hour saving x $165/hour operating cost for average 23.5 tonne payload.

[26] $2,150/tonne non-food Nutrition North air rate from Yellowknife vs. $155/tonne for 1,678 kms equivalent return trip distance from Hwy 1/3 Jct. to Norman Wells at 75 km/h.

[27] Current $675/psgr fare between Norman Wells and Edmonton compared to personal vehicle cost at $.50/km x 2000 kms from Norman Wells for a family of four.

Total transport cost savings benefit anticipated from these performance changes are shown in the following table.

NWT Highway System Investment

Mackenzie Highway Extension from Wrigley to Inuvik to Tuktoyaktuk
Potential Traffic Attraction and Savings Benefit
(tonnes and savings per year)

Mackenzie Valley Traffic	*2009/10*	2015	2020	2025	2030
$56 / Tonne Savings *[for traffic shifts from Winter Road to All Weather Road]*					
Community Resupply	*500*	524	544	564	583
Mackenzie Basin Oil & Gas	*6,000*	27,000	27,000	40,000	54,000
Potential Mackenzie Hwy Traffic Shift		29,539	29,564	42,589	56,613
Potential Mackenzie Hwy Savings Benefit/Year		$1,654,184	$1,655,584	$2,384,956	$3,170,328
Mackenzie Delta Traffic					
$229 / Tonne Savings *[for traffic shift from Dempster Highway to Mackenzie Highway]*					
Mackenzie Delta Oil & Gas		38,000	38,000	54,000	76,000
Beaufort Sea Oil & Gas		4,000	8,000	8,000	12,000
Total Traffic		42,000	46,000	62,000	88,000
Less Fuel by Barge		9,660	10,580	14,260	20,240
Balance by Truck		32,340	35,420	47,740	67,760
Plus Community Resupply	*18,729*	19,628	20,377	21,108	21,838
Potential Mackenzie Hwy Traffic Shift		51,968	55,797	68,848	89,598
Potential Mackenzie Hwy Savings Benefit/Year		$11,900,670	$12,777,548	$15,766,097	$20,517,945
Mackenzie Air Traffic					
$1,995 / Tonne Savings *[for air cargo shift to truck direct from Edmonton]*					
Cargo Tonnes per Year	1,700	2027	2,353	2758	3,162
Potential Mackenzie Hwy Traffic Shift 90%		1,824	2,118	2,482	2,846
Potential Mackenzie Hwy Savings Benefit/Year		$3,638,581	$4,224,812	$4,951,091	$5,677,371
$425 / Person Savings *[for air passenger shift to personal vehicle travel]*					
Passengers per Year	119,193	136,953	151,136	166,870	184,273
Potential Mackenzie Hwy Traffic Shift 10%		13,695	15,114	16,687	18,427
Potential Mackenzie Hwy Savings Benefit/Year		$5,820,503	$6,423,280	$7,091,975	$7,831,603

Laying Geo-Textile for All-Weather Road Construction on the Inuvik-Tukoyaktuk Alignment

While the preceding table shows the direct transport cost savings that system performance changes can provide, there are many other less easily monetized potential benefits including:

- Increased Tourism Access – Mackenzie Valley communities will gain tourism access previously limited by high cost air travel. As well, Mackenzie Valley Highway connection with the Dempster, Klondike and Alaska Highways will complete the sort of circular route known to be popular with tourists.
- Mackenzie Gas Project – While the bulk of pipe and materials will be delivered by barge to river stockpile sites, inevitable procurement delays will cause some shipments to miss the summer shipping window, impacting project cost and schedule, which an all-weather road can help mitigate. All-weather road availability will also be an immense benefit for expediting priority replacement parts, camp catering supplies and work force travel otherwise dependent upon air transport.
- Oil and Gas Development – In the Central Mackenzie Basin, all-weather road access for oil and gas exploration and production firms will allow substantial extension of the drilling season currently limited by a short winter road operating window. In the Beaufort/Delta, all-weather road access to a Tuktoyaktuk supply base will allow extended shoulder season support of both off-shore and on-shore drilling activity between the summer sealift/barge and winter/ice road seasons.

Construction of the all-weather Mackenzie Valley Highway would save $1.3 million/year of winter road construction costs. It would also create opportunities for the Yukon and NWT governments to reduce maintenance costs on the Dempster Highway as two highways leading to the Mackenzie Delta may not be required. Closing the Dempster Highway, or curtailing operations to a seasonal summer only road, would save the Yukon Government up to $5 million/year in maintenance costs (20% of Yukon Highways Budget). For the purpose of this study, it is assumed that the Mackenzie Valley All-Weather Road would allow Yukon to cut winter maintenance on the Dempster Highway and save at least $2.5 million/year.

Total direct savings available from full development of the Mackenzie Valley Highway are summarized below:

NWT Highway System Investment

Mackenzie Highway Extension from Wrigley to Inuvik to Tuktoyaktuk

Total Savings Benefit from Infrastructure Investment

Annual Savings Benefit For:	2015	2020	2025	2030
Mackenzie Valley Truck Traffic	$1,654,184	$1,655,584	$2,384,956	$3,170,328
Mackenzie Delta Truck Traffic	$11,900,670	$12,777,548	$15,766,097	$20,517,945
Mackenzie Air Cargo Traffic	$3,638,581	$4,224,812	$4,951,091	$5,677,371
Mackenzie Air Passengers	$5,820,503	$6,423,280	$7,091,975	$7,831,603
Additional Savings From:				
Winter Road Termination	$1,300,000	$1,300,000	$1,300,000	$1,300,000
Dempster Hwy Winter Closure	$2,500,000	$2,500,000	$2,500,000	$2,500,000
Total Savings Benefits/Year	**$26,813,937**	**$28,881,223**	**$33,994,119**	**$40,997,247**

4.1.3 Infrastructure Investment

There are several options for incremental investment in a Mackenzie Valley All-Weather Road. These include:

- Initial construction of the Inuvik to Tuktoyaktuk segment to complete a southern connection to the Arctic Coast via the existing Dempster Highway. (From Tuktoyaktuk a 20 km section of this segment is already under construction.)
- Staged construction from the south incrementally linking up with permanent bridges already built, to replace winter road segments increasingly susceptible to reduced seasonal operating windows from a warming climate in the North.

The estimated capital and maintenance costs for Mackenzie Valley Highway infrastructure investment are summarized below.

Total Cost Estimate for Full Mackenzie Valley Highway Development:

Road Building	$1,400 million
Bridge Construction	$ 223 million
Engineering	$ 178 million
	$1.8 billon

Incremental Cost Estimate for Partial System Development:

Between	And	Distance	Cost/km	Total cost
Wrigley	Norman Wells	333 kms	$1.9 million	$633 million
Norman Wells	Inuvik	483 kms	$1.9 million	$918 million
Inuvik	Tuktoyaktuk	142 kms	$1.7 million	$241 million
		958 kms		$1.8 billion

Annual Maintenance Cost:

958 kms	$13,570/km	$13 million/year

Source: "Mackenzie Valley All-Weather Road Economic Analysis", Government of the Northwest Territories, Department of Transportation (September 2009). Construction unit costs and total costs estimated here are extended from $1.67 billion (2006) construction cost estimate revised to $1.8 billion (2011).

This investment will be substantially offset by the direct transport system savings identified in the previous section. The results of a summary level life-cycle investment assessment incorporating these savings benefits are shown in the following table.

Annual maintenance is more than covered by the direct transportation and current maintenance cost savings from full development of this project. The balance of the net savings benefit match 20% of construction capital cost.

Before discounting, this investment shows net savings benefits exceeding \$.7 billion and \$350 million with a 5% discount rate.

The negative net present value represents a threshold for the balance of non-monetized benefits not addressed in this assessment. To the extent that the discounted balance of other benefits are valued at \$1.3 billion or more, they will warrant project investment.

Mackenzie Valley Highway

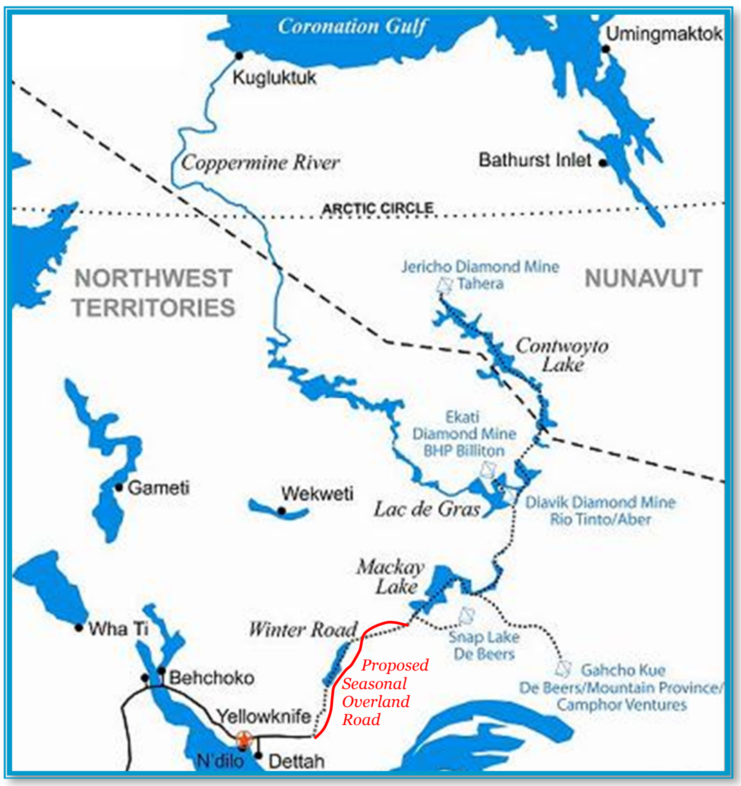
All-Weather Road Construction Investment/Benefits Assessment

Calendar Year	Project Year	AWR Transport Savings	AWR Annual Maintenance	Net Savings Benefit
2012	-2			-$600,000,000
2013	-1	*($1.8 billion investment over 3 years)*		-$600,000,000
2014	0			-$600,000,000
2015	1	$26,813,937	13,000,000	$13,813,937
2016	2	$27,484,286	13,325,000	$14,159,286
2017	3	$28,171,393	13,658,125	$14,513,268
2018	4	$28,875,678	13,999,578	$14,876,100
2019	5	$29,597,570	14,349,568	$15,248,002
2020	6	$32,491,376	14,708,307	$17,783,069
2021	7	$33,303,661	15,076,014	$18,227,646
2022	8	$34,136,252	15,452,915	$18,683,337
2023	9	$34,989,658	15,839,238	$19,150,421
2024	10	$35,864,400	16,235,219	$19,629,181
2025	11	$42,492,648	16,641,099	$25,851,549
2026	12	$43,554,965	17,057,127	$26,497,838
2027	13	$44,643,839	17,483,555	$27,160,284
2028	14	$45,759,935	17,920,644	$27,839,291
2029	15	$46,903,933	18,368,660	$28,535,273
2030	16	$56,371,214	18,827,876	$37,543,338
	17	$57,780,495	19,298,573	$38,481,922
	18	$59,225,007	19,781,037	$39,443,970
	19	$60,705,632	20,275,563	$40,430,069
	20	$62,223,273	20,782,452	$41,440,821
	21	$63,778,855	21,302,014	$42,476,841
	22	$65,373,326	21,834,564	$43,538,762
	23	$67,007,659	22,380,428	$44,627,231
	24	$68,682,851	22,939,939	$45,742,912
	25	$70,399,922	23,513,437	$46,886,485
			Savings & Maintenance Values Escalated at 2.5%	**$722,580,833**
			Value of Net Benefit Discounted at 5.0%	**$352,732,410**
			Infrastructure Investment Capital Cost	**$1,800,000,000**
			Net Present Value of Investment	**-$1,329,245,300**
			Savings Benefits to Capital Cost	**20%**
			Internal Rate of Return	**-4.9%**

4.2. Slave Geological Province Mine Haul System

The Slave Geological Province includes current and future mines in both the NWT and Nunavut. These mines are seasonally supported by annual construction of the Tibbitt to Contwoyto Winter Road (TCWR). In 2006 a warm winter season lead to premature TCWR closure and consequent airlift of mine development and operations traffic for which truck delivery was precluded. There is concern that risk of premature road closure may become more frequent with a warming climate in the North. A seasonal overland road (SOR), parallel to southern portions of the TCWR has been proposed to mitigate this risk. The SOR is the subject of infrastructure investment assessment in this section of the report.

Tibbitt to Contwoyto Winter Road Joint Venture Map



4.2.1 System Overview

Three currently producing diamond mines (Diavik, Ekati and Snap Lake) and the Gaucho Kue diamond mine starting in 2014, continue to rely on the Tibbitt to Contwoyto Winter Road (TCWR), which is built annually by a consortium of the diamond mines.

<u>Recommended Approach for Slave Geological Province Mine Haul System</u>

Continue existing, privately funded, Tibbitt to Contwoyto Winter Road trucking system as lowest total cost mine supply system:

- ***for producing diamond mines; and***
- ***for new mineral exploration and development***

TCWR Tanker Trucks

TCWR historical traffic volumes are shown in the table at the bottom of the next page. Considering the ten years from 2000 to 2009, the traffic carried by TCWR has ranged from a low of 125,380 tonnes (3,959 loaded inbound trucks) in 2000 to 343,285 tonnes (11, 656 loaded inbound trucks) in 2007.

However, the uncertainties created by global warming can mean warmer than normal winters that can curtail the TCWR season. An unusually warm winter in 2006 forced early closure of the southern portion of the TCWR, which crosses many small, shallow lakes and is therefore more susceptible to warmer weather. As shown in red in the TCWR historical traffic table, nearly a third of the 2006 diamond mine freight had to be airlifted at much greater cost.

The consequences of the warm winter of 2006 prompted a study of the medium and long term options for the TCWR. An immediate measure implemented by the TCWR Consortium starting in 2007 consisted of the construction every winter of a “secondary route” that bypasses the troublesome spots on the regular TCWR alignment in the Gordon Lake area. This solution has worked well, as evidenced by the high tonnages handled by TCWR in 2007 and 2008

As a context for TCWR performance change analysis and investment assessment in the following subsections, the table on the next page provides a recap of the relevant Phase 1 traffic demand projections for Slave Geological Province diamond mine resupply through 2030.

Recap of Phase 1 Slave Geological Province Mine Supply Traffic Forecast

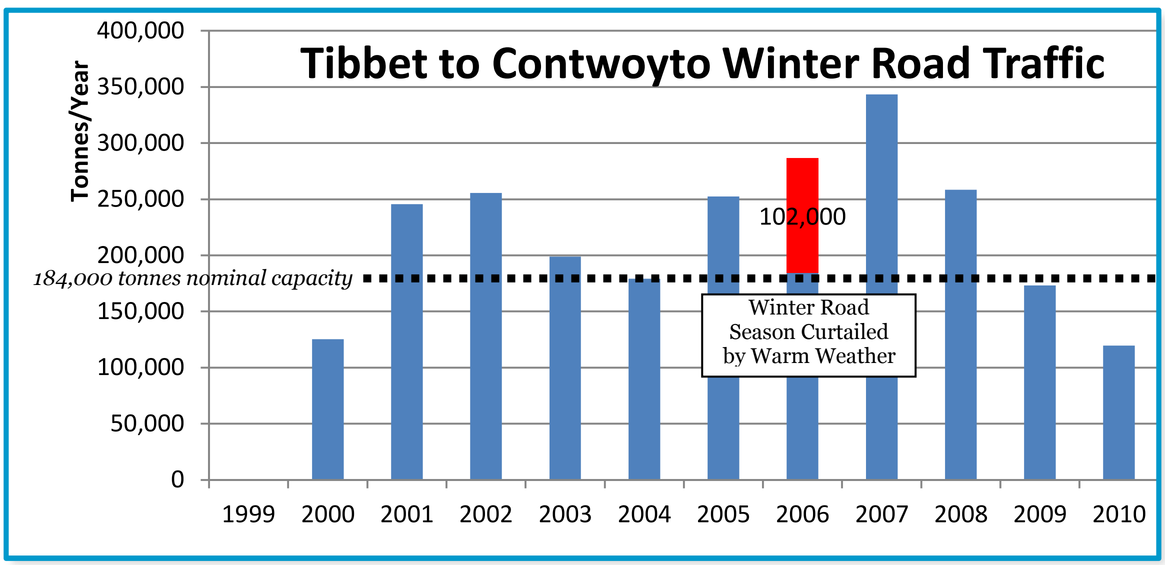
(Tonnes/Year)

Mine		2010	2015	2020	2025	2030
Ekati	Fuel	36,000	57,000	57,000		
	Supply	12,000	18,000	18,000		
Diavik	Fuel	18,000	69,000	69,000	69,000	
	Supply	22,000	82,000	82,000	82,000	
Snap Lake	Fuel	27,000	29,000	29,000	29,000	29,000
	Supply	6,000	12,000	12,000	12,000	12,000
Gacho Kue	Fuel	2,000	25,000	25,000	25,000	25,000
	Supply	1,000	18,000	18,000	18,000	18,000
Total	**Fuel**	**83,000**	**180,000**	**180,000**	**123,000**	**54,000**
	Supply	**41,000**	**130,000**	**130,000**	**112,000**	**30,000**
	All Traffic	**124,000**	**310,000**	**310,000**	**235,000**	**84,000**

4.2.2 Performance Change

The potential for TCWR capacity shortfall is a function of both mine supply traffic volume and winter road season length. The risk that a warming climate will curtail the TCWR seasonal operating window in a year with heavy traffic volume can result in prohibitively expensive capacity shortfall - with contingency air transport required to keep mines operating.

Since 1999 TCWR traffic has increased from one to four mines (and then declined with temporary closure of the Tahara Mine in 2008). During this period the critical combination of heavy traffic volume and a curtailed seasonal operating window occurred in 2006. In 2006 the seasonal operating season was capped by warm weather at 184,000 tonnes with a capacity shortfall of 102,000 tonnes. (See following table).

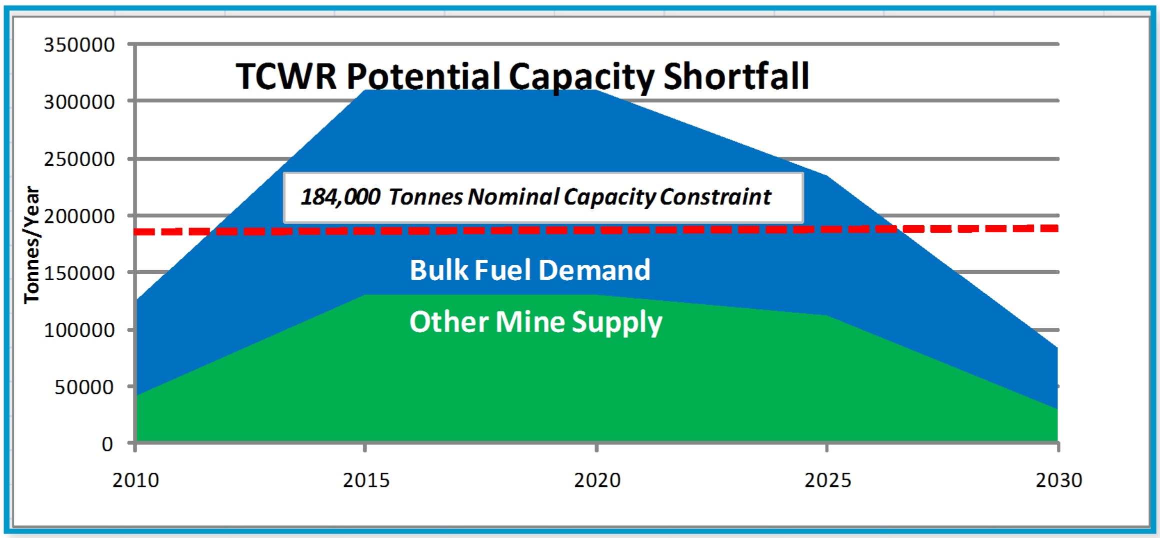


The additional contingency cost of air transport for a 102,000 tonne shortfall in TCWR capacity during 2006 was almost $100 million:

Airlift Cost	$1,100/tonne	$112 million total
Less TCWR Cost	$157/tonne	$16 million total
Added Contingency Cost	**$943/tonne**	**$96 million total**

This sets a worst case scenario for TCWR performance change: if forecast future TCWR traffic exceeds 184,000 tonnes/year, there is a risk of capacity shortfall with a seasonal operating window curtailed by warm weather. The consequence is a $943/tonne contingency cost to airlift the shortfall tonnage in that year.

The following graph shows the years during which there is a risk that forecast traffic can exceed a nominal TCWR capacity constraint of 184,000 tonnes/year based on the 2006 seasonal capacity shortfall.



There is a period of approximately 15 years between 2010 and 2030 during which traffic is forecast to exceed a nominal TCWR capacity constraint and a shortfall could result. The worst case scenario for a maximum shortfall during this period is:

Peak Traffic Demand	310,000 tonnes
Nominal Capacity	184,000 tonnes
Capacity Shortfall	126,000 tonnes
Additional Cost/Tonne	$943 per tonne
Total Additional Cost	**$118.8 million**

The cost consequence of performance change from a warming climate in the North is assumed to be $118.8 million due to a curtailed TWCR operating window anytime in the 2012 to 2027 time period. If there is a curtailed TCWR operating window once every 5 years that cost consequence could be as much as $356.4 million of additional transportation cost to keep the Slave Geological Province diamond mines in operation.

The following table shows for the relevant 15 year forecast period, a range of potential warm winter/short season risk events:

Risk of Warm Winter/Short Season	Every 5 Years	Every 10 Years	Every 15 Years
Additional Cost of Risk Event	$356.4 million	$237.6 million	$118.8 million
Annualized Risk Event Cost	$23.8 million	$15.8 million	$7.9 million

The graph on the preceding page also shows that if bulk fuel demand is removed from the TCWR capacity requirement, the residual of other mine supply traffic can be accommodated without any risk of a shortfall over the 20 year forecast period. The proposed Coronation Gulf Port and Winter Road (see Section 2.2 Western Sealift System) would divert bulk fuel traffic from the TCWR and avoid any prospect of capacity shortfall.

An alternative to the BIPAR (Coronation Gulf Port and Road) option is a Seasonal Overland Road (SOR). An SOR can replace the southern 170 km of TCWR that is more susceptible to warmer winters, with a 163 km parallel overland road from Tibbitt to Lockhart Lake. It has been estimated from ice thickness data that the SOR would add approximately 30 days to the current operating season of TCWR. The addition of an extra month would remove the risk of early TCWR closure precluding a complete mine resupply program.

The SOR would remain seasonal because the northern part of TCWR will still be on (thicker) lake ice, and given the more northern and colder climate, is not likely to be susceptible to warmer winters. It was concluded that from Lockhart Lake northwards any foreseeable warming of winters was very unlikely to affect the strength or the season-length of the TCWR.

4.2.3 Investment Assessment

Construction of the 163 km SOR is estimated to cost $192 million in 2007 dollars ($1.2 million/km). The primary benefit from this investment is reduction of the risk to Slave Geological Province diamond mine supply due to a curtailed winter road operating season. That benefit was valued in the preceding section at $118.8 million every time the risk is realized. Spreading that risk over the 15 year forecast period during which it could occur, the annualized benefit has been calculated in the previous section for risk event occurrence every 5, 10 or 15 years. This benefit is applied to the SOR capital cost in the following investment assessment (note that consistent with the high level screening for all infrastructure investments considered in this study, ongoing maintenance, periodic reinvestment, amortization and residual value have not been analyzed in this assessment).

Seasonal Overland Road Development

Investment Assessment of Risk Reduction Benefit

For the Tibbet to Contwoyto Winter Road

Warm Winter/Short Season:	Once Every 5 Years	Once Every 10 Years	Once Every 15 Years
Annualized Risk Reduction Benefit	$23,800,000	$15,800,000	$7,900,000
Benefit Discounted at 5.0% for 15 years	**$247,035,861**	**$163,998,597**	**$81,999,299**
Infrastructure Investment Capital Cost	$192,000,000	$192,000,000	$192,000,000
Net Present Value of Investment	$55,035,861	-$28,001,403	-$110,000,701
Risk Benefit to Capital Cost	129%	85%	43%
Internal Rate of Return	9%	2.8%	-5.5%
Pay Back (Years)	8	12	24

From the investment assessment above, it can be concluded that if the risk of a warm winter/short season is held to be high (i.e., occurring at least once every 5 years between now and 2025) then the benefit of airlift cost avoided will exceed the SOR capital cost by one third and the investment will achieve a 9% internal rate of return (based solely on the savings benefits). Otherwise, if the risk is determined to be less, the SOR benefit will not match its capital cost.

It appears that, barring a warm winter like the one in 2006, the continued implementation of a "southern bypass" initiated in 2007 would provide sufficient capacity on the TCWR to handle the forecast diamond mine tonnages over the next 20 years.

The SOR would be an "insurance policy" against the risk of warm winters and the added expense of airlifting displaced truck traffic in case of a warm winter. However, by the time the SOR is completed, most of the diamond mines will likely start the declining phase of production, which could make a large SOR investment with a short life cycle unattractive.

The airlift contingency cost consequence of warm winter/short season risk is reduced as diamond mine production and traffic decline within 15 years. The trade-off may well be a large SOR investment with a short life versus a smaller BIPAR investment with a long life.

4.3. Nunavut-Manitoba Road System

This section deals with the proposed Nunavut-Manitoba all-weather road and the potential modal shifts and transportation savings which it could provide for the Kivalliq Region.

The governments of Canada, Manitoba and Nunavut have funded a $1 million study completed in 2007 to review alternative alignments and recommend a preferred route for a road connecting Kivalliq communities to Manitoba. The preferred route is a 1,100 km all-weather road from Sundance (northeast of Thompson, past Gillam, at the northern terminus of Manitoba Highway No. 290) to Rankin Inlet, including connections to Churchill, Arviat and Whale Cove.

More recently in November, 2010, the Governments of Nunavut and Manitoba signed a memorandum of understanding to conduct a full benefit/cost assessment for the Nunavut-Manitoba Road. In this section of the report a high level assessment is narrowly focused on specific transportation savings. Broader socio-economic benefits are left to be monetized by others.

The specific transportation benefits of full Nunavut-Manitoba Road development include a shift of sealift general cargo to faster, frequent highway general freight; air cargo shift to much less expensive trucking; and air passenger shift to personal vehicle travel. Initial development of an inter-community road system may also provide some interim sealift benefit for regional hub distribution.

The Nunavut-Manitoba road will first link the Kivalliq region to the railhead at Churchill, with intermodal rail connection to the southern highway system at Thompson or through to Winnipeg. Ultimately, Churchill will also be linked by all-weather road to the southern highway system.

Intermodal Railhead at Port of Churchill, Manitoba

EXHIBIT 16: NU-MB AWR BUSINESS CASE STUDY AREA AND CONSTRUCTION TIMING

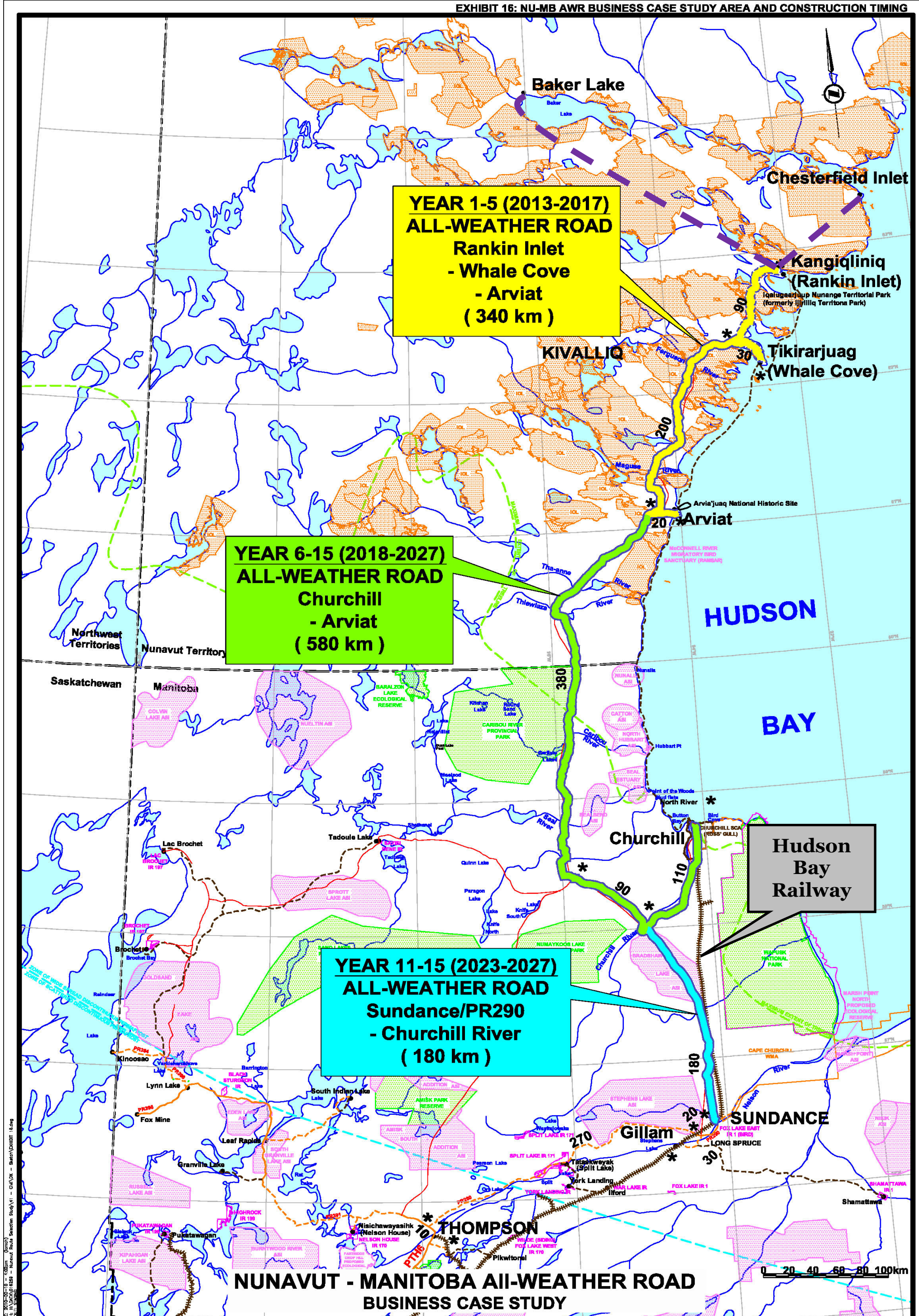


Exhibit 16, Sept. 24, 2008

4.3.1 System Overview

The Kivalliq Region, while in closest proximity to the southern Canadian rail and road network, like the rest of Nunavut is dependent upon sealift for resupply shipments that can only be scheduled in the limited summer season – and on air transport for everything else.

Highway connection to the railhead at Churchill, Manitoba or to the roadhead at Gillam, Manitoba could substantially change the cost and service performance of the transportation system in the Kivalliq Region.

Incremental investment in a Nunavut-Manitoba road system is proposed in stages that will first connect Rankin Inlet, Whale Cove and Arviat in the Kivalliq Region. Each stage of development would include truck transport currently unavailable between Kivalliq communities and the rest of Canada:

- With connection to intermodal rail service at Churchill,[28] initially by a cross-boundary winter road, followed by completion of a year around all-weather road; and
- With connection to the Manitoba Highway system following completion of the final stage of all-weather road construction linking Churchill to Gillam.

<u>Recommended Approach for the Nunavut-Manitoba Road</u>

Integrated development of an all-weather and winter road system providing inter-community connections first, followed by connections to the rest of Canada, gradually transforming the Kivalliq Region transportation system with:

- ***Initial potential for regional sealift cargo distribution;***
- ***Interim Intermodal Integration via the Churchill railhead; and***
- ***Ultimate all-year alternative for sealift cargo, air cargo and air travel.***

Current Kivalliq sealift and air transport forecasts will change significantly with Nunavut-Manitoba Road System development. As a baseline from which to recast future traffic shifts, the table on the following page recaps the Phase 1 forecast of sealift and air transport for Kivalliq Region mines and communities assuming no change in current modal split.

[28] Rehabilitation of the 877 km Hudson Bay Railway between The Pas and Churchill is currently underway to be completed in 2018 with a $60 million investment being equally shared by the Governments of Canada and Manitoba and the rail line owner, OmniTRAX.

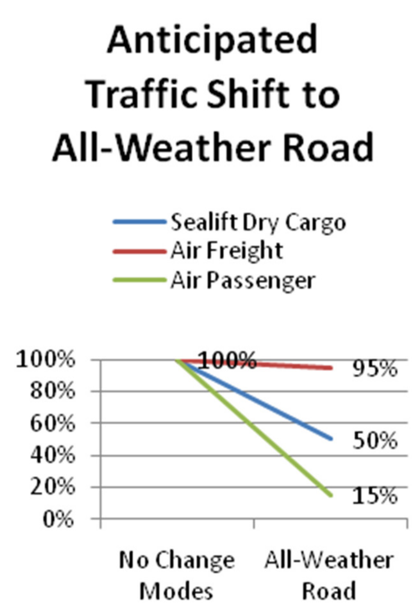
Recap of Phase 1 Traffic Forecast for the Kivalliq Region
(Tonnes/Year)

Sealift Transport		2010	2015	2020	2025	2030
	Mines					
	General Freight	17,100	38,100	68000	68000	16,500
	Bulk Fuel	23,200	52,200	78,000	78000	24,000
	Total	40,300	90,300	146,000	146,000	40.500
	Communities					
	General Freight	14,592	15,403	16,126	16,748	17,892
	Bulk Fuel	27,696	29,233	30,606	31,786	32,029
	Total	42,288	44,636	46,732	48,534	49,921
	TOTAL					
	General Freight	31,692	53,503	84,126	84,748	34,392
	Bulk Fuel	50,896	81,433	108,606	109,786	56,029
	Total	82,588	134,936	192,732	194,534	90,421
Air Transport						
Air Cargo (tonnes/year)		4,298	5,457	6,615	8,205	9,795
Air Passenger (psgrs/year)		175,000	197,050	217,525	240,275	265,300

4.3.2 Performance Change

Although Kivalliq fuel supply will likely continue by sealift tanker, a Nunavut-Manitoba road will change the modal split for Kivalliq Region dry cargo resupply. For full development of a highway connection between Kivalliq communities and Winnipeg, the following is assumed:

- Fuel for Kivalliq communities and resource developments will continue to be delivered via sealift, even if the Nunavut-Manitoba all-weather road is built.
- Most resource development dry cargo will continue to be delivered by summer sealift, but most community resupply dry cargo will shift to all-weather road. A net shift of 50% of marine dry cargo is assumed attracted to just-in-time truck transport year around from Winnipeg, that should cost no more than the current sealift limited to the summer shipping season and could save $33/tonne (see table following).
- Most air cargo should be attracted to all-weather road trucking by the huge cost saving potential. 95% of Kivalliq air cargo is assumed to be attracted to a Nunavut-Manitoba road at estimated savings of $1,760/tonne (see table following).
- A connection to the southern Canadian highway system should attract family shopping and holiday travel in personal vehicles. It is assumed that 15% of current air passengers will shift to all-weather road travel with the family vehicle at an estimated savings of $452 per person (see table following).



The anticipated modal shifts above are based on the potential changes in cost performance for transportation in the Kivalliq Region as shown below.

	No Change	All-Weather Road	Potential Savings
General Freight	$423/tonne	$390/tonne	$33/tonne
Air Freight	$2,150/tonne	$390/tonne	$1,760/tonne
Air Passenger	$699/person	$247/person	$452/person

Notes: NSSI GN Agreement Rate for Area E (Kivalliq) ex Montreal = $385/tonne
NSSI container rental rate at $370 and assuming 10 tonnes/load = $37/tonne + $1/tonne handling = $38/tonne
Paved road Winnipeg-Thompson 748 km x 2 at 85 km/h = 17.6 hours x $165/hour at 23.5 tonne payload = $124/tonne
Gravel road Thompson-Rankin Inlet 1230 km x 2 at 65 km/h = 37.8 hours x $165/hour at 23.5 tonne payload = $266/tonne
Driving cost Winnipeg-Rankin Inlet 1978 km x $.50/km = $989 per trip for family of 4 = $247/person
Air cargo cost Winnipeg-Rankin Inlet at $2.15/kg former food mail rate = $2,150/tonne
Air passenger cost Winnipeg-Rankin Inlet at First Air fare of $699/passenger

The following table quantifies total annual system performance cost changes from all-weather highway development and the savings benefit that could provide.

Manitoba-Nunavut All-Weather Highway System Development

Potential Traffic Attraction and Savings Benefit

	2010	2015	2020	2025	2030
Sealift Dry Cargo Diversion					
$33 / Tonne Savings *[for sealift shift to truck from Winnipeg]*					
Current Sealift Forecast (tonnes/year)	31,692	53,503	84,126	84,748	34,392
Savings Induced Shift at 50% (tonnes/year)	15,846	26,752	42,063	42,374	17,196
Potential Sealift Shift to Truck (savings/year)	$522,918	$882,800	$1,388,079	$1,398,342	$567,468
Air Cargo Diversion					
$1,760 / Tonne Savings *[for air cargo shift to truck from Winnipeg]*					
Current Air Cargo Forecast (tonnes/year)	4,298	5457	6,615	8205	9,795
Savings Induced Shift at 95% (tonnes/year)	4,083	5,184	6,284	7,795	9,305
Potential Air Cargo Shift to Truck (savings/year)	$7,186,256	$9,123,268	$11,060,280	$13,718,760	$16,377,240
Air Passenger Diversion					
$452 / Passenger Savings *[for air travel shift to road]*					
Current Air Travel Forecast (psgrs/year)	119,193	136,953	151,136	166,870	178,273
Savings Induced Shift at 15% (psgrs/year)	17,879	20,543	22,670	25,031	26,741
Potential Air Travel Shift to Road (savings/year)	$8,081,285	$9,285,413	$10,247,021	$11,313,786	$12,086,909
TOTAL POTENTIAL TRANSPORTATION COST SAVINGS	**$15,790,459**	**$19,291,481**	**$22,695,380**	**$26,430,888**	**$29,031,617**

The potential changes in cost performance and resulting modal shifts for Kivalliq Region transportation demonstrate that construction of a Nunavut-Manitoba all-weather road will attract substantial traffic and lower supply chain costs in the region. In particular, year around access to the southern highway system means that Kivalliq communities can reduce inventories and shipment response time at no more (and perhaps a little less) than current sealift rates for summer-only dry cargo service.[29]

[29] Note that sealift operators may well react to trucking competition with lower rates.

4.3.3 Infrastructure Investment

The 2007 Nunavut-Manitoba Route Selection Study estimated the cost of the 1,100 all-weather road at $1.18 billion in 2006 dollars ($1.073 million/km). With escalation from 2006 cost levels, current investment cost of $1.3 billion is assumed.

Construction of a Nunavut-Manitoba all-weather road system is proposed in three stages: (1) a Nunavut section connecting Kivalliq communities; (2) a cross-boundary section connecting to the Hudson Bay Railway at Churchill, Manitoba; and (3) a completed Manitoba section connecting to the southern highway system at Gillam, Manitoba (Sundance).

The estimated capital and maintenance costs for this infrastructure investment are summarized below.

Incremental Cost Estimate for Partial System Development:

	Between	And	Distance	Total cost
(1) Nunavut Section	Rankin Inlet	Whale Cove	120 kms	$142 million
	Whale Cove	Arviat	220 kms	$260 million
			340 kms	$402 million
(2) Cross-Boundary Section	Arviat	Churchill	580 kms	$684 million
(3) Manitoba Section	Churchill River	Sundance	180 kms	$212 million
Total Cost Estimate for Full Highway Development:			**1,100 kms**	**$1.3 billion**
Annual Maintenance Cost:		$13,570/km	1,100 kms	$15 million/year

Source: Nishi-Khon/SNC-Lavalin $1.18 billion (2006) estimate for Nunavut-Manitoba Road Route Selection Study with 10% escalation to current cost levels (2010). Average cost per km is applied to each section and does not reflect regional construction cost differences likely. Maintenance cost assumed similar to Mackenzie Valley Highway at $13,570 per km.

Staged construction will allow incremental investment with initial benefits from a regional community connector road system. In addition to the social attraction of inter-community access, the commercial prospect of a distribution hub that can provide regional truck delivery to other communities would be enhanced. As well, the all-weather inter-community road system can be connected to the Churchill railhead by winter road on an interim basis.

However, the most significant transportation savings will only occur with completion of a year around cross-boundary connection – either initially via intermodal trailer/container service on the Hudson Bay Railway or ultimately with all-weather road connection to the southern highway system at Gillam.

The results of a summary level life-cycle investment assessment of direct transportation savings benefits, maintenance and capital cost are shown for the full all-weather highway development in the adjacent table.

This assessment confirms that transportation savings should cover maintenance cost of an all-weather road. However, 25 year life cycle residual value of net savings after maintenance costs does not match the $1.3 billion capital cost of construction. Undiscounted, those savings reach $383 million after 25 years or less than $200 million discounted at 5% per year.

At a 5% discount rate over a 25 year project life cycle those savings reach only 15% of capital cost and Net Present Value is a negative 1 billon dollars. The total of other less easily monetized socio-economic benefits would have to exceed that $1 billion for this project to be financially justified on its own merits.

Construction of the Nunavut-Manitoba all-weather road is not a pre-requisite for resource development in the Kivalliq region. This is evidenced by completion of the Meadowbank gold mine near Baker Lake and by current development of the Meliadine Mine near Rankin Inlet.

In short, an all-weather road to Manitoba will attract traffic and provide transportation savings - but connecting Nunavut to the southern highway system is the strategic benefit that will warrant the project.

Manitoba-Nunavut Highway
All-Weather Road Construction
Investment/Benefits Assessment

Calendar Year	Project Year	AWR Transport Savings	AWR Annual Maintenance	Net Savings Benefit
2017	-2			-$433,333,333
2018	-1	*($1.3 billion investment over 3 years)*		-$433,333,333
2019	0			-$433,333,333
2020	1	$22,695,380	15,000,000	$7,695,380
2021	2	$23,262,764	15,375,000	$7,887,764
2022	3	$23,830,149	15,759,375	$8,070,774
2023	4	$24,397,533	16,153,359	$8,244,174
2024	5	$24,964,918	16,557,193	$8,407,724
2025	6	$29,734,749	16,971,123	$12,763,626
2026	7	$30,395,521	17,395,401	$13,000,120
2027	8	$31,056,293	17,830,286	$13,226,007
2028	9	$31,717,066	18,276,043	$13,441,022
2029	10	$32,377,838	18,732,945	$13,644,893
2030	11	$36,289,522	19,201,268	$17,088,254
	12	$37,015,312	19,681,300	$17,334,012
	13	$37,741,103	20,173,332	$17,567,770
	14	$38,466,893	20,677,666	$17,789,227
	15	$39,192,683	21,194,607	$17,998,076
	16	$39,918,474	21,724,472	$18,194,001
	17	$40,644,264	22,267,584	$18,376,680
	18	$41,370,055	22,824,274	$18,545,781
	19	$42,095,845	23,394,881	$18,700,964
	20	$42,821,636	23,979,753	$18,841,883
	21	$43,547,426	24,579,247	$18,968,179
	22	$44,273,217	25,193,728	$19,079,489
	23	$44,999,007	25,823,571	$19,175,436
	24	$45,724,797	26,469,160	$19,255,637
	25	$46,450,588	27,130,889	$19,319,699
Savings & Maintenance Values Escalated at 2.5%				**$382,616,574**
Value of Net Benefit Discounted at 5.0%				**$195,993,819**
Infrastructure Investment Capital Cost				**$1,300,000,000**
Net Present Value of Investment				**-$1,010,767,316**
Savings Benefits to Capital Cost				**15.1%**
Internal Rate of Return				**-6.8%**

Strategic selection of a Nunavut-Manitoba All-Weather Road investment should preclude competing consideration of a regional deep water dock to distribute the same traffic, despite the potential attraction of an initial inter-community all-weather road system to do that.[30]

[30] This does not preclude interim regional delivery over an inter-community all-weather road system for hub distribution from a single sealift beach landing.

5. Northern Air Transport Systems

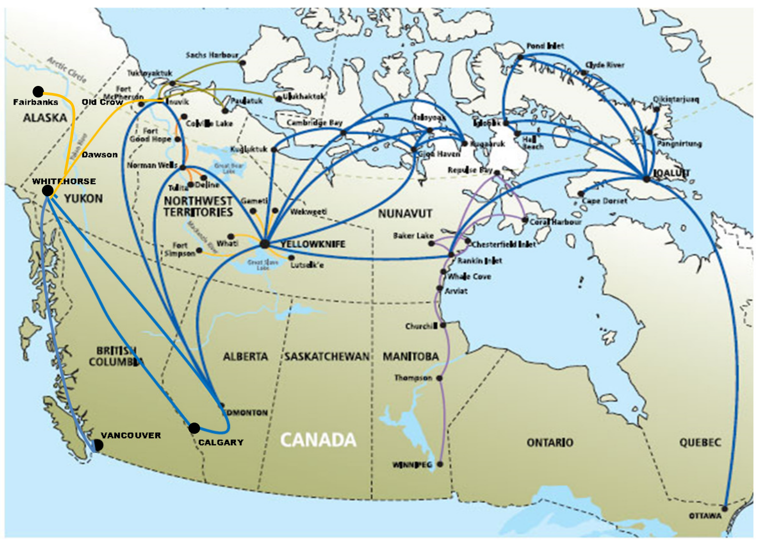
This chapter identifies airport infrastructure needs for the Northern Aviation System. It reports the following priority capital projects:

- Iqaluit Airport – In excess of $200 million capital investment estimated for runway repaving, airfield electrical system replacement, combined services building and including a new $60 million air terminal building.
- Cambridge Bay Airport - $34.4 million in short-term improvements to extend apron, upgrade runway lighting and landing systems and including $10 million to shore up gravel runway. Longer term, within 5 years runway paving and extension and within 10 years air terminal building expansion required.
- Rankin Inlet Airport - $32.2 million for short-term improvements to construct new taxiway, expand aircraft parking apron and including air terminal building expansion. Longer term, additional 50% expansion of air terminal building capacity required.
- Whitehorse International Airport - $15.7 million air terminal building expansion completed in 2010 to accommodate international flights, including currently Condor and potentially Swiss Air, with continuing flights to Alaska.
- Mayo Airport - $2.2 million over 5 years for visual approach navaids and to rebuild runway due to permafrost degradation, including $1.5 million for runway resurfacing, apron and taxiway reconstruction. Pending scheduled service will require additional investment for airport recertification.
- Faro Airport - $1 million over 5 years for new air terminal building, apron expansion and airside resurfacing. Additional investment may be required to accommodate intense resource development activity currently anticipated.
- Northwest Territories - $6 million in runway extension projects are currently underway or completed at Tulita, Fort Good Hope and Fort McPherson.

This chapter highlights ongoing incremental infrastructure investment that continues to meet isolated community requirements for passenger, cargo and medevac services as well as inconsistent resource development demand and compliance with changes in Canadian aviation regulations.

At many of Canada's northern communities the movement of people and goods is only accomplished by seasonal surface transport or by air. Airports provide northern residents with a year-round link to the outside world. Air services also provide a crucial link to essential services and work opportunities that are often not available within the community. Employment in many communities is tied to the resource and tourism industries for which workers and visitors often require air transport.

A relatively extensive road network in Yukon provides most communities with year-round access to essential goods and services. Nunavut, on the other hand, is entirely dependent on air or seasonal sealift. Transportation in the Northwest Territories tends to vary with people and cargo being transported by all-weather and winter roads in the west and along the Mackenzie Valley, by a rail connection in the south (i.e. Hay River) and by marine and air transport in the other regions.



Canadian North B737 at Norman Wells Airport, NWT

5.1 System Overview

The Northern Air System has three components:

- The Scheduled Air Carriers, which provide mainline service between Southern Canada and four northern Gateways – Whitehorse, Yellowknife, Rankin Inlet and Iqaluit – supported by an extensive network of connecting or feeder service between the four gateways and smaller communities throughout the North.
- The Northern Airport System, which supports northern air service through a system of 80 airports operated by the territorial governments as well as a number of other airports operated by resource companies, tourist operators and federal government departments.
- The air navigation system, which serves to direct safe and orderly operations in northern air space under the administration of Nav Canada.

Territorial governments have been managing and maintaining airports for a number of years and it is apparent that the planning processes used by the governments are providing a reasonable level of operations and maintenance support.

Recommended Approach for the Northern Air System

Maintain highest possible standards with additional air system capacity investment as required to support largely roadless northern communities heavily dependent on air transport:

- ***For travel, medevac and other essential services;***
- ***For all-season resupply including food and mail; and***
- ***For sustainable resource, tourism and other economic development.***

It is evident that the governments have considered the relationship between existing airport infrastructure and potential resource development. When resource companies are in the exploration phase, any airport development must be considered in terms of those exploration findings evolving into an actual mining operation with related airport infrastructure requirements. But most importantly airports must be able to respond to community needs (e.g. medevac, passenger and resupply service).

The Phase 2 Infrastructure Needs Assessment for Northern Air Transport Systems is based on stakeholder consultations conducted with air carriers, the Northern Air Transport Association, the territorial governments and NavCanada.

5.2 Performance Changes

Changes in air system performance are ongoing throughout the North. These changes are driven by the increasing requirements of remote communities reliant on air transport, by inconsistent resource development demand, and by changes in Canadian Aviation Regulations.

Through the stakeholder consultation process, the nature, cause and impact of these changes have been identified. The following three subsections present aviation stakeholder perspectives on changing infrastructure and related issues for the current air carrier, airport and air navigation systems in the North.

5.2.1 Air Navigation System

Nav Canada was consulted regarding navigational issues and current plans for the North:

- A key issue is the ability to monitor aircraft flying through northern air space.
- Area Navigation (RNAV) will continue to improve airport functionality. RNAV is a method of navigation that permits aircraft operation on any desired course within a coverage area.
- Satellite access for RNAV functionality is continually improving. For example, the European satellite system, Galileo, will be online in approximately 2012. This system will enhance RNAV operations throughout the North.
- A general concern is the number of cell towers and wind turbines being installed that can affect RNAV procedures.
- There is a need for accurate runway surveys (runway coordinates) to support RNAV.
- The employment effect that introduction of Automated Weather Observation Systems (AWOS) will have by making current Community Aerodrome Radio Station (CARS) operators redundant is a concern.
- Airports with existing navigational aids - NDB, VOR/DME, ILS[31] - are well served.
- Instrument Landing System (ILS) replacement programs were identified for:
    - Hay River: 2010-2011
    - Iqaluit, Whitehorse, Watson Lake: 2012-13
    - Yellowknife, Resolute Bay: 2013-14

[31] Non-Directional Radio Beacon; Very high frequency Omnidirectional Radio range/Distance Measuring Equipment; Instrument Landing System.

5.2.2 Air Carrier Systems

The scheduled air carrier network of northern mainline routes through gateway airports and connecting to smaller communities is operated primarily by Air North, First Air and Canadian North. Air Canada/Jazz and WestJet Airlines also provide southern connections to northern gateway airports. As well, there are a large number of charter operators.

From stakeholder consultations with major scheduled and charter carriers in the North as well as with the Northern Air Transport Association, the following issues were identified:

- A main concern is that a change to newer generation aircraft will impose a penalty on the carrier as airports may not be able to accommodate new aircraft without some kind of a restriction (e.g. payload). As well, there are currently no gravel certified replacement aircraft for the older B737-200. *Some larger airports may be required to pave runways to accommodate newer generation aircraft.*
- A number of respondents identified apron size as a constraint. *It is important that airport aprons are adequately sized to accommodate aircraft and helicopter operations, particularly during peak traffic periods.*
- Federal rule changes are proposed related to aircraft performance that may affect the competitiveness of some operators by resulting in payload penalties. The rule will require pilots to meet manufacturer's published aircraft performance criteria when computing takeoff distance or to demonstrate that the particular aircraft can, in the event of an engine failure, clear a prescribed obstacle.
- All operators identified a need for longer runways as a requirement at community airports to support a broader range of aircraft. A runway length of 5,000 feet appears to be the preferred standard.
- A number of operators would like to see larger apron areas at some airports for more efficient manoeuvring, particularly during peak traffic periods.
- It is recognized that there is a demand for published GPS approaches. Comments also suggested that the Nav Canada approval process for publishing GPS procedures must be more efficient and timely.
- In some cases larger terminal buildings were identified as being needed to accommodate growing passenger volumes and resource industry crew rotations where resource development is occurring nearby.

A common concern relates to airport accessibility from both an in-flight perspective (navigation) and communications perspective on local weather and airfield conditions. Some airports have no communications and others with CARS have limited hours of operation. Aircraft that are GPS equipped are better able to navigate using RNAV and as satellite access improves aircraft navigation will be further enhanced, particularly in the eastern Arctic. The introduction of AWOS at airports will provide pilots with improved real-time weather communications. *It is important to remain sensitive to the impact that the installation of AWOS at airports with CARS may have on employment in the community*

While not directly related to infrastructure needs, there is also a common concern among northern scheduled carriers that southern carriers currently entering the more profitable gateway markets will compromise their ability to maintain high cost service to smaller communities.

5.2.3 Northern Airport Systems

Communities in the North are generally well-served by their airports. However, discussions with airport users and government agencies revealed a number of issues that must be considered in determining how an airport will respond to resource development over the next twenty years.

It has been demonstrated that changes in Canadian Aviation Regulations can impact basic community air services. It is important, therefore, that airports in communities receiving scheduled air service conform with any amended regulations for aircraft currently serving those communities. Also, replacement aircraft that can provide better service to the community must also be assessed in terms of any new airport infrastructure that may be required.

There are numerous new or proposed regulations that affect or potentially affect airport operations in the North (e.g. Canadian Aviation Regulations, Canadian Air Transport Security Authority, Wildlife Management Planning). With increased regulation the territorial governments incur significant incremental costs in the day-to-day operation and management of their airports. These costs are often recovered from aircraft operators who subsequently pass on the costs to the shipper and the traveller. *It is important for the federal government to consider how financial allocations to the territories should be structured so that the territorial governments can meet the financial burden of regulatory change and at the same time ensure affordable travel.*

With the proposed introduction of the Canadian Aviation Regulations 2010 rule there was significant discussion on required runway length to support a broad range of aircraft types. The required runway length is mainly determined by the type of aircraft that will be using the facility. The significant issue to carriers is whether a particular aircraft can access an airport and not incur a payload penalty. To maximize the airport role within a community it is essential that the runway be capable of handling the types of aircraft that need to access the community. At minimum an airport must be able to support medevac operations. Approximately 30 percent of the airports within the territories have airports with runways greater than 4,500 feet. These airports also tend to be located within larger communities. Another 30 percent of airports have runways greater than 3,500 feet. *Airports with shorter runways must determine whether medevac aircraft can be accommodated if the Canadian Aviation Regulations 2010 rule is enforced.* It is important to note that a change in runway length can also change overall airfield geometry, which significantly increases construction costs.

The requirement to provide Runway End Safety Areas (RESA) can be problematic at some airports because of geographical constraints. Incidents where aircraft have skidded off runway surfaces have focused federal government attention on the requirement for RESA. The International Civil Aviation Organization and the U.S. Federal Aviation Administration already require RESA at many airports. *It is important to keep in mind the physical limitations and significant cost of implementing RESA in the North.*

Communications with the three territorial governments showed a number of other common concerns relating to airport operations:

- Airports in close proximity to resource development should consider designating on-airport areas where resource-related activity can be accommodated. *Airports that expect to support resource development should prepare Master Plans that respond to this need by identifying designated on-airport areas.*
- Air terminal buildings and shelters differ widely at airports across the North. In general, *a terminal of 210 square metres is identified as the optimum size* for smaller northern airports.
- In all cases northern gateway airports are expanding air terminal buildings or constructing new ones to meet growing passenger needs. It is generally acknowledged that the cost of constructing an air terminal can be significant in remote communities (e.g. $3.0 million± in Nunavut).
- General concern about federal funding, rising security costs (i.e. Canadian Air Transport Authority) and regulatory burden associated with airport certification.
- Concerns about the requirements for Runway End Safety Areas (RESA) and inability for some airports to meet the requirement because of physical constraints. The same concern holds for runway extensions and general airport expansion requirements.
- Capital investment at airports must always consider community needs first (e.g. medevac, community access).
- A general concern about how the implementation of Automated Weather Observation Systems (AWOS) at airports would affect Community Aerodrome Radio Station (CARS) operators. Conversely, at airports without AWOS there can be concerns about CARS hours of operation.
- Airport runway extensions must consider how a change in code, based on Transport Canada aerodrome standards, would affect overall airfield requirements. The change would also require increased capital investment.
- General comments were received about the requirement for airport fencing for both security and wildlife management.
- EK35, a dust suppressant and surface stabilizer, is being considered as a treatment to extend the life of gravel runways.
- Gravel supply is a major concern at most airports. Typically, an 8-10 year supply of gravel is prepared when runway overlay contracts are awarded.

As well, a number of federal and territorial regulations impact northern airport operations. For example, the federal designation of an airport as either Certified or Registered will determine the regulatory requirements that apply to that facility. An operator will face increased oversight if an airport that is currently designated as Registered is re-designated as Certified. It is noteworthy that only 14 percent of the airports in Yukon are certified compared to 85 percent and 95 percent in the Northwest Territories and Nunavut, respectively. The reason for this difference is that more airports in the Northwest Territories and Nunavut rely on scheduled air service and airports receiving scheduled service are required to be certified.

There are a number of changes to the Canadian Aviation Regulations that are proposed or pending that have the potential to negatively impact airport operations and aircraft operators and their ability to effectively serve northern communities. These changes may impose payload penalties on aircraft operators and/or require runway extensions that will be costly and may not always be physically possible because of geographical obstacles.

Air North and Canadian North Combi Aircraft at Inuvik Airport, NWT

5.3 Infrastructure Investment

In this section of the report, airport infrastructure will be assessed to determine what already exists and what is required to support ongoing community and resource needs. The intent is not to evaluate ongoing operations and maintenance - which government agencies already provide. Rather, the objective is to consider how resource development – in combination with regulatory changes and changes in aircraft technology - will affect airports and the need for infrastructure improvements

The territorial governments have well-developed plans for airport maintenance and renewal and, in some cases, airport expansion. Typical 10-year capital plans show governments investing $9.0 to $27.0 million annually in maintenance and upgrading projects.

The extent of infrastructure development in any year will, of course, be determined by the availability of capital funding. The federal Airport Capital Assistance Program (ACAP) is applicable to eligible scheduled airports throughout Canada and provides capital funding for safety-related airside projects, heavy airside mobile equipment and air terminal/groundside projects. Transport Canada will contribute at least 85% of approved project costs for projects in the North. Total Canada wide funding under this program has averaged about $36 million over the last ten years. According to Transport Canada, in 2008-09 total ACAP expenditures in the three territories were over $12 million, representing almost a quarter of total program funding for that fiscal period.

While the cost of a runway extension or apron expansion averages about $250 per square metre, actual costs can vary significantly from territory to territory. For example, the cost of constructing a standard air terminal building is about $800,000 in Yukon, compared to $3.0 million in Nunavut. Factors that can impact costs include availability of construction materials (e.g. gravel), availability of equipment, transportation access, permafrost issues, geography and geotechnical constraints.

Not surprisingly, many of the airports that are ideally positioned to support resource development are also targeted by their respective governments for upgrades - in anticipation of the increased traffic that resource activities will generate.

Aprons and air terminal buildings are typical shortfalls at a number of northern airports. Since local airports are often used as staging points for crew changes and the transfer of equipment and supplies, many of these airports are subject to upgrade programs, including replacement of existing air terminal buildings.

The three territorial governments own and operate some 80 airports throughout Northern Canada and it is evident that they are very focused on airport infrastructure programs that respond to the demands of new federal regulations, changing aircraft technology, community needs and ongoing resource development.

The territorial airport system is characterized by a number of airstrips, community airports and regional hubs that feed into larger gateway airports, which are connected to Southern Canada. In addition, a number of resource and tourism operations have developed their own airports so that goods and people can be transported directly.

Airport Category Examples	
Gateway Hubs	**Whitehorse, Yellowknife, Rankin Inlet, Iqaluit**
Regional Hubs	**Old Crow, Dawson City, Inuvik, Norman Wells, Cambridge Bay, Resolute Bay**
Community Airports	**Beaver Creek, Teslin, Wha Ti, Fort Liard, Colville Lake, Grise Fiord, Pangnirtung**
Resource/Tourism Airports	**Ekati, Diavik, Snap Lake, Painters Lodge**

The governments of Yukon, Northwest Territories and Nunavut have a long history of managing northern airports and responding to traffic demands. Community airports are configured to ensure that they are equipped with the necessary runway, taxiway, apron and support facilities so that users can continue to provide essential services as demand increases through population growth and/or economic development.

Both the territorial governments and the airlines are adept at anticipating infrastructure requirements, which may be based on resource development, community needs or a mix of both. However, in committing hard dollars to airport infrastructure improvements, a distinction must be made between the traffic demands of assured resource development and those of speculative exploration activities, which may be far less sustainable.

An airport inventory and condition and needs assessment was conducted through discussions with government officials and airport users concerning individual airports, a review of airport planning documentation (e.g., airport master plans) and information available in other documents (e.g., Canada Flight Supplement).

This infrastructure assessment is summarized in the following Airport Inventory and Evaluation Summary Tables.

NORTHERN TRANSPORTATION SYSTEMS ASSESSMENT

AIRPORT INVENTORY AND EVALUATION SUMMARY TABLE

Airport	Airport Category	Scheduled Air Service	Status	Runway Length	Runway Width	Runway Surface	Apron/Taxiways	Airfield Lighting	Approach Lighting	Nav Aids	Fencing	Communications	ATB/Shelter	Fuel Avail	Weather Info	Comment
	Areas with potential resource development investment															
Yukon Government																
Burwash	Community	No	Registered	5,005'	100'	Gravel. Resurfaced 2006/2007.	Yes. Apron needs to be expanded.	Yes. Needs replacement within 10 years.	No	Yes	No. Wildlife fence required.	Yes	Yes	No	Yes	Estimated cost for airport work is $3.5 M.
Silver City	Airstrip	No	Registered	3,000'	75'	Gravel. Soft spots 1,000' from Runway 18 threshold. Subject to sink holes.	No	No	No	No	No	No	No	No	No	Trees located along both sides of runway (75' from centreline). Airstrip is a research site and is used to access ice fields and for tourism to Mount Logan. Government may remove this airstrip from their inventory. The cost to rehabilitate the airport would be approximately $4.0M.
Haines Junction	Community	No	Registered	5,000'	100'	Gravel. No rehabilitation since 1993.	Yes. Apron needs to be doubled in size.	Yes	No	No	No. Wildlife fence req'd	No	Yes	No	No	Estimated $2.5 M for rehabilitation
Braeburn	Airstrip	No	Registered	3,000'	75'	Gravel. Numerous holes in runway surface. Soft sections 200' from threshold. Gravel supply is a problem.	Yes. Apron needs to be expanded.	No	No	No	No	No	No	No	No	Trees located along both sides of runway (75' from centreline). Klondike Highway adjacent to airstrip. The airport may be within the highway ROW. Estimated cost for rehabilitation is $2.0M
Cousins	Airstrip	No	Registered	3,200'	100'	Gravel. Resurfacing required.	No. Apron expansion required.	No	No	No	No. Wildlife fence req'd	No	No	No	No	Considering the airport for an air park. Estimated capital requirement $2.5 M.
Pelly Crossing	Community	No	Registered	3,305'	75'	Gravel. The runway surface is soft during the spring thaw and major drainage work is required.	Yes. The apron/taxiway surfaces are soft during the spring thaw and major drainage work is required. A larger apron is req'd.	No	No	No. GPS approach is restricted because of significant crosswind issues.	No	No	No.	No	No	The airport is relatively close to the Minto mining site however Minto has there own airstrip. Medevac uses the airstrip in winter when the surface is frozen. Low priority for rehabilitation at this time.
MacMillan Pass	Airstrip	No	Registered	1,500'. A runway extension is required.	50'	Gravel. Surface made up of large cobble stones and would require rehab to accommodate a broader scope of aircraft.	No	No	No	No	No	No	No	No	No	A remote airstrip however the site is close to a tungsten mine on the Northwest Territories border (Mactung). The airport is used for crew changes. Possible link to Watson Lake or Ross River for crews. The government has no investment plans at this time.
Faro	Community	No	Registered	4,000'. Runway extension challenged by bedrock at one end and access road at the other. Resurfacing is req'd.	100'	Gravel. Soft sections 200' from the runway threshold.	Yes. Apron being expanded this year.	Yes. Airfield lighting requires replacement.	No	NDB	No	Yes	Yes. New ATB scheduled for next year.	Yes	No	Significant costs to expand the airport. The airport is well positioned to support a number of key resource developments: Mactung, Selwyn, Cantung and Wolverine. The Town has developed an aircraft fueling facility.
Ross River	Airstrip	No	Registered	5,113'	100'	Gravel. Resurfaced 2 years ago however there are sub-surface drainage issues.	Yes	Yes. Emergency use only.	No	No	No. Perimeter wildlife fencing is required.	No	Yes	No	No	Possible need for a new airport closer to the First Nations community (9 km).
Twin Creeks	Airstrip	No	Registered	2,900'	75'	Gravel. Runway resurfacing is required.	No	No	No	No	No	No	No	No	No	Airsitrp used as a fire fighting base. Airstrip is maintained for mining interests. Investment required ($1.0 M). Approximately 70 annual movements.

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Yukon Government				Areas with potential resource development investment												
Old Crow	Regional	Yes	Certified	5,019' - Runway extension. Considering a EK 35 surface treatment.	100'	Gravel - considering EK 35 treatment.	Apron is constrained and will require expansion.	Edge Lighting.	No. PAPI for guidance.	NDB	Yes	Yes	The ATB (includes CARS) is relatively new.	Community may be constructing a fuel facility on north side of airport.		Concern with environmental contamination at the maintenance garage. May be a justification to pave the runway to support jet aircraft operations. Scheduled service between Whitehorse, Old Crow, Dawson City and Fairbanks a possibility. oil and gas exploration is ongoing in areas north of Old Crow.
Wiley	Airstrip	No	Registered	2,500'	60"	Gravel	No	No	No	No	No	No	No	No	No	Airport may be removed from government inventory. The airport is part of the Dempster Hwy.
Ogilvie	Airstrip	No	Registered	2,500'	50'	Gravel	No	No	No	No	No	No	No	No	No	The airport runway is comprised of large loose cobblestone. Only suitable for aircraft with wide tires. Estimate cost to rehabilitate $1.0 M. The airport may be taken off the government inventory.
Chapman	Airstrip	No	Registered	3,000'	75'	Gravel	No	No	No	No	No	No	No	No	No	Airport may be removed from government inventory. No investment planned.
Dawson City	Regional	Yes	Certified	5007"	100"	Gravel	Yes. New apron and taxiway required on south side.	Yes	No	NDB	No. fencing is required. Primarily for wildlife control.	Yes	ATB needs replacement or significant renovation.	Yes		Possible CARS staffing requirement. Approximate investment $6.0 M.
McQuesten	Airstrip	No	Registered	2,800'	75'	Gravel - needs resurfacing.	No	No	No	No	No. Needs perimeter wildlife management	No	No	No	Yes	Airstrip is used by miners and outfitters. The government has no investment plans at this time. High cost to get airstrip resurfaced ($1.0M)
Mayo	Community	No	Registered	4856' - Major runway rehabilitation.	100'	Gravel	Need major expansion to apron (x2). Second taxiway is required to relieve congestion. Primarily due to apron re-fueling.	Edge Lighting. Lighting Is being rehabilitated.	No. VASIS for guidance.	NDB	Yes	No	Yes	No		Approximate investment $6.0 M. Close proximity to Bellekeno Mines. Mayo is a likely candidate for investment given the proximity to signficiant resource development areas.
Beaver Creek	Community	No	Registered	3,745'. Runway should be extended to 5,000'.	100'	Gravel	Yes. Aprons needs to be doubled in size.	Yes	No	NDB	No. A wildlife management fence is required.	Yes	Yes	No	No	Customs point of entry. Located on the Alaska Highway and in proximity to mine developments (Casino). Total investment required $2.0 M.
Fort Selkirk	Airstrip	No	Registered	2,000'	75'	Gravel	No	No	No	No	No	No	No	No	No	Isolated airport. Only maintenance equipment is a 60 year old grader. Airport located near old Hudson Bay Trading Post and as such there is some tourism interest. The site is not suitable for an airstrip and a new airport would be required. The government has no investment planned at this time.
Minto	Airstrip	No	- SEE RESOURCE AIRPORTS													
Whitehorse	Gateway	Yes	Certified	13R-31L - 9,500', 13L-31R - 4,018', 01-19 - 1,798'. Potential lengthening of Runway 13L-31R.. Drainage issues on ATB side of main runway.	150', 80', 75'	Paved	Yes. Major apron expansion at the old WW II apron. Apron 1 improvements and new aircraft parking areas.	Yes	Yes	ILS, NDB, DME/VOR	Yes	Yes	Yes. Ongoing expansion and improvements to ATB. New fire hall and maintenance garage planned	Yes	Yes	Airport is going through major expansion plans for aviation-related development areas. In addition, an ATB expansion is in progress. Total capital investment planned $20.0 M. Refer to Whitehorse Master Plan.

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Airport	Airport Category	Scheduled Air Service	Status	Runway Length	Runway Width	Runway Surface	Apron/ Taxiways	Airfield Lighting	Approach Lighting	Nav Aids	Fencing	Comms	ATB/Shelter	Fuel Avail.	Weather	Comment
Carcross	Airstrip	No	Registered	2,200'	75'	Gravel	No	No	No	No	No	No	Yes	No	No	Poor approaches and no land for expansion. Government considering removing from inventory.
Teslin	Community	No	Registered	5,036'	100'	Gravel. Runway soft in spring. Frost heaves approx 600' from threshold. Resurfacing reqd within 5 years.	Yes. New taxiway required.	Yes. needs new edge lighting	No	NDB	No	No	No	No	No	Estimated capital investment required $3.8 M
Hyland	Community	No	Registered	3,297'. May require a runway extension for mining needs.	100'	Gravel	No	No	No	No	No	No	No	No	No	Mining in the area however no plans for investment. Close proximity to Selwyn and Cantung mines. Of the nearby airports to the mine sites (MacMillan Pass, Twin Creeks and Finlayson Lake) Hyland has the best existing infrastructure.
Watson Lake	Regional	No	Certified	5,500'	150'	Paved	Yes. Apron and taxiway resurfacing.	Yes. Upgrade the 08-26 lighting.	Yes	ILS, NDB, VOR/DME. The ILS needs replacement	Yes	Yes	Yes. ATB parking lot needs repaving. Access road resurfacing and ditching	Yes	No	Airport Master Plan (2007) identifies a number of airport improvements. Oil and gas exploration in the general area.
Finlayson Lake	Airstrip	No	Registered	1,847'. Runway would need to be lengthened, widened and resurfaced. No land available. Cost to rehabilitate estimate at $3.0 M.	50'	Gravel	No	No	No	No	No	No	No	No	No	Mining in the area (Wolverine). The cost to improve the airport would be approximately $3.0 M however there is not available lands for improvements.
Pine Lake	Airstrip	No	Registered	3,000'	100'	Gravel	No	No	No	No	No	N	No	N	No	
Carmacks	Community	No	Registered	5,000'	100'	Gravel. Runway needs resurfacing. Estimate cost $3.0 M.	No	No	No	No	No. reqd for large mammals.	No	Yes. ATB built in 1994 and never used.	No	No	Storm drainage issues at airport. Airport used largely for medevac. Significant mining and oil and gas exploration.
Northwest Territories																
Aklavik	Community	Yes	Certified	3,000'. Runway may be extended	75'	Gravel	No	Yes	No	Yes	No	No	Yes	No	No	Maintenance garage needs replacement. Airport has storm drainage issues.
Colville Lake	Community	No	Certified	2,743'. Runway will be extended to 4,000' or 5,000'	100'	Gravel	Apron	Yes	No	No	No	No	No	No	No	The Airport will be relocated and will include longer runways, a passenger shelter and a GPS RNAV approach with AWOS. The proposed site is about 3.2 km from the existing airport and therefore the access road construction will cost approximately $12.0 M. Oil and gas resources.
Deline	Community	Yes	Certified	3,933'. Runway will be extended to 4,500'. The runway is 15 years old and is due for rehabilitation.	100'	Gravel	Yes	Yes	Yes	Yes	No	Yes	ATB is 15 years old (120 m2).	No	Yes	Oil and gas interests in the area.
Fort Good Hope	Community	Yes	Certified	3,935'. Runway should be extended to 4,000' or 4,500'.	98'	Gravel	Yes	Yes. Runway lighting needs upgrading	Yes	Yes	No	Yes	ATB to be expanded from 90m2 to 120m2.	No	Yes	

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Northwest Territories					Areas with potential resource development investment											
Fort Liard	Community	No	Certified	2,946'.	98'	Gravel	Yes	Yes	Yes	Yes	No	Yes	ATB needs to be replaced.	No	Yes	A Master Plan was prepared for the airport identifying medium (apron expansion, runway extension and zoning) and long-term needs (lots, taxiways, new ATB and improved runway. The government is not considering investment at this time.
Fort McPherson	Community	Yes	Certified	3,500'. Possible extension by 500'.	100'	Gravel	Yes	Yes. New airfield lighting.	No	Yes	No	No	Yes. Needs to be replaced.	No	No	Seasonal schedule for air service.
Fort Providence	Community	No	Registered	2,998'	100'	Gravel	Yes	Yes	No	No	No	No	Yes	No	No	Located along the highway. A new bridge is being constructed. There is also a major ditching project and environmental cleanup (Phase 3 Site Assessment in progress).
Fort Resolution	Community	No	Certified	4,000'	100'	Gravel	Yes	Yes. Electrical upgrades are required.	Yes	Yes	No	Yes	Yes. The ATB and Maintenance Garage need replacement.	No	Yes	Environmental cleanup of leaking underground storage tank.
Fort Simpson	Community	Yes	Certified	6,000'. Runway resurfacing required within 5 years.	145'	Asphalt	Yes. Apron will require expansion.	Yes. Electrical upgrades are required.	No	Yes	No	Yes	ATB expansion will be triggered by pipeline construction. Need a new sand storage shed.	Yes	Yes	Master Plan identifies short-term needs (drainage improvements, ATB modifications, obstacle clearing), Medium term includes Apron expansion (4,000 m2), ATB expansion (340 m2), access road modifications, ATB parking lot and utility and service road improvements. The long-term plan identifies additional apron expansion (6,200 m2), airfield pavement overlays, additional ATB expansion and a new service road. Airport is used for pipeline staging. As the pipeline progresses there will be a requirement for increased capacity.
Fort Smith	Community	Yes	Certified	Runway 11-29 (6,000'), Runway 02- 20 (1,800'). Runway re-surfacing required.	Runways 11-29 (200'), 02-20 (100')	Main runway paved, alternate gravel.	Yes	Yes. Lighting upgrades are required.	Yes	Yes	No	Yes	Yes	No	Yes	Asbestos removal is in progress at the maintenance garage.
Gameti (Rae Lakes)	Community	Yes	Certified	3,000'	100'	Gravel	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	Limited expansion potential. No capital needs at this time. The airport is close to mining development (Fortune Minerals).
Hay River	Community	Yes	Certified	Runway 13-31 (6,000'), Runway 04- 22 (4,000').	150' (both)	Main runway paved, alternate gravel. Runways need resurfacing.	Yes	Yes. Problems with the electrical systems.	Yes. Obstacles (light poles) on the approach.	Yes	No	Yes	Yes. The ATB, Maintenance Garage and FEC needs upgrading. Environmental problems at ATB with leaking oil tank. A new sand shed is required.	Yes	Yes	A number of Transport Canada buildings need maintenance and environmental cleanup. Problems with the sewage lagoon. The Transport Canada land farm needs to be commissioned. The Master Plan identified short-term (apron expansion, runway repairs, security fencing, ATB modifications, parking lots, medium term identifies runway overlay, new taxiway, ATB modifications, decommissioning the sewage lagoon and connecting to the municipal system and lot development. The long-term plan shows a new taxiway, apron expansion, ATB expansion and runway overlay.

NORTHERN TRANSPORTATION SYSTEMS ASSESSMENT

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Airport	Airport Category	Scheduled Air Service	Status	Runway Length	Runway Width	Runway Surface	Apron/Taxiways	Airfield Lighting	Approach Lighting	Nav Aids	Fencing	Comms	ATB/Shelter	Fuel Available	Weather	Comment
Inuvik	Regional	Yes	Certified	6,000'	150'	Asphalt	Yes	Yes	Yes. Electrical needs replacement.	Yes. New ILS.	No	Yes	Yes. Old ATB and assortment of buildings, trailers etc. Maintenance garage is new.	Yes	Yes	Transport Canada to remediate the fire training area. Legacy towers may affect runway zoning. Needs commercial development areas. Nav Canada restrictions affect land development.
Jean Marie River	Community	No	Registered	2,512'. extension to 3,500'	60'	Gravel	Yes	No. Installing LED edge lighting system.	No	No	No	No	No	No	no	
Lutselk'e	Community	Yes	Certified	3,003'	100'	Gravel. Supply of gravel is a major issue.	Yes	Yes. Lighting system needs replacing.	Yes	Yes	No	Yes	ATB needs to be replaced.	No	Yes	
Nahanni Butte	Community	No	Registered	2,554'	50'	Gravel/earth	Yes. Apron was constructed a few years ago.	No	No. Needs runway lighting. Bush clearing required on approaches.	No	No. Fencing required to keep buffalo off runway.	No	No	No	No	Poor location for an airport. Major drainage issues. Limited expansion potential, river on one side, mountain on the other. Close to mining interests (Canadian Zinc).
Norman Wells	Regional	Yes	Certified	5,997'	150'	Asphalt. Resurfaced about 4 years ago	Yes. Apron is constrained with current scheduled air service.	Yes. Electrical upgrade required.	Yes	Yes	No	Yes	Yes. ATB needs to be relocated to better serve passengers.	Yes	Yes	Commercial development required. May change airport fuel supply from natural gas to fuel oil. Water Bomber Base. Id significant upgrading of all airfield surfaces, lighting, approach slope indicators, FEC, parking lots etc. Total $9.0 M.
Paulatuk	Community	Yes	Certified	4,000'	100'	Gravel	Yes	Yes	Yes,. New lighting system	Yes	No	Yes	Yes. New ATB this year	Yes	Yes	
Sachs Harbour	Community	Yes	Certified	4,000'	100'	Gravel	Yes	Yes	Yes	Yes	No	Yes	Yes. New ATB this year.	Yes	Yes	No other capital investment planned
Trout Lake	Community	**NEW AIRPORT BEING BUILT.**														
Tuktoyaktuk	Regional	Yes	Certified	5,000'	150'	Gravel	Yes	Yes. Needs replacing and FEC needs to be relocated	Yes	Yes. Work on PAPI required	no	Yes	Yes. New ATB (220 m2)	No	Yes	Runway extension constrained
Tulita	Community	Yes	Certified	3,000'	100'	Gravel	Yes	Yes	Yes	Yes	No	Y	Yes			
Ulukhaktok/Holman	Community	Yes	Certified	4,300'	100'	Gravel	Yes	Yes	Yes	Yes	No	Yes	Yes. ATB and maintenance garage need replacement.	Yes	Yes	
Wekweeti	Community	Yes	Certified	3,000'. Runway to be extended to 3,934'.	75'	Gravel	Yes	Yes. New airfield lighting in the extended runway.	Yes	No	No	No	Yes. Relatively new (7 to 8 years old)	No	No	Courier would like a 5,000' runway
Whati	Community	Yes	Certified	2,991'	100'	Gravel	Yes	Yes	Yes	No	No	No	Yes	No	No	Runway extension is constrained. Government will be trying EK35. Overall airport condition Is good.
Wrigley	Community	Yes	Certified	3,500', No extension planned.	100'	Gravel	Yes	Yes. Edge lighting needs replacement.	Yes	Yes	No	Yes	Yes. old ATB needs replacement and/or rehabilitation.	No	Yes	Significant environmental problems. Maintenance issues.
Yellowknife	Gateway	Yes	Certified	Runway 15-33 (7,500'), Runway 09- 27 (5,000')	Both 150'	Paved	Yes	Yes	Yes	Ye	Yes	Yes	Yes	Yes	Yes	Significant planed airport improvements. ATB relocation & taxiways & aprons, de-icing area, runway extensions, New CSB. Total $100.0M

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Nunavut				Areas with potential resource development investment												
Grise Fiord	Community	Yes	Registered	1,988'	75'	Gravel	Yes	Yes. needs new edge lighting	Yes. Improved approach lighting required.	Yes	No	Yes	No	Yes	Yes	Airport is essential to community. Twin Otter aircraft only.
Resolute Bay	Regional	Yes	Certified	6,500'	200'	Gravel. Overlay required.	Yes needs new lighting	Yes.	Yes	Yes. Nav Canada replacing ILS	No	Yes	Yes	Yes	Yes	DND is considering an enhanced role at this airport. Offshore oil and gas exploration to the north and west.
Arctic Bay	Community	NEW AIRPORT BEING CONSTRUCTED AT THIS TIME 4,000' RUNWAY NEW ATB														
Pond Inlet	Community	Yes	Certified	4,006'	98'	Gravel. Resurface required.	Yes	Yes.	Yes	Yes	No	Yes	Yes	Yes	Yes	Future of this airport is largely tied to Resolute Bay. Demand growing for larger aircraft. Runway can be extended to 5,000'. Apron and taxiways are constrained.
Clyde River	Community	Yes	Certified	3,500'	100'	Gravel. needs resurfacing.	Yes	Yes. Need new edge lighting	Yes	Yes	No	Yes	Yes	Yes	Yes	
Kugluktuk	Community	Yes	Certified	5,500'	100'	Gravel	Yes	Yes. need new edge lighting	Yes	Yes	No	Yes	Yes. ATB needs replacement.	Yes	Yes	Close to mining interests (Stornaway, MMG Minerals, Hope Bay).
Cambridge Bay	Regional	Yes	Certified	5,000'	150'	Gravel	Yes	Yes	Yes	Yes	No	Yes	Yes. ATB need to be 3X larger.	Yes	Yes	Significant expansion required to aprons and taxiways
Gjoa Haven	Community	Yes	Certified	4,400'	100'	Gravel. needs resurfacing	Yes	Yes, need new edge lighting	Yes	Yes	No	Yes	Yes. Replace ATB	Yes	Yes	
Taloyoak	Community	Yes	Certified	4,020'	100'	Gravel. Needs Resurfacing	Yes	Yes, need new edge lighting	Yes	Yes	No	Yes	Yes. Replace ATB (160 m2). Approximate cost $3.0 M	Yes	Yes	
Kugaaruk	Community	Yes	Certified	5,000'	100'	Gravel. Needs resurfacing	Yes	Yes. need new edge lighting	Yes	Yes	No	Yes	Yes	Yes	Yes	Close to mining interests (Diamonds North).
Igloolik	Community	Yes	Certified	4,095'	100'	Gravel. Needs resurfacing	Yes	Yes. need new edge lighting	Yes	Yes	No	Yes	Yes. ATB needs renovation.	Yes	Yes	
Hall Beach	Community	Yes	Certified	5,410'	150'	Gravel. Needs resurfacing	Yes	Yes, need new edge lighting	Yes	Yes	No	Yes	Yes. ATB expansion to 210 m2	Yes	Yes	Mining in area.
Qikiqtarjuaq	Community	Yes	Certified	3800'	100'	Gravel. Needs resurfacing	Yes	Yes. need new edge lighting	Yes	Yes	No	Yes	Yes. ATB expansion to 210 m2	Yes	Yes	Airport is constrained.
Pangnirtung	Community	Yes	Certified	2,920'. Runway needs extension to 5000' for ATR 72 ops	100'	Gravel	Yes	Yes.	Yes	Yes	No	Yes	Yes.	Yes	Yes	Airport is constrained. A new airport is required at a cost of approximately $40.0M. The area fish plant would like to expand and there are mineral deposits in the area. The airport is also the gateway to the national park.
Iqaluit	Gateway	Yes	Certified	8,600'	200'	Asphalt	Yes	Yes	Yes	Yes	Yes	Y	Yes. relocate ATB, CSB, FEC	Y	Yes	Master Plan identifies approx $70 M investment
Kimmirut	Community	Yes	Certified	1,900'	75'	Gravel	Yes	Yes	No	Yes	No	N	Yes	N	Yes	Need a new airport. Close to True North Gems mining.

NORTHERN TRANSPORTATION SYSTEMS ASSESSMENT																
AIRPORT INVENTORY AND EVALUATION SUMMARY TABLE																
Airport	Airport Category	Scheduled Air Service	Status	Runway Length	Runway Width	Runway Surface	Apron/Taxiways	Airfield Lighting	Approach Lighting	Nav Aids	Fencing	Comms.	ATB/Shelter	Fuel Available	Weather	Comment
Cape Dorset	Community	Yes	Certified	3,988'	100'	Gravel. Runway needs resurfacing.	Yes	Yes. Replace edge lighting	Yes	Yes	No	Y	Yes. New ATB required within 20 year timeline.	Yes	Yes	
Coral Harbour	Community	Yes	Certified	5,000'	100'	Gravel. Runway needs resurfacing.	Yes	Yes. Replace edge lighting	Yes	Yes	No	Y	Yes	Yes	Yes	Close to mining interests (Anglo-American Exploration).
Repulse Bay	Community	Yes	Certified	3,400'. Runway extension	100'	Gravel	Yes	Yes	Yes	Yes	No	Y	Yes. New ATB	Yes	Yes	New airport required sometime in the future.
Baker Lake	Regional	Yes	Certified	4,195'	100'	Gravel. Runway needs resurfacing.	Yes. Apron and taxiways need to be expanded	Yes. Replace edge lighting	Yes	Yes	No	Y	Yes. New ATB	Yes	Yes	Master Plan in progress. Major mining interests around Baker Lake.
Chesterfield Inlet	Regional	Yes	Certified	3,600'	100'	Gravel. Runway needs resurfacing.	Yes	Yes. Replace edge lighting	Yes	Yes	No	Y	Yes. New ATB	Yes	Yes	
Rankin Inlet	Gateway	Yes	Certified	6,000'	100'	Asphalt	Yes. Apron and taxiways need to be expanded	Yes	Yes requires precision approach.	Yes	No	Y	Yes. ATB needs to be expanded	Yes	Yes	Master Plan recommends $32M in capital investment to meet growth needs.
Whale Cove	Regional	Yes	Certified	3,937'	100'	Gravel. Runway needs resurfacing.	Yes	Yes. Replace edge lighting	Yes	Yes	No	Y	Yes. New ATB	Yes	Yes	
Arviat	Community	Yes	Certified	4,000"	100'	Gravel. Runway needs resurfacing.	Yes	Yes. Replace edge lighting	Yes	Yes	No	Y	Yes. New ATB	Yes	Yes	Mining interests in area. If mining proceeds the apron would require
Sanikluaq	Community	No	Certified	3,800'	100'	Gravel. Runway needs resurfacing.	Yes	Yes. Replace edge lighting	Yes	Yes	No	Y	Yes	Yes	Yes	
Nanisivik	Regional	Yes	Certified	6,400'	150'	Gravel	Yes	Yes	Yes	Yes	No	Y	Yes	Yes	Yes	
RESOURCE AIRPORTS																
Yukon																
La Biche	Devon Canada	No	Registered	3,000'	100'	Gravel	No	Yes	No	No	No		No	No	No	
Minto	Minto Explorations Ltd.	No	Registered	4,495'	100'	Gravel	No	Yes	No	No	No		No	No	No	
Tungsten	North American Tungsten	No	Registered	3,700'	100'	Gravel	No	No	No	No	No	N	No	No	No	
Taltson River	NWT Power Corp	No	Registered	3,792'	50'	Gravel	No	No	No	No	No	N	No	No	No	
Snare River	NWT Power Corp	No	Registered	3,000'	75'	Gravel	No	No	No	No	No	N	No	No	No	
Snap Lake	De Beers	No	Registered	5,282'	150'	Gravel	No	Yes	No	No	No	N	No	No	No	
Rae Edzo	Dogrib Rae Band	No	Registered	3,372'	98'	Gravel	No	No	No	No	No	N	No	No	No	
Prairie Creek	Canadian Zinc Corp	No	Registered	3,900'	100'	Gravel	No	No	No	No	No	N	No	No	No	
Gahcho Kue	De Beers	No	Registered	5,146'	148'	Gravel	No	No	No	No	No	N	No	No	No	
Ekati	BHP Billiton Diamonds	No	Registered	6,392'	148'	Gravel	No	Yes	Yes	Yes	No	N	No	No	No	
Diavik	Diavik Diamond Mines	No	Registered	5,234'	167'	Gravel	No	Yes	Yes	Yes	No	N	No	No	No	
Colomac	DIAND	No	Registered	5,100'	75'	Gravel	No	No	No	No	No	N	No	No	No	
Nunavut																
Doris Lake	Hope Bay Mining	No	Registered	7,894'	200'	Ice	No	No	No	No	No	N	No	No	No	January through April
Eureka	Environment Canada	No	Registered	4,802'	150'	Gravel	Yes	Yes	No	Yes	No	N	Yes	No	Yes	

For the purpose of this report, each of the territorial governments was also asked to identify the top priorities for airport infrastructure development over the coming years. These are identified in the following three Airport System subsections

5.3.1 Yukon Airport Investment

Whitehorse International Airport is the gateway to the Yukon and offers both domestic and international service, depending on the time of year. Condor currently flies a weekly flight (May to October) between Whitehorse and Frankfurt and Swissair will be starting a seasonal weekly schedule in 2011. The Whitehorse airport has recently completed a $15.7 million terminal expansion designed to accommodate growing international and domestic traffic.

Air cargo and passengers destined for Yukon normally move via Whitehorse to community airports throughout the territory. The Yukon Government manages and operates 28 airports that are included in this study.

The Yukon Government has an extensive inventory of airports that can provide support to resource operations. Approximately 28 percent of Yukon airports have runway lengths greater than 4,500 feet. Longer runways allow operators to fly a wider range of aircraft including corporate jets and larger turboprop aircraft, like the ATR.

While mineral development in Yukon is widespread, oil and gas exploration is focussed either in the northern portion of the Yukon or generally in an area stretching from Carmacks to Watson Lake and eastward. Many of the resource development areas in the Yukon are connected by road. However, where airport support is required it is important to ensure that the necessary facilities and infrastructure are in place.

Dawson City, Mayo, Beaver Creek, Burwash, Faro, Teslin and Watson Lake airports are all situated in reasonable proximity to major resource development areas and these airports either have suitable existing airfield infrastructure or are being considered within government planning for further improvements.

- Mayo Airport is programmed for major apron expansion and runway rehabilitation due to permafrost degradation (total capital cost $2.2 million over 5 years).
- Faro Airport is programmed for an apron expansion and a new air terminal building (total capital cost $1 million over 5 years)
- Dawson City Airport is in the process of expanding aprons, installing wildlife fencing and possibly relocating the air terminal building.
- Beaver Creek Airport is being considered for runway extension and apron expansion and Burwash is being considered for an apron expansion.
- Watson Lake Airport will be considering expansion plans to accommodate fixed base operations, e.g. hangaring, aircraft maintenance, engine overhaul, avionics repair.

All of the airports are programmed for rehabilitation (e.g., runway renewal, airfield lighting upgrades). Some mining operations along the border with the Northwest Territories have their own airports (e.g., Cantung) whereas others may be encouraged to take over operations of existing airports (e.g., Macmillan Pass). Top priority for airport infrastructure investment in Yukon is reported to be:

- In general, rehabilitation of aging infrastructure (e.g., air navigation systems, physical infrastructure), including what was inherited from Transport Canada.
- Financing the high cost of ever increasing federal regulatory requirements (e.g., RESA, security, wildlife).
- Apron expansions and reconstruction of manoeuvring surfaces at **Mayo** and **Faro Airports** in order to meet the present and future needs of the mining industry.

Additional work will be required to recertify aerodromes where scheduled service is required to support resource development (e.g., Mayo).

5.3.2 Northwest Territories Airport Investment

Yellowknife Airport is the gateway airport to the Northwest Territories with significant ongoing capital investment in air terminal facilities, runway extensions, apron and taxiway construction and new aviation-related development areas. A $20.7 million Combined Services Building was recently completed at the Yellowknife Airport. Including the Yellowknife Airport, the Government of the Northwest Territories manages and operates 27 airports that are included in this study.

Resource development in the Northwest Territories is mainly concentrated in the Slave Geological Province extending from Great Slave Lake to Coronation Gulf. As with the other territories, the Northwest Territories has an impressive inventory of airports that can, if required, provide support to resource development areas. Approximately 27 percent of the airports have runway lengths exceeding 4,500 feet.

It is noteworthy that a number of diamond mines (e.g. Ekati, Diavik, Snap Lake) have constructed airfields at their mine sites. This allows these companies to transport workers directly to the site from airports elsewhere in the North or from Southern Canada. These airports are generally equipped with infrastructure that allows all-weather, 24/7 operations.

However, there are a number of prospective mining areas that do not have airfields in close proximity and may rely on support from local public airports. For resource interests, strategically situated airports outside of Yellowknife include Colville Lake, Deline, Gameti and Wekweeti.

Strategic airports related to oil and gas development and pipeline construction extend from Tuktoyaktuk and Inuvik in the north to Fort Providence and Hay River in the south. Many of these airports are well developed and have constructed infrastructure in response to existing needs and proposed resource development.

For example, Inuvik, Norman Wells and Fort Simpson have paved runways that are 6,000 feet in length - supporting a wide range of aircraft - and these airports have well developed infrastructure, including air terminal buildings and aprons to support oil and gas needs.

Government infrastructure plans for these airports are largely focused on aviation-related activities that will support oil and gas development. Top priority for airport infrastructure investment in NWT is reported as follows:

- Runway extensions were recently completed at Fort Good Hope and Tulita and the extension at Fort McPherson is scheduled for completion in September 2011.
- **Yellowknife, Hay River, Norman Wells** and **Inuvik Airports** will continue to figure prominently because of their roles as gateways and/or regional hubs.
- **Tuktoyaktuk Airport** will not become a priority until there is renewed oil and gas activity in the Mackenzie Delta and Beaufort Sea. It presently has a 5,000 foot gravel runway that is physically constrained by water at both ends. Development plans include a new air terminal building and a field electrical centre.

5.3.3 Nunavut Airport Investment

The Iqaluit and Rankin Inlet airports are both considered gateways to Nunavut and both airports are completing master plans that are targeting relatively major investment over the next few years. Nunavut, unlike the other territories, has no highway connections and, therefore, the movement of goods and people is entirely reliant on the sealift in the summer and air transport year-round. Accordingly, virtually all communities have an airport with scheduled air service.

As with Yukon and the Northwest Territories, resource development is widespread with base metal, gold and diamond operations in the western part of Nunavut, gold and uranium mining in the central area, iron ore on Baffin Island and scattered resource activities throughout the rest of the territory. Active mines in Nunavut include Meadowbank and Meliadine operated by Agnico Eagle Mines and the Newmont Mining Corp. Hope Bay Mine, which is under construction. Shear Minerals is exploring kimberlite deposits near Chesterfield Inlet. Offshore oil and gas activity appears to be located in areas south of Coral Harbour and north and west of Resolute Bay, Pond Inlet and Arctic Bay.

Rankin Inlet and Baker Lake are well positioned to support development in the central regions and Cambridge Bay and Kugluktuk are situated to provide support to the western regions. The government is actively maintaining all of the airports within the territory and master plans are being, or have been, completed for Rankin Inlet, Baker Lake and Iqaluit. In addition, consideration is being given to new airports in Repulse Bay, Kimmirut and Pangnirtung.

Top priority for airport infrastructure investment in Nunavut is reported to be:

- Improvements at **Iqaluit Airport** because of its hub/gateway role, its importance to the military, the expected growth in demand related to mining activity in the region (e.g. Baffinland, Peregrine) and the fact that present operations exceed capacity (total capital cost estimated in excess of $200 million including $60 million air terminal building).
- Improvements at **Cambridge Bay Airport** because of its role as a regional hub, the growth in demand related to mining development (e.g. Hope Bay) and the recently announced High Arctic Research Station. (total capital cost $34.4 million short term improvements to runway lighting and landing system, gravel runway structure and apron extension. Doubling the size of air terminal building required within 10 years).
- Improvements at **Rankin Inlet Airport** because of its hub/gateway role, the expected growth in demand from mining activities in the region (e.g. Meadowbank, Meliadine) and, again, the fact that present operations exceed capacity (total capital cost $32.2 million including expansion of air terminal building, new taxiway and apron).
- Improvements at **Baker Lake Airport** because of the growth in demand related to mining development in the area (e.g. Meadowbank).

It is expected that **Nanisivik Airport** will be decommissioned because of a declining need on the part of the military.

5.3.4 Northern Air Ship Investment

While it may still be premature to plan on airship availability, this 20 year outlook on northern infrastructure needs would be remiss without mention of airship potential in a northern transportation systems context. Airships have long been suggested as a solution for many northern logistics challenges. However, until recently the suggestions have not been backed with meaningful investment.

That is beginning to change, especially with military funding of airship prototypes in the United States. Two projects are currently being developed for military missions, one of which is expected to have an initial prototype version flying in 2011.

Airships are now being built that will be capable of transporting payloads of 25 tonnes, at a cruise speed of 130 kph, on an un-refuelled basis for distances up to 2,000 km. Airships can fly any route and are re-deployable, so they provide far greater flexibility without resorting to extensive ground support infrastructure, roads, railways or port facilities. Buoyant lift reduces propulsion requirements so an equivalent payload airship uses 1/10th of the fuel of a Hercules aircraft.

Accordingly, airships are more cost effective to operate and they emit lesser amounts of green house gases. Airships are also scalable. It will be possible to build airships with payloads of 350 tonnes and greater.

In addition to the lighter-than-air traditional blimp, more recent innovation is the heavier-than-air hybrid. The hybrid version is slightly heavy when unloaded, which means that the aircraft doesn't require tie downs while loading and unloading. Hybrids land and takeoff using a hovercraft like mechanism known as an "air cushion landing system (ACLS)". The ACLS allows the aircraft to operate from any reasonably flat surface, including ice, snow, sand, water and open fields. This capability reduces, or eliminates, the need for runways and other ground infrastructure. At reduced payloads, these aircraft are also capable of vertical lift.

Airships are comparatively robust aircraft which can be operated safely in wind conditions up to 25 knots. As a general rule, airships can operate in the same weather conditions as helicopters. Icing conditions and snow loads are both manageable as is extreme cold.

Generally the transportation costs for an airship will be higher than road, rail or marine. Airships have 5 – 10 times higher operating costs as compared to trucking. Airships will never replace conventional transportation. On the contrary, airships will extend the reach of existing modes. Future northern applications could include:

- Extending winter road seasons;
- Lightering cargo from sealift vessels;
- Remote delivery from a transportation hub; or
- Mine supply with minimal environmental footprint.

In summary, this section of the report has highlighted the ongoing incremental aviation infrastructure investment that continues to meet isolated community requirements for passenger, cargo and medevac services, as well as inconsistent resource development demand and compliance with changes in Canadian aviation regulations.

6. Conclusions

Following are key findings from the Northern Transportation Systems Study:

- *Combined with incremental community harbour improvements ongoing in Nunavut, the full scale of transportation infrastructure proposed for the Mary River Iron Mine on Baffin Island may create spin-off opportunities for long term community resupply improvement in the Qikiqtaaluk Region.*
- *Staged development of a Coronation Gulf Port and Road could initially provide lower cost inbound bulk transport for existing diamond mines in the Northwest Territories with early project revenues for subsequent full facility development to support base metal mining in the Kitikmeot Region of Nunavut.*
- *Port, rail and/or road infrastructure investments would provide the resource development industry in Yukon with lower cost tidewater access to help mineral exports stay competitive in the Asian market.*
- *Incremental investment in both the proposed Mackenzie Valley Highway and the Nunavut-Manitoba Road could initially improve community resupply reliability, local goods distribution and regional resource development access; and ultimately supplement high cost air cargo and passenger transport with all-weather road connections to the southern highway system.*
- *Runway extensions, new aprons and air terminal buildings may be required for workforce crew changes and air cargo support for the large scale resource development projects being considered over the next 20 years.*

This report concludes with the following high level financial summary that should be considered as a first step in helping to prioritize infrastructure investments in the North. Project benefits that are not quantified here include increased safety, reliability, community development and environmental protection. Though less easily monetized, these benefits are equally, if not more, significant to infrastructure decisions in a changing Northern climate.

Infrastructure Investment Project	Investment Capital Cost	Internal Rate of Return	Net Present Value	Benefit To Cost Ratio	Pay Back Period
Skagway Mineral Export Terminal	$81 million	40%	$431 million	7 : 1	3 yrs
Canol Corridor Super Load Road	$52 million	20.5%	$209 million	5.4 : 1	7 yrs
Klondike Corridor Rail to Whitehorse	$67 million	17.1%	$174 million	4 : 1	8 yrs
Yukon Hwy 1 & 2 Truck Lane Build-Out	$82 million	11.3%	$72 million	2 : 1	10 yrs
Coronation Gulf Port & Road(BIPAR)	$127 million	10.6%	$52.5 million	1.5 : 1	8 yrs
NWT Seasonal Overland Road *	$192 million	9%	$55 million	1.3 : 1	8 yrs
Standard Gauged Rail to Carmacks	$576 million	8.4%	$237 million	1.5 : 1	12 yrs
Iqaluit Sealift Ramp/Staging Site	$22 million	6.1%	$2.6 million	1.2 : 1	15 yrs
Iqaluit Deep Water Port	$65 million	-1.2%	-$34 million	.44 : 1	30 yrs
Mackenzie Valley All-Weather Hwy	$1.8 billion	-4.9%	-$1.3 billion	.20 : 1	50+ yrs
Nunavut-Manitoba All-Weather Hwy	$1.3 billion	-6.8%	-$1.0 billion	.15 : 1	50+ yrs

*** assuming highest risk of warm winter/short season (every 5 years).**

Although the financial assessments are derived from shipper savings, which are not the same as commercial revenue streams or broader socio-economic benefits, they do provide a high level indication of the relative attraction for public and/or private investment. Moving toward the top of the table, investments show increasing private sector financial viability. Moving toward the bottom of the table, investments show increasing requirement for public interest financing.

Resource projects will increase the prospects for private sector financing of northern transportation infrastructure. Governments should look closely for any opportunities to piggyback community resupply benefits on resource development projects. Public sector buy-in to a private sector project can leverage the legacy of northern transportation infrastructure investment. To further that legacy in a harsh environmental and financial climate requires careful consideration of all options for cost sharing partnerships where multiple needs can be met with a single multi-use facility.

White Pass & Yukon Route Railway at Carcross, Yukon (2010)

Appendix

Power Generation: Issues and Opportunities

The Phase 1 Report found that the majority of transportation demand in much of the North is for bulk fuel delivery. The prospect of many new mining projects expanding demand for diesel fired power generation and the consequent transportation impact of that demand has been a major focus for this Phase 2 Infrastructure Needs Assessment. The potential for hydro-electric power generation, and perhaps nuclear power, to replace transportation infrastructure with transmission infrastructure is a long term opportunity which should not be overlooked. Potential for that infrastructure substitution is outlined in this appendix.

Yukon Power System

Yukon Power System Overview

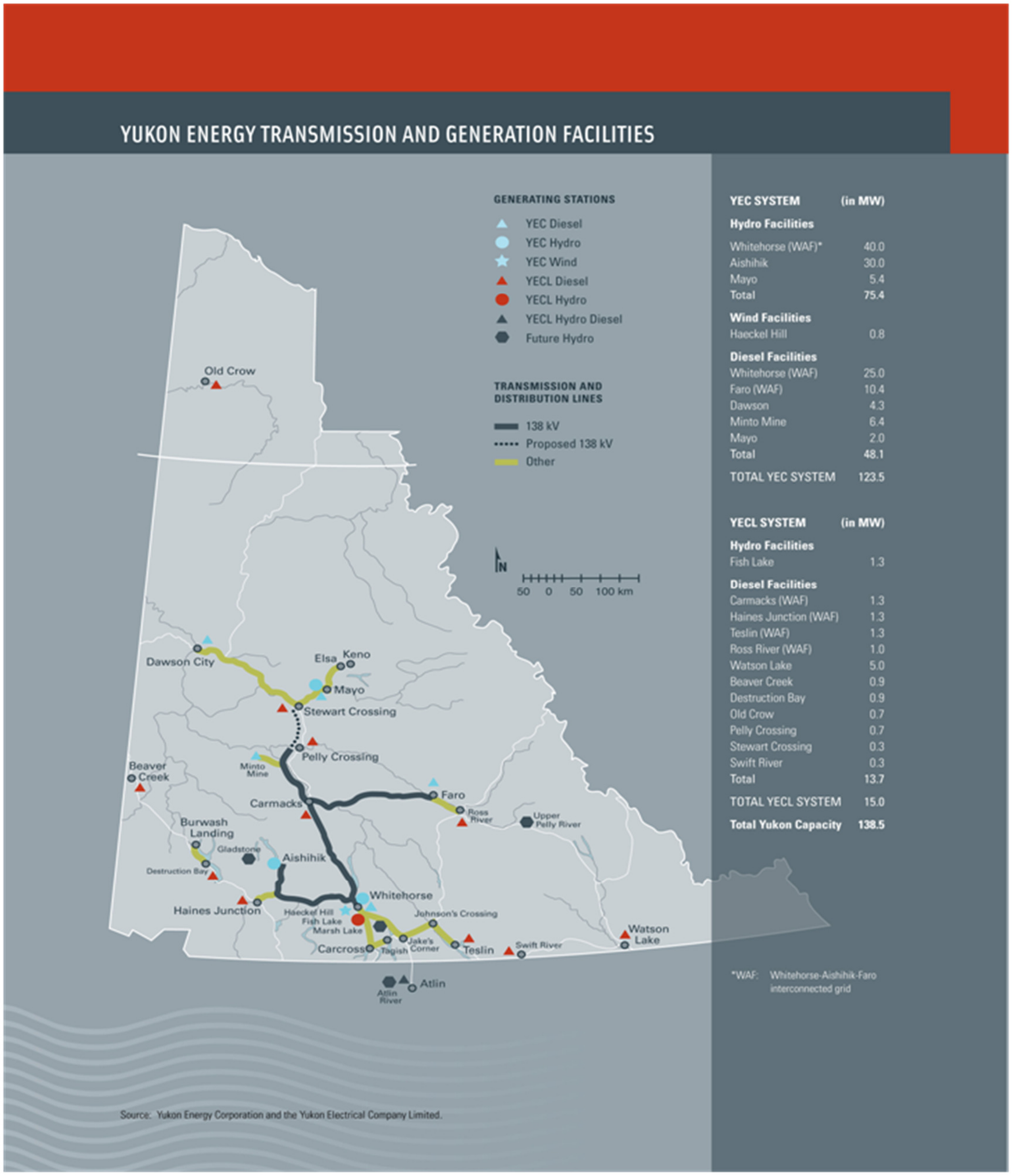
Until the late 1980s, most of the electrical generation facilities in the North were owned by the federal government's Northern Canada Power Commission (NCPC). The first of its Yukon facilities, a five megawatt hydro plant in Mayo in the central Yukon, was built in 1951, followed by hydro plants at Whitehorse and Aishihik. In 1987, all of the Northern Canada Power Commission's assets in the Yukon were devolved to the Yukon government.

Electrical generation and distribution in Yukon is now carried out by the Yukon Energy Corporation (YEC), a publicly-owned electrical utility that operates at arms-length from the Yukon government. It is a wholly-owned subsidiary of the Yukon Development Corporation, established by an Act in 1987 for the main purpose of providing a "continuing and adequate supply of energy in the Yukon in a manner consistent with sustainable development." It functions as an agent of the Yukon government. Rates charged to customers are regulated by the Yukon Utilities Board.

The Company sells directly to consumers in a number of communities in Central Yukon, and through a wholesale arrangement to Yukon Electrical Company Limited (YECL) which retails power to users in the larger southern communities including Whitehorse. YECL is a private company owned by Atco Electric Limited. It also produces 16 megawatts (MW) of electricity under license from YEC, which it sells to smaller communities in Yukon, which are not on the grid.

At November, 2009, Yukon's total electricity generating capacity was 137 megawatts. 75 MW is provided by YEC hydro facilities in Whitehorse, Mayo and Aishihik. 36 MW is produced by YEC's diesel generation facilities, used mainly for back-up. Just under one megawatt is added by two wind turbines located on hills near Whitehorse.

The following map shows the breakdown of the generating capacities of Yukon's power plants.



Current Power Supply and Future Demand Status

Demand for electricity in Yukon has been steadily increasing during the last ten years. Due to the ever-increasing price of diesel fuel, YEC wants to avoid developing diesel fuel powered generation facilities in the future, if possible. And the current load demand takes up virtually all of the existing hydro capacity.

The mining forecast included herein for seven mines scheduled to come on stream in Yukon from 2010 and 2016 will carry a demand for some 160 megawatts of electricity. Wolverine and Cantung Mines, to be in production this year, will rely on self-generated diesel power.

Yukon Energy Expansion Plans and Alternative Energy Strategies

Planning work is underway for expansion of the Mayo hydro plant. This project, called "Mayo B" will increase the capacity of the facility from 5 Mw to between 10 and 15 MW, and basically keep Yukon "even" considering known load demand through its construction period. While Mayo B will provide power to two of the mines included in the NTSA, its new capacity will not be able to satisfy the needs of the larger mines being planned.

Mayo B will serve the Bellekeno Mine when completed, and excess power will be transmitted to the grid to connect with the transmission line recently installed from Carmacks to Pelly Crossing with a spur to the Minto Mine. This line will be completed to the Dawson – Mayo Grid at Stewart Crossing and the eventual Mayo B hook-up there, by the end of 2010 and will help supply Yukon-wide power loads. The new transmission line serving Carmacks and now Pelly Crossing took two diesel fuel-dependant plants out of the system.

The current rate cost passed on to users for diesel-generated electricity produced by YEC is quoted at 35 cents/kilowatt-hour. This can only increase with inevitable energy price increases and future construction costs.

Work is continuing on adding a third turbine at the Aishihik hydro plant which will add seven MW to the system when completed. And an old hydro power project at Lindeman Lake is being re-examined to see if it can be economically re-designed and put into service.

With the abundance of hot springs in Yukon, research work is underway to determine if geothermal heat processes can be economically developed. Yukon's geological and volcanic structures seem suitable for this technology which is considered to have the potential to produce between 500 and 1,500 megawatts of power.

YEC management believes that the resource industry and government power agencies have to become closer partners in finding solutions for future resource project power requirements. YEC will have to look beyond early predictions of mine lives (ongoing exploration work tends to extend production periods) for its amortization term, and the mining industry will have to participate in power project financings. As the resource industry power demand diminishes with mine life, it may fall to Yukon community growth to make up the attendant load loss.

There is also some interest in coal gasification as a power source. The huge Cash Minerals coal deposit in central Yukon has potential, and the Company has commissioned engineering work to study the economic viability of coal for generating electricity. YEC management have suggested that the ultimate solution to meeting future power needs will be from a "basket of solutions" of hydrocarbon and growing renewable generation systems including hydro, wind, solar, small nuclear and bio-mass.

NWT Power

NWT Mining - Changing Attitudes on Power and Infrastructure Requirements

Current and most proposed mine developers are/will be confronted by future challenges associated with the supply and transportation of diesel fuel for power generation in mining operations, and its impact on infrastructure requirements. Understandably now, the industry's has new appreciation for and an increasing priority for hydro transmission lines. This form of energy could displace some 50% of the total fuel requirement for an open pit mine, and would go a long way toward removing the current total dependency on roads for inbound mine supply.

Also to be noted is that mature mines consistently achieve logistics efficiencies that reduce inbound mine supply demand, and provide attendant truck cost savings from this. Residual requirements for investment in roads and road maintenance amid the presence of overland power transmission could accordingly support increased air transport service for reduced mine resupply requirements.

NWT Power System Overview

In 2007-08 , a new publicly-owned parent company governing all power interests in NWT, the Northwest Territories Hydro Corporation (NT Hydro) was formed. The new company was created to facilitate the development of hydro electric power on an unregulated basis, while protecting the GNWT's investment in the Northwest Territories Power Corporation (NTPC). NTPC was formed in 1948 by the federal government to provide an integrated public utility industry in the north.

Restructuring also occurred in two former subsidiaries of NTPC, the Northwest Territories Energy Corporation (03) Ltd. (NTEC 03) and the Sahdae Energy Ltd. (Sahdae). Formerly subsidiaries of NTPC, these companies are now sister companies of NTPC and are subsidiaries of NT Hydro.

NWT Current Power Supply

NTPC owns and operates 2 principal hydroelectric power generating systems and a third smaller system, all in the Great Slave Lake region, that account for 79% of all power sold by the NTPC. These plants feed transmission lines targeting specific mines and/or communities. In the Great Slave region power is generated from hydroelectric plants on the Snare and Taltson Rivers and Bluefish Lake. Yellowknife is also served by the 28 megawatt Jackfish Lake diesel facility.

Snare River Hydro Plant

The Snare River hydro system is located some 140 km Northwest of Yellowknife in the Tlicho First Nations territory. It consists of five hydroelectric facilities generating 28 MW now serving the City of Yellowknife, and the municipalities of Behcho Ko and Dettah. Commissioned in 1948, it also supplied power to the Giant Mine at Yellowknife prior to its closure.

The Taltson River hydro plant is located 65 kms north of Fort Smith. Current generation capacity is 18 MW. The system delivers power to Fort Smith, Fort Resolution, Enterprise and the Hay River area. It was completed in 1965, principally for the Pine Point Mine which closed in 1986.

The Bluefish Hydro system, serving the Con Mine, was purchased from Miramar Mines in 2003. It produces 7 MW of electivity and now feeds the City of Yellowknife.

NTPC officials stated at the Detah Mining Opportunities Workshop on March 30th and 31st , 2010 that the Corporation was exposed to world crude oil prices, and accordingly was dedicated to reducing its dependency on diesel fuel over the long term. Evidencing this, a wind turbine project is being planned for Tuktoyaktuk's future electrical needs.

NWT - Future Demand Status

NTEC (03) has two operations: the development of hydroelectric business opportunities outside of the regulated utility business and investment in the Deze Energy Corporation. The Deze Energy Corporation is pursuing a hydroelectric project that will ostensibly provide hydro electricity to the diamond mines. Sahdae's sole function is to pursue a hydro development project on the Great Bear River to provide power to the potential Mackenzie Valley pipeline project, should it proceed.

Unlike southern Canada there is no integrated transmission grid in the NWT. The distances between small population centres make it uneconomic to build an integrated transmission system. Therefore, NTPC operates 28 separate power systems, serving a population of approximately 42,000 that spans more than 1.1 million square kilometres. In Inuvik and Norman Wells, electricity is generated from turbines powered by natural gas. In all other communities the corporation relies on diesel-powered generators.

NWT Power Corporation has conducted a feasibility study to supply power from the Taltson Hydro system around the east end of Great Slave Lake to the Lac des Gras area and discussed potential supply arrangements with Ekati, Diavik and DeBeers. Unfortunately, the three mines have some 90 megawatts of power generation facilities in place through sunk investments. New electrical transmission to these mines, while perhaps less costly, is not economical considering remaining mine life; (likely) declining production; and the Power Corporation's need for an adequate amortization period for its investment which may not be available. However, negotiations continue and suitable arrangements are possible if the electrical rate is attractive enough and the supply "franchise" period tied to mine life. To provide such service, the Power Corporation will have to start gaining confidence in the long term sustainability of mine development in the Slave Geologic Province and other regions it could service. (Yukon Energy Corporation is now considering this new "risk" strategy in evaluating future growth opportunities.)

NWT Power Issues and Opportunities - Mining Industry

Representatives of the mining industry generally confirm that the broader strategy for developing northern transmission infrastructure is as important, if not more important, than southern road access for developing new mines. Even for exploration, which the NWT Chamber of Mines points out goes on regardless of the attractiveness of the prospect, the industry feels that the presence of hydro transmission will do more in the long run to increase the prospects of remote resource properties coming into development, than a road.

The industry also makes the point that the presence of improved transmission should not compromise the attraction of incremental, legacy road development in the Territories. It does, however shift the spin when ranking the mining infrastructure wish list, especially at locations where communities and mines are in close proximity

There is currently no excess generating capacity at the Snare Hydro facility, but a feasibility study has been completed indicating the potential to develop 10 and 4 MW respectively at Sites 7 and 4 at Indian Lake, north of the existing facilities. This would likely require a franchise agreement from a company such as Fortune Minerals for its NICO mine; Tlicho First Nation government consent; and a significant capital investment to proceed. It also would require 70 km of new transmission lines. Environmental baseline studies have yet to be initiated and an Environmental Assessment (EA) will be required. Consequently, these sites could not be introduced to the grid until 2015 at the earliest, even if the baseline work commenced immediately.

There is also an initiative by the Tlicho Investment Corporation, together with SNC Lavalin and the NTPC to construct up to 20 MW of run-of-river hydro development on the La Martre River near Wha Ti. Little previous work has been done to advance this project, but it could be integrated with the Tlicho all-weather road initiative and represents a significant new source of hydro power potential for the Snare grid.

A NTPC executive informed a recent Mine Opportunities Workshop in Detah, NWT that the feasibility study for this project is now completed and agrees that this is the best opportunity for expansion of the Snare power system. Power demand could be provided by the community of Wha Ti, the NICO mining operation, and expansion could provide an additional feed into the existing Snare grid.

A feasibility study and EA were recently completed indicating the Taltson River system could be expanded to supply from 36 to 56 MW power, targeting the Slave Geologic Province. Potential users of this project would include the Pine Point mine and the Thor Lake Mine. The hydro development plan includes expanding the power transmission lines around the East Arm of Great Slave Lake to connect the existing and proposed diamond mines to sell them lower cost power. As previously noted, there is a concern that this power might be too late to use at the existing mines, given the current investment in diesel power generation and remaining mine life. There are also indications that this expansion is being reconsidered because there is not enough demand from the diamond mines to justify the project.

The Jackfish diesel generating station in Yellowknife has 28MW of additional, excess generating capacity that can service new demand. However, the industry is concerned that this expansion could result in a much higher blended diesel/hydro rate for users, and with no potential for heat recovery at any mine sites served by the expanded plant. It believes the resulting rate increase for current residential consumers on that grid system would be controversial and possibly impact community relations.

Aerial view of Bluefish dam.

There is a plan to retrofit and expand the Bluefish hydro dam near Yellowknife to improve its efficiencies and add an additional 3-5 MW to the system.

Bluefish Dam, surface-accessible by ice road only, is now 70 years old and has been kept serviceable by periodic upgrades carried out over the last 38 years. The Bluefish system, as currently configured, is considered by NTPC to have reached the end of its productive life and the Company is proposing a replacement dam to be located approximately 400 metres downstream from the current site, pending regulatory and environmental approvals which are currently well underway. Construction will likely commence in 2011.

Summarizing, there is a demand potential for 150-200 MW of new power demand in the NWT as follows:

NICO	10 MW
Yellowknife Gold	10 MW
Prairie Creek	10 MW
Thor Lake	6 MW
Thor Lake Process Plant	10 MW
Tamerlane	30 MW
Gahcho Kue	10 MW
Tundra/Courageous Lake	60 MW

With a possible conversion of existing diesel-power systems by:

Diavik	41 MW
Ekati	30 MW
Snap Lake	20 MW

Concerns and recommendations expressed by Chamber of Mines representatives include:

Reportedly, there is legislation in place precluding the NTPC from investing proactively in new power developments without a franchise agreement with new mines. Considering EA's and feasibility studies completed for the Taltson system expansion, the question has been raised as to whether or not this is an exception to the legislation, and/or this represents an opportunity now for the mining industry.

The current expansion prospects being examined to provide additional power capacity on the current hydro grid system including the proposal to supply diamond mines from Taltson River expansion; expansion of the Bluefish system; and the new Lac La Martre opportunity are insufficient to supply the collective new mining industry demand, and will likely be too late to contribute meaningfully to some of the mine developments that already have had to invest in expensive diesel generating and heat recovery systems. Thus alternative sources of supply are required.

These could include bio-mass power generation or wind turbines, but only if they are integrated with reliable base load generating sources such as hydrocarbon-based systems (diesel or gas), and/or hydro with water storage capabilities.

The currently stranded Mackenzie Delta and Mackenzie Valley Basin gas reserves (and Eagle Plains gas reserves in Yukon) are potentially important resources that could be used to supply energy from a new gas-fired Integrated Combined Cycle Gasification ("IGCC") plant to supplement hydro development where possible.[32] This requires additional study.

Fortune Minerals has provided information on gas plants in Ontario. This indicates a $183 million capital cost to generate 600 MW for an IGCC plant near Milton, Ontario. Research is continuing on the costs and benefits for a 200MW gas plant in the NWT, with attendant transmission to major potential resource projects and nearby communities.

It should be noted that the Russian approach to oil and gas exploration in remote areas is to generate power where discoveries have been made, and transmit electricity to new exploration and development areas. This allows them to use efficient top-drive electric motors on oil and gas exploration drilling rigs and eliminates the need for diesel fuel.

[32] These stranded gas reserves may also provide the option for liquefied natural gas as an alternative to diesel fired generation with regional LNG truck delivery to remote northern communities and resource development sites.

Nunavut Power

Nunavut Power System Overview

On April 1st, 2001, Nunavut Power Corporation assumed ownership of all previously-owned assets of NTCP located in the new territory of Nunavut, and took up the mandate to supply electricity to its communities. Renamed Qulliq Energy Corporation in 2003, this territorial corporation is 100 per cent owned by the Government of Nunavut. It is the only generator, transmitter and distributor of electrical energy in Nunavut.

Qulliq Energy Corporation is incorporated and operates under the Qulliq Energy Corporation Act and its energy pricing is regulated pursuant to the Utility rates Review Council Act. It operates under three trade names;

- Nunavut Power: generates and supplies electricity
- Nunavut Energy Centre: addresses the energy conservation and demand side management mandate, and
- Qulliq Energy: provides core services to corporate functions.

Nunavut Current Power Supply

The corporation generates and distributes power through the operation of twenty-seven stand alone diesel plants in 25 communities, providing mechanical, electrical and line maintenance from three regional centres, and administering the corporation's business activities from a headquarters in Baker Lake and offices in Iqaluit.

All electricity needs in Nunavut are met by imported fossil fuel supplies. Qulliq Energy Corporation is the only energy corporation in Canada without developed local energy resources or regional electricity transmission capability, creating a situation of huge fossil fuel dependency. Each community in Nunavut has its own independent electricity generation and distribution system. There is no back-up grid.

Nunavut - Future Demand Status

In Nunavut, there are additional development projects in the mining sector that will require power.

The new Agnico-Eagle Meadowbank mining operation is generating 28 MW using diesel-powered generation.

Other mines in various stages of planning and development include:

Hope Bay	26 MW
Meliadine	20 MW
Baffinland (2)	45 MW
Kiggavik	22 MW
Izok Lake	30 MW
Hackett River	30 MW

Many other mines are in their infancy, however most of these projects that actually end up in production will require power in the 10 to 30 MW range. An open pit, diesel powered mining operation will require a 50/50 split in fuel consumption between the heavy mining equipment and power generation. Fuel represents some 70% of the total mine re-supply freight, once the mines are operational.

Nunavut has identified several large potential hydro projects with power generation capacity in the 200 MW range which would be suitable as a low cost energy source for future mine development and help make them more competitive in world markets.

See the table below for hydro project potential in Nunavut.

Review of Hydro Availability

River	No. of Sites	Total Capacity
Back River	7	1,100 MW
Thelon River (64N 96W)	*4*	*200 MW*
Dubawnt River (64N 100W)	*5*	*500 MW*
Kazan River (64N 95W)	*3*	*150 MW*
Thlewiaza River	6	75 MW
Tha-anne River	4	40 MW
Maguse River	5	40 MW
Ferguson River	4	20 MW

Nuclear Energy

There is an initiative to sell and install new modular nuclear power plants at remote mining sites. Several companies are looking at these including Hyperion, Dunedin Energy Systems, and Toshiba which has committed financing for a battery installation at Galena, Alaska to demonstrate the technology. The designs are modular and can be constructed to generate 10 MW, an attractive size for many mining sites.

The stigma around nuclear power in the north makes this technology politically and environmentally controversial, but compared to hydrocarbon-based alternatives it may become more acceptable over time. Particularly so if the very availability of secure low-sulphur, low-pour "winter" diesel fuel supply, continues to be an issue in the north!

The proposed nuclear battery installation in Alaska, if shown to be environmentally safe, might allow this to be a future option in the NWT and Nunavut and would present a much more practical and efficient energy system for remote mining sites.

The Chamber of Mines recommends that the public utility mandate in both territories be reviewed and amended as required to allow for proactive investment in new power developments in anticipation of the demand from new mining and hydrocarbon resource ventures. Hydro developments should be promoted where possible, with expansion of the electrical grids, as well as the use of other alternative energy sources such as wind, stranded gas and nuclear.