LOGISTICAL CHALLENGES IN THE ARCTIC

eitan dehtiar

May 24, 2012

CBMU
The Canadian Board of Marine Underwriters

Agenda

- Introduction and background
- Northern transportation landscape
- Conclusions
- Ice road video

Background

- From Bay Street to Yellowknife and back
- Ten years' northern logistics experience
- Designed and managed supply chains for several large scale arctic resource projects
- Currently focussed on arctic development and international logistics projects

SkyLink™ AVIATION INC.

CHURCHILL GATEWAY DEVELOPMENT CORPORATION

Ичалка Баржа 200 р.т. 14-9-52.

Ичалка Баржа 200 р.т. 17/9-52

Leading Aviation Transport & Logistics Service Provider

- Leading transportation and logistics service provider in support of commercial applications, peacekeeping missions, military, humanitarian, and other governmental applications
- Getting people and cargo where they need to go – on time and under any conditions
- Executes "difficult jobs in difficult places" often performing missions in challenging environments
- For over 20 years in more than 75 countries, SkyLink has delivered assistance and support services in the world's most challenging and remote regions

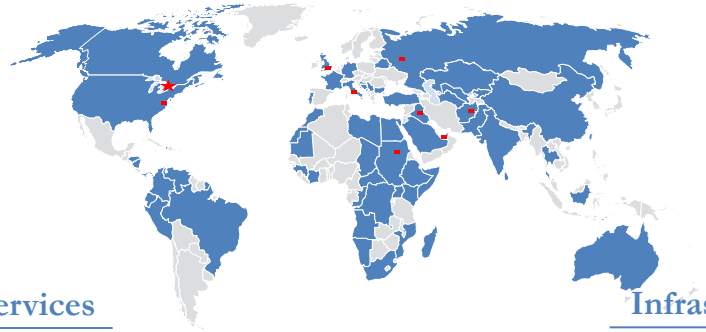
INTERNATIONAL EXPERIENCE – LOCAL EXPERTISE

AVIATION SERVICES	GLOBAL EXPERIENCE	"LAST-MILE" LOGISTICS

To-site

At-site

Fuel Services



★ Head Office (Toronto, Ontario)
▪ Global Office Network

Infrastructure

Logistics

Planning/Admin

Churchill Gateway Development Corp

Established in June 2003

Mission

- To diversify the commodity base
- Increase inbound & outbound traffic
- Ensure sustainability through the northern transportation system

Roles

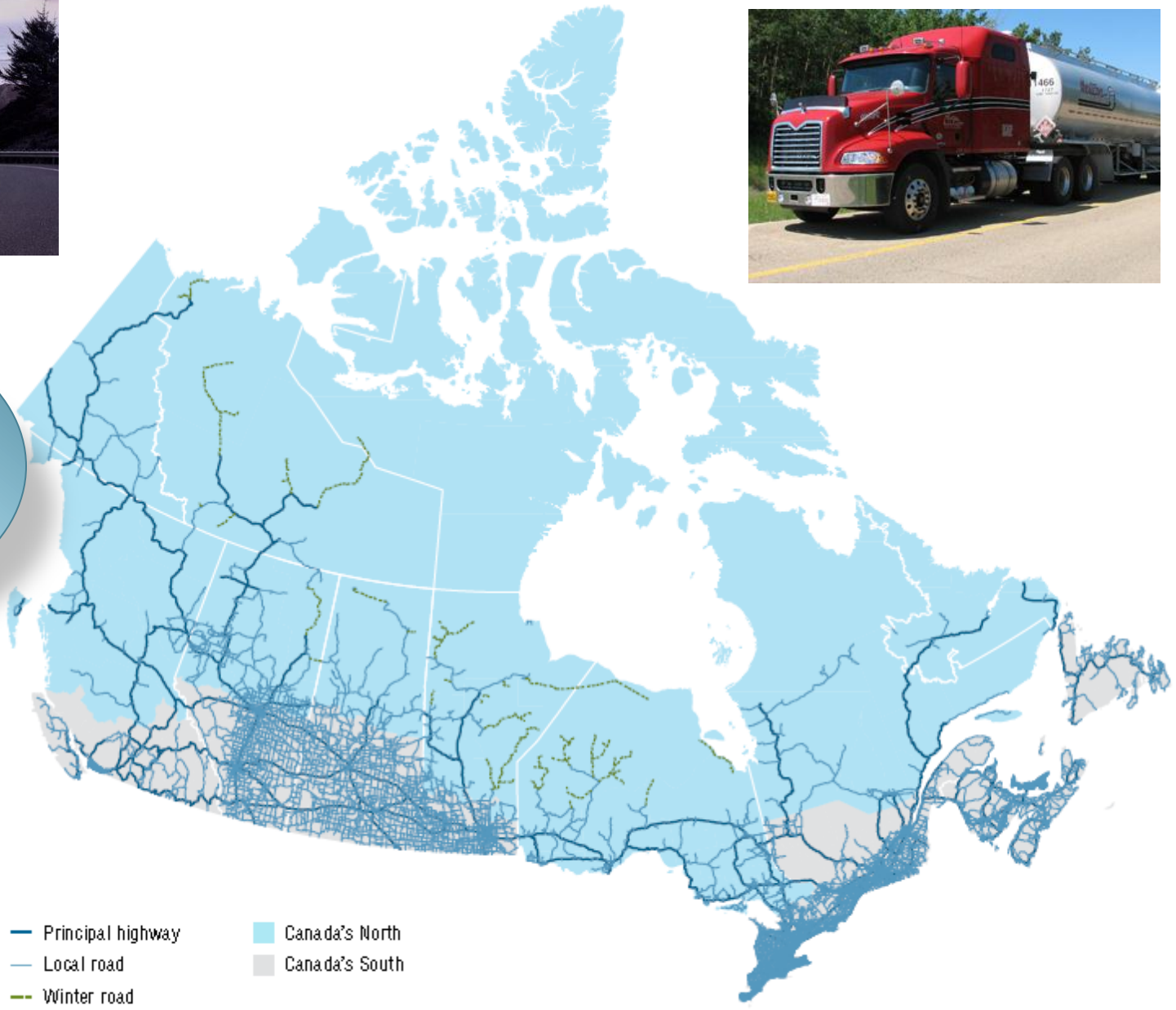
- Marketer of the Corridor
- Facilitates research to identify new commodities

CHURCHILL GATEWAY
DEVELOPMENT CORPORATION

Northern Transportation Landscape

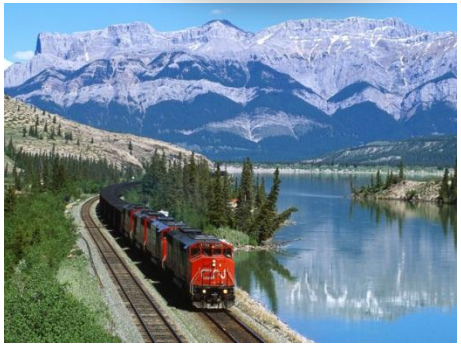
- Limited infrastructure/highway network
- High reliance on air and marine
- New projects often require construction of all supporting infrastructure (rail, road, port)
- Extremely high transportation costs

Road Infrastructure in Canada



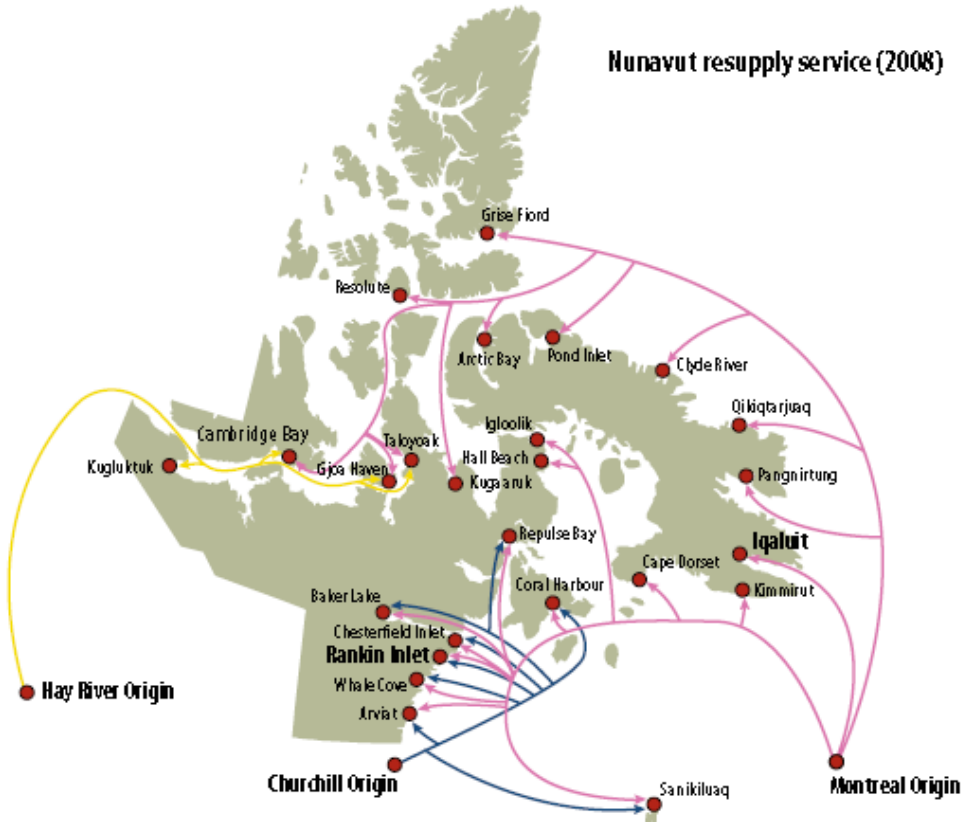
Sources: Golder Associates; The Conference Board of Canada.

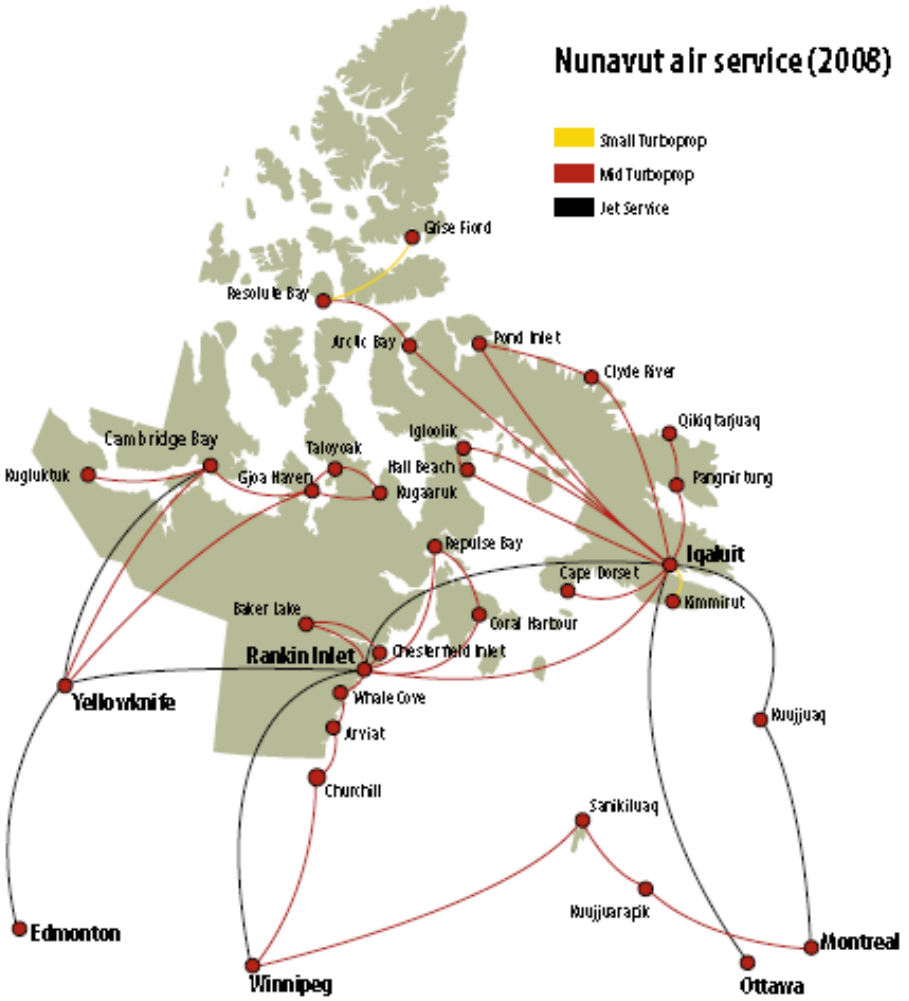
Rail Infrastructure in Canada



Sources: Golder Associates; The Conference Board of Canada.

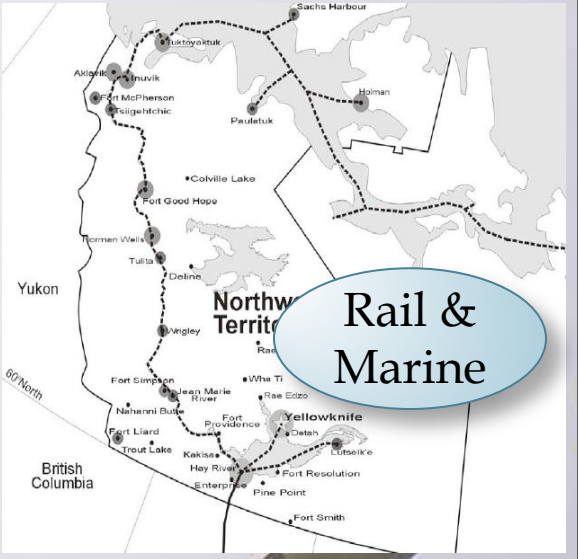
Air & Marine are Critical in the North

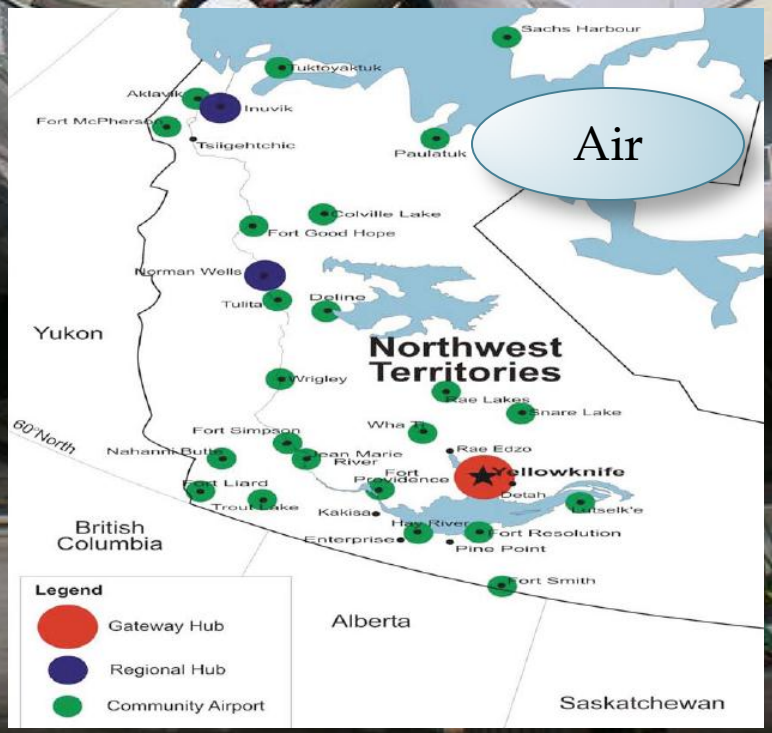


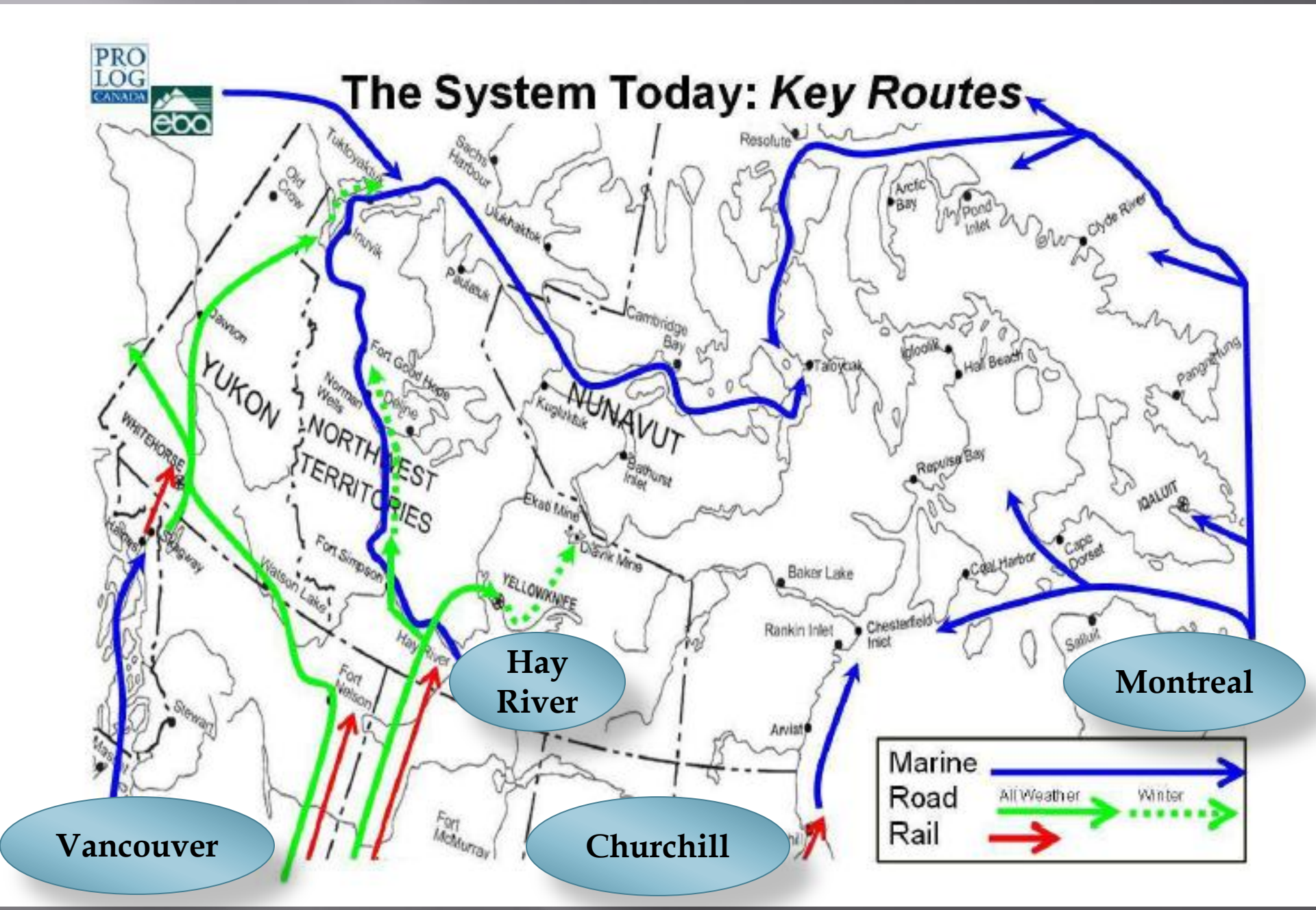


Ingirrasiliqta: Let's Get Moving
Nunavut Transportation Study

NWT Transportation






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

Why is the arctic transportation system so underdeveloped?

- Huge infrastructure gaps
- Limited roads
- Small airports
- Bridges: take a long time to build, expensive

Sample Required Infrastructure

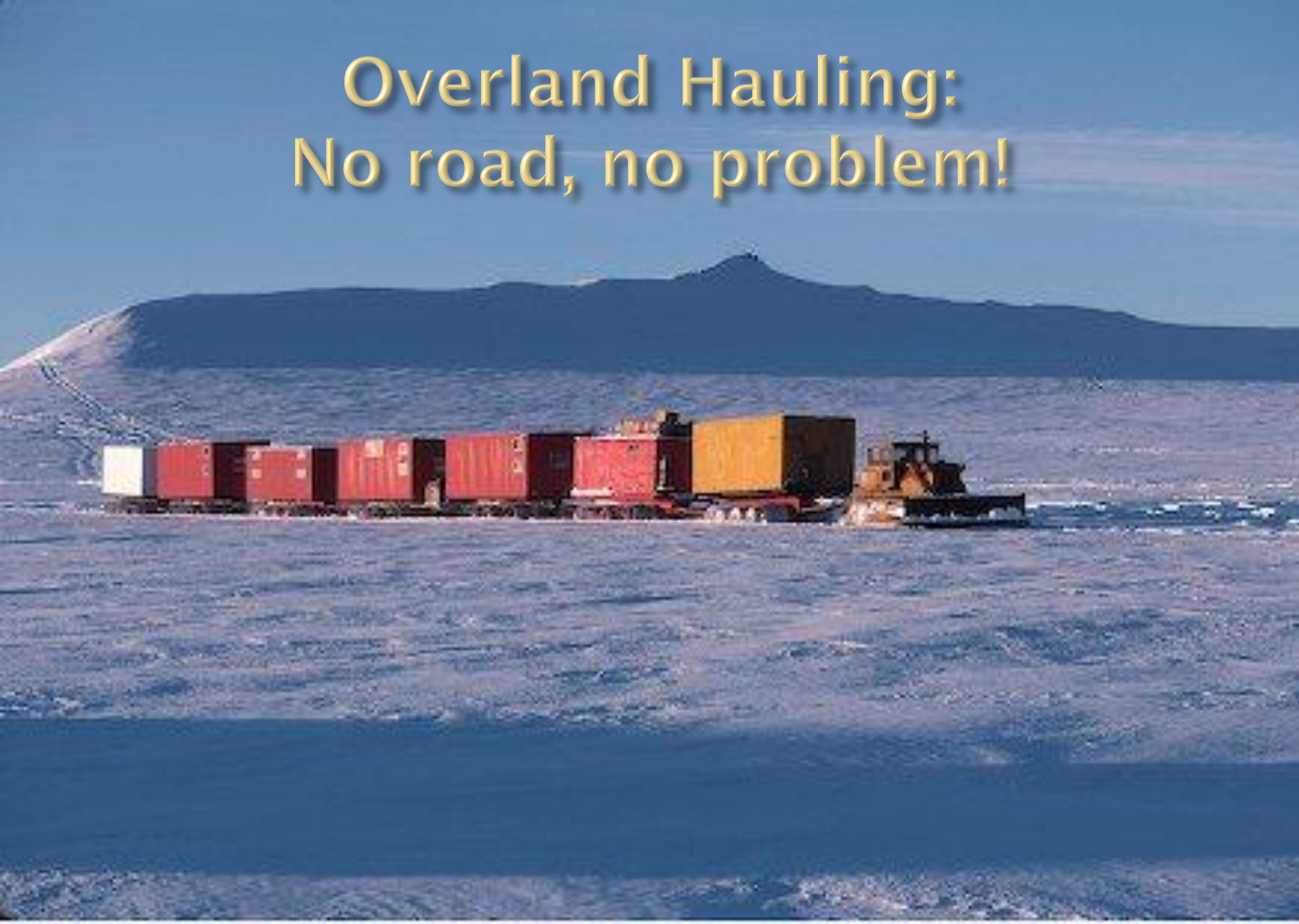
Infrastructure Investment Project	Investment Capital Cost	Internal Rate of Return	Net Present Value	Benefit To Cost Ratio	Pay Back Period
Skagway Mineral Export Terminal	$81 million	40%	$431 million	7 : 1	3 yrs
Canol Corridor Super Load Road	$52 million	20.5%	$209 million	5.4 : 1	7 yrs
Klondike Corridor 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).

Arctic Transportation

- Cat trains/overland hauls
- Winter roads
- All-weather roads
- Limited rail
- Marine
- Air
- Future developments

Overland Hauling: No road, no problem!



Baker Lake, Nunavut

- Overland haul from Baker Lake to various mining exploration camps up to 200km away
- Haul season runs from early January-mid May
- Between 30-100 trips per year at 25,000lbs each
- Low impact flotation tires

Challenges

- No snow!
- Packing the trail
- Blizzards wipe out the trail
- Limited offload capabilities
- Speed – 10km/h
- Freight weight limitation
- Environmental liability
- 5 months/year operation
- Terrain rough on equipment
- Alternative - fly using ice strip

Winter Roads

- Driver shortages (ramp up for only 2 months)
- Service to locations which may otherwise not be economical to service
- Expensive annual construction and maintenance costs
- Short operating season; climate change means increased variability and uncertainty – this significantly impacts operating plans
- For most of the year, projects serviced by winter roads are limited to air support; high cost of emergency response and poor planning
- Cash flow – materials must be purchased at one time vs. throughout the year, and significant storage capacity required at site

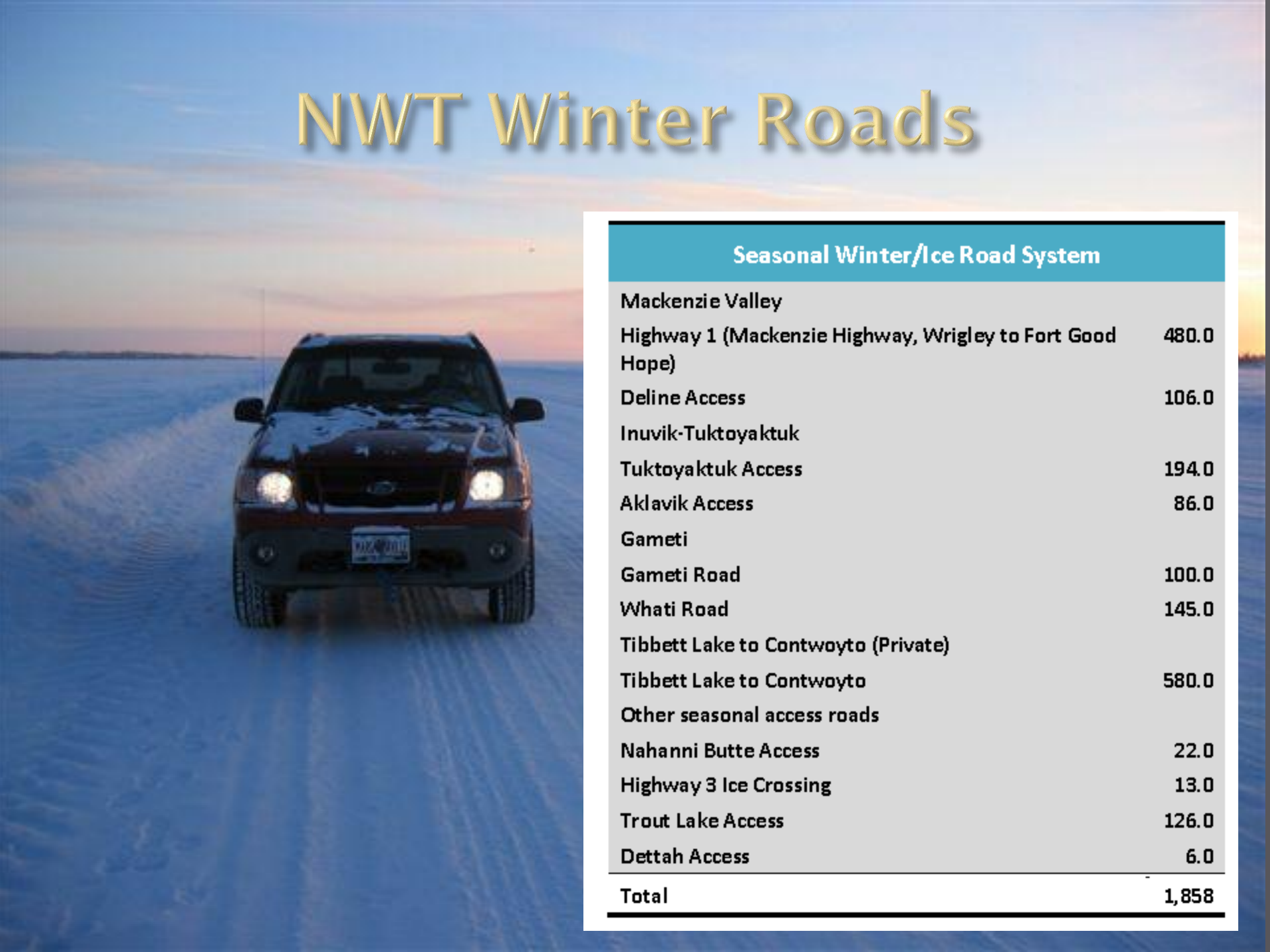
Critical Resupply

- Fuel
- Construction materials
- Tires
- Oversized freight
- Mine resupply materials
- AN, calcium chloride, etc.

Where's my stuff?

A year's worth of materials arrives in a 60 day window, at -40 and with regular blizzards!

NWT Winter Roads



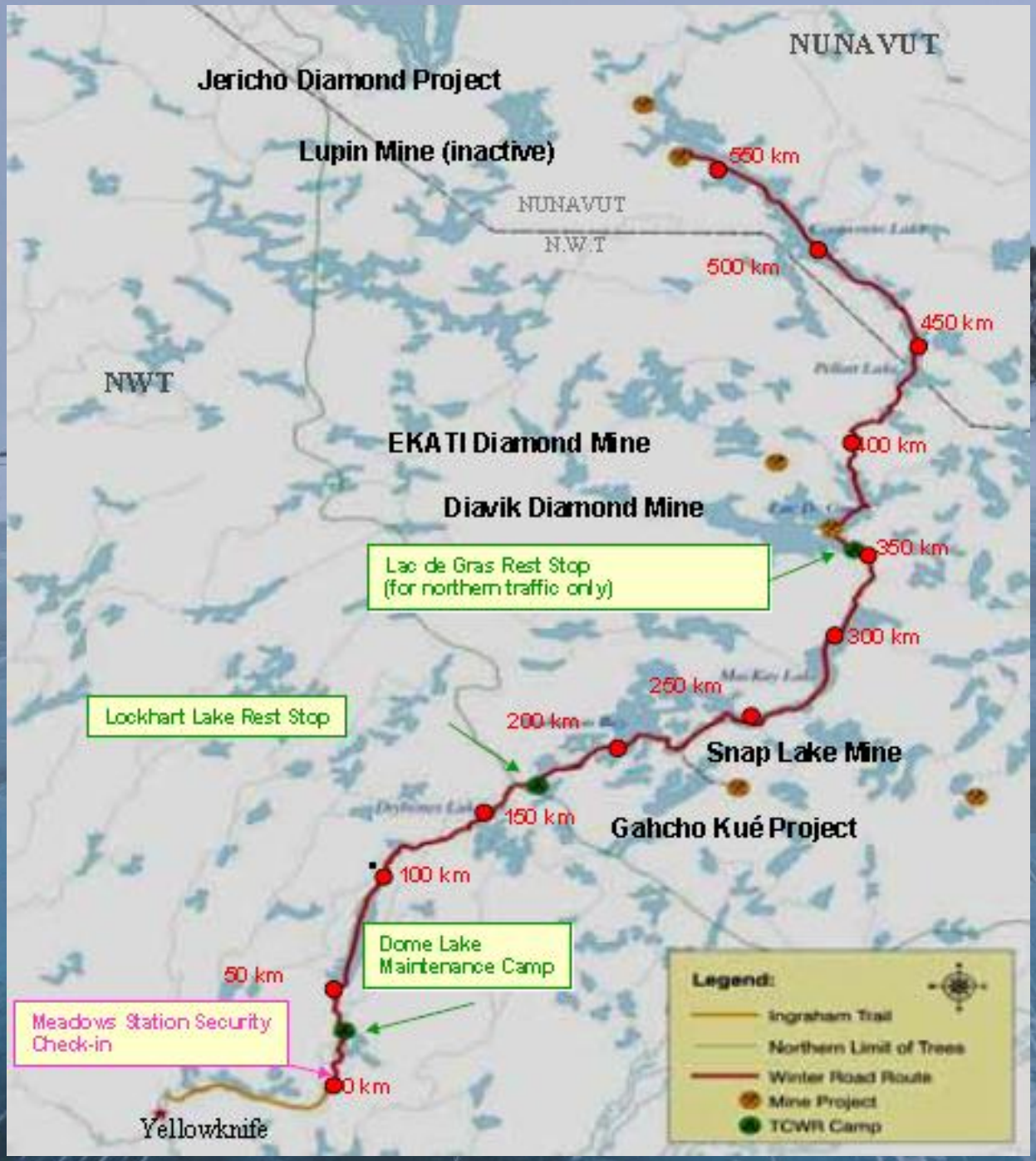
Seasonal Winter/Ice Road System	
Mackenzie Valley	
Highway 1 (Mackenzie Highway, Wrigley to Fort Good Hope)	480.0
Deline Access	106.0
Inuvik-Tuktoyaktuk	
Tuktoyaktuk Access	194.0
Aklavik Access	86.0
Gameti	
Gameti Road	100.0
Whati Road	145.0
Tibbett Lake to Contwoyto (Private)	
Tibbett Lake to Contwoyto	580.0
Other seasonal access roads	
Nahanni Butte Access	22.0
Highway 3 Ice Crossing	13.0
Trout Lake Access	126.0
Dettah Access	6.0
Total	1,858

Sample Winter Road Construction & Maintenance Costs

CONSTRUCTION AND MAINTENANCE COSTS FOR WINTER ROADS**	
Crossing Type	Construction and Maintenance Cost for One Season ($/km)
Compacted snow road	$35,000 per km
Compacted snow road with an ice cap	$25,000 to 41,000 per km
Floating ice road with overland portages	$22,000 per km
** Areva Kiggavik Project (Nunavut) Environmental Impact Statement - December 2011	
This project requires a 103km winter road - $2.5-$4million annual cost (January-April hauling)	
De Beer's Ontario's Victor Mine: 415km winter road; annual construction cost $5million, total annual cost $12million, half the hauling season of the Areva road	

Tibbitt to Contwoyto Winter Road

- ***Point of origin:*** 70 km north of Yellowknife, NWT
- ***Original purpose***: supply Lupin Gold Mine at Contwoyto Lake Nunavut Territory
- ***Length***: 600 km to Lupin with 87% of route over lake ice, 15% land portages
- ***Width:*** 50 metres on lakes; narrower on portages (12-15 metres)
- ***Ice thickness:*** Can support light vehicle loads at 70 cms; increasing to full highway truck loads as ice thickens, often exceeding 107 cms
- ***Speed limits on ice***: Loaded trucks - 25 km/hr, with some areas 10 km/hr; empty trucks – 60-70 km/hr on "Express Lanes" – which are return (southbound lanes) built on larger lakes
- ***Speed limits on land (portages)***: 30 km/hr, must slow to 10 km/hr on/off portage
- ***Number of Portages:*** 64 located along the route,
- ***Maintenance Camps:*** 3 camps that can accommodate 49 personnel each are located at Dome Lake, Lockhart Lake and Lac de Gras
- ***Manager:*** Joint Venture Management Committee (JVMC) comprised of BHP Billiton Diamonds Inc., Diavik Diamond Mines Inc. and DeBeers Canada Inc.
- ***Road Constructor:*** Nuna Logistics Ltd (main route), RTL Robinson Enterprises Ltd. (secondary route) contracted by the JVMC
- ***Engineering:*** TetraTech (previously EBA Engineering)


NUNAVUT
Jericho Diamond Project
Lupin Mine (inactive)
550 km
NUNAVUT
N.W.T
500 km
450 km
NWT
EKATI Diamond Mine
400 km
Diavik Diamond Mine
350 km
Lac de Gras Rest Stop
(for northern traffic only)
300 km
250 km
Lockhart Lake Rest Stop
200 km
Snap Lake Mine
150 km
Gahcho Kué Project
100 km
Dome Lake
Maintenance Camp
50 km
Meadows Station Security
Check-in
0 km
Yellowknife
Legend:
Ingraham Trail
Northern Limit of Trees
Winter Road Route
Mine Project
TCWR Camp

Tibbitt to Contwoyto Winter Road Annual Volumes

Year	Operating Period	Total Tonnes Hauled (northbound)	Number of Truckloads (northbound)	Tonnes per Northbound Truckload	Number of Backhauls (southbound)
2001	Feb 1 – Apr 13	245,586	7,981	30.77	201
2002	Jan 26 – Apr 16	256,915	7,735	33.21	433
2003	Feb 1 – Apr 2	198,818	5,243	37.92	883
2004	Jan 28 – Mar 31	179,144	5,091	35.19	165
2005	Jan 26 – Apr 5	252,533	7,607	33.20	243
2006	**Feb 5 – Mar 26***	**177,674**	**6,841**	**25.97**	**469**
2007	Jan 27 – Apr 9	330,002	10,922	30.21	818
2008	Jan 29 – Mar 31	245,585	7,484	32.81	890
2009	Feb 1 – Mar 22	173,195	4,847	35.73	530
2010	Feb 4 - March 21	120,020	3,508	34.21	429
2011	Jan 28 - March 31	239,000	6,832	34.98	530

***Road shut down early due to thin ice; approx 1,200 loads flown to mines in summer/fall of 2006**

The cost of an early thaw

- Russian aircraft mobilized due to limited local lift capacity
- Equivalent of 1,200 truck loads flown to the NWT diamond mines
- Significantly higher cost
  - Mi-26 @$20,000/hr+ fuel, Hercules @ $12,000/hr+fuel
- 24-7 operation
- “One more year like this and we would have to evaluate shutting down”

The cost of trying to get an early start

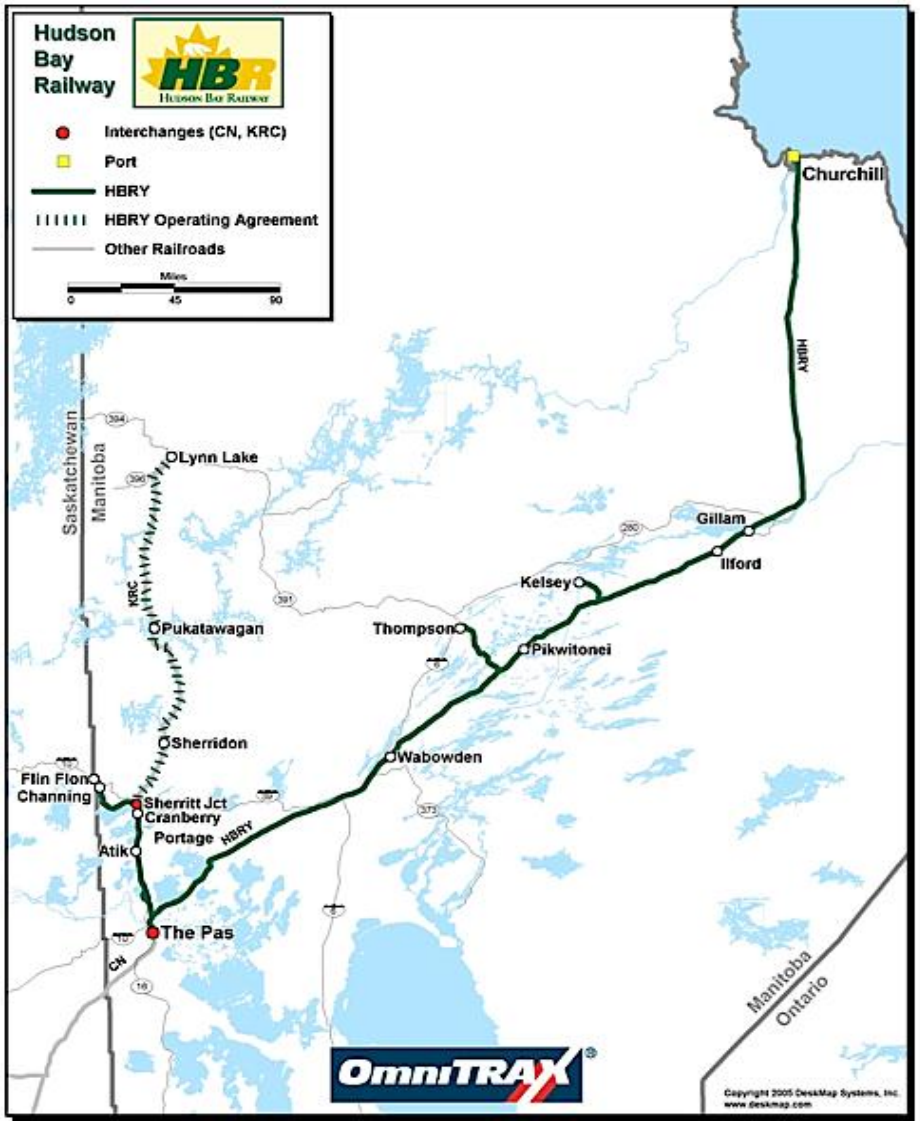
Extending the Season

- Light loads early;
- Flooding winter roads to thicken ice structure;
- Monitoring ice sheet thickness with ground penetrating radar;
- Plowing snow off the road enhances the freezing effect (snow has an insulating effect); and
- Restricting hauling to hours of darkness towards the end of the season when the ice sheet is stronger.

All-Weather Roads

- 108 KM road from Baker Lake to Meadowbank is the longest road in Nunavut
- Estimated cost of $100,000,000
- Dedicated road – expensive to operate and maintain
- Increased flexibility and longer hauling window than winter roads, but similar challenges in Nunavut where marine is primary resupply source
- Environmental and permitting considerations

Rail


Hudson Bay Railway
HBR
Hudson Bay Railway
Interchanges (CN, KRC)
Port
HBRY
HBRY Operating Agreement
Other Railroads
Miles
0
45
90
Churchill
HBRY
Saskatchewan
Manitoba
Lynn Lake
KRC
Pukatawagan
Gillam
Ilford
Kelsey
Thompson
Pikwitonei
Sherridon
Wabowden
Flin Flon
Channing
Sherritt Jct
Cranberry
Portage
Atik
The Pas
CN
Manitoba
Ontario
OmniTRAX
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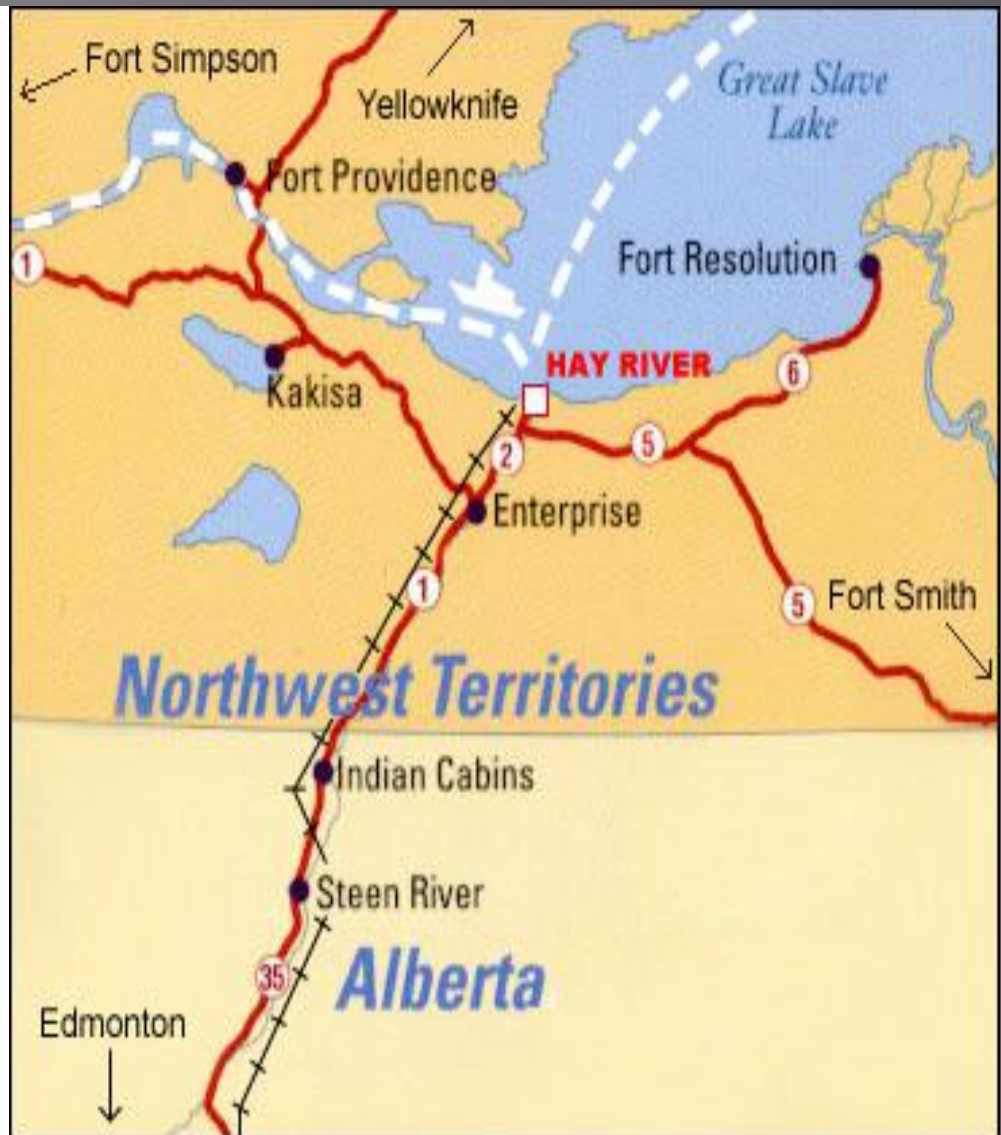
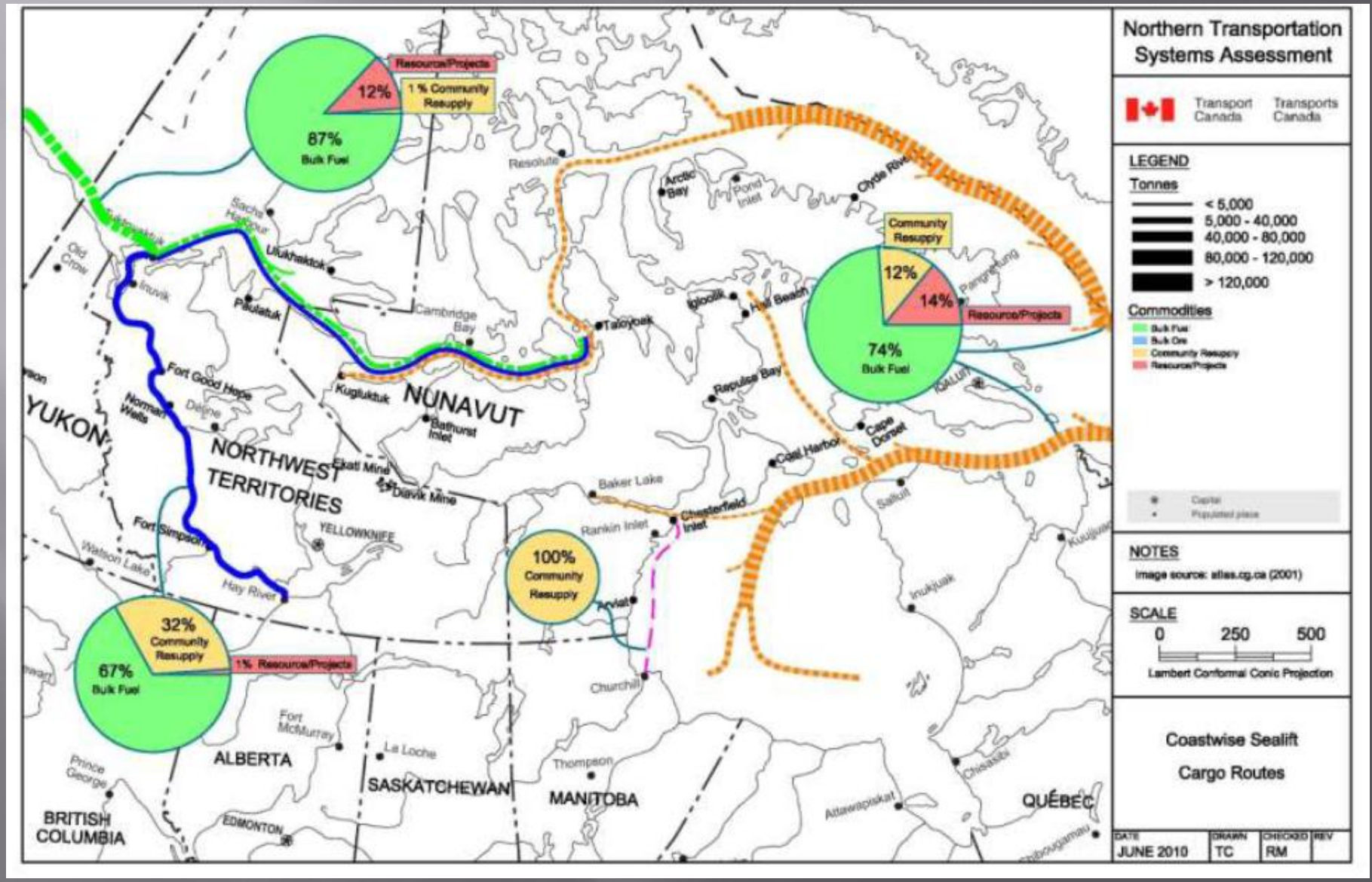

Fort Simpson
Yellowknife
Great Slave Lake
Fort Providence
Fort Resolution
1
Kakisa
HAY RIVER
6
2
5
Enterprise
1
5
Fort Smith
Northwest Territories
Indian Cabins
Steen River
35
Alberta
Edmonton

Northern Sealift

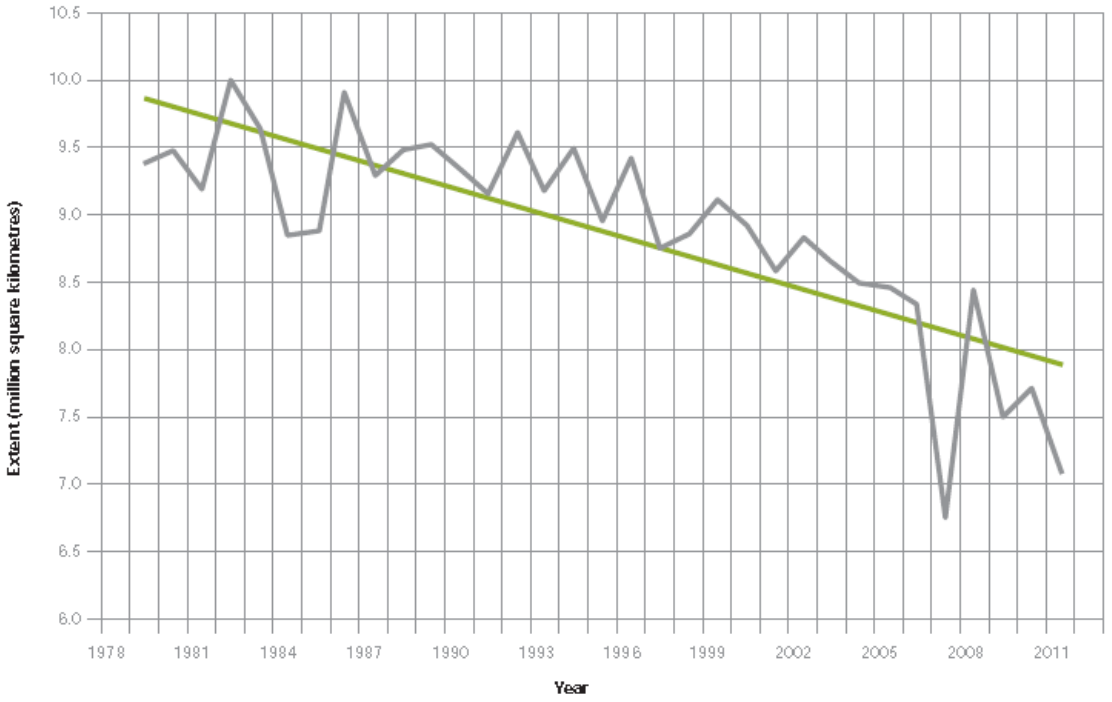
- Yukon has access to 3 ports that are ice-free year round
- Many NWT and all Nunavut communities rely entirely on annual sealift for fuel and annual resupply materials
- Arctic communities are serviced from the following ports:
  - Churchill, Manitoba
  - Hay River, NWT
  - Montreal, Quebec (Valleyfield, Becancour)

Sealift Distribution



Changes in Sea Ice

Figure 3. Decline in average sea ice extent in September, 1979-2011



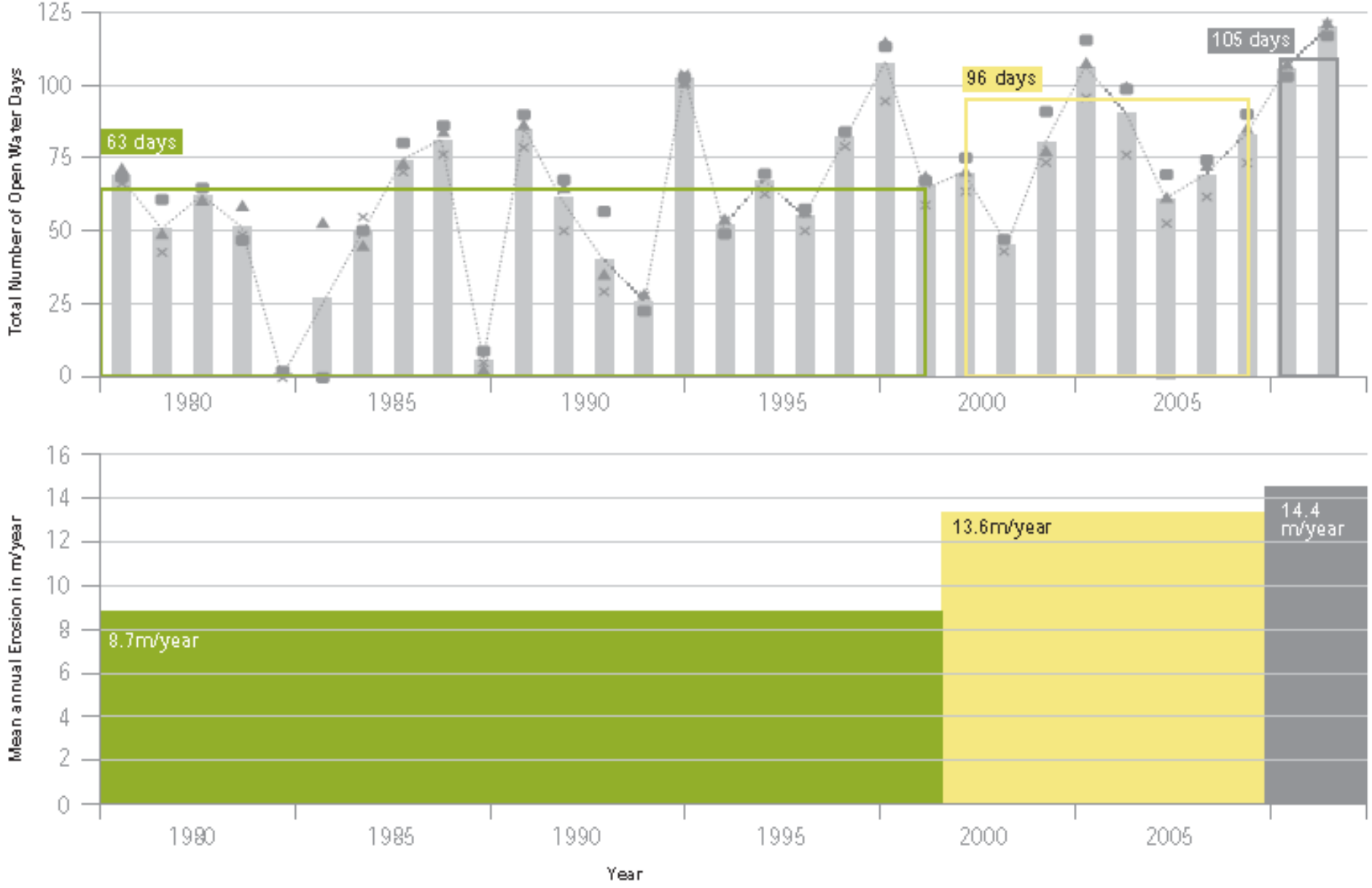
Source: National Snow and Ice Data Centre

* United Nations Framework Convention on Climate Change.

Route	Length (km)	% accessible, 2000-2014	% accessible, 2045-2059	Accessibility change (%) relative to baseline	Transit time (days), 2045-2059
Northwest Passage	9,324	63%	82%	+30%	-
Northern Sea Route	5,169	86%	100%	+16%	11
'North Pole' Route	6,960	64%	100%	+ 56%	16
'Arctic Bridge'	7,135	100%	100%	+ 0%	15

Source: Reprinted by permission from Macmillan Publishers Ltd (Nature Climate Change) 'Divergent long-term trajectories of human access to the Arctic', Copyright 2011 ®

Figure 5. Increase in average number of ice-free days in the Beaufort Sea compared to rates of coastal erosion



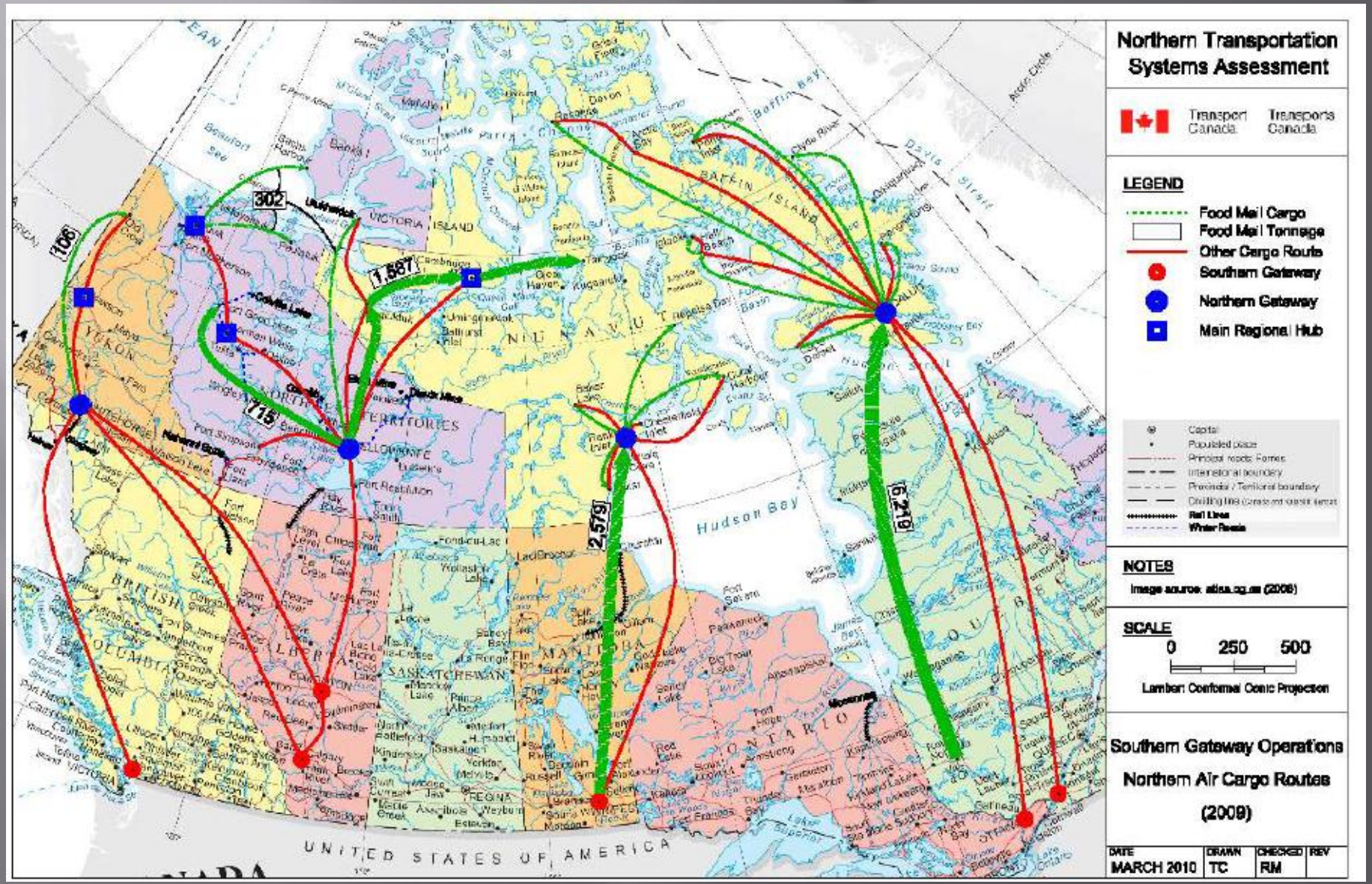
Source: National Snow and Ice Data Center - courtesy of Irina Overeem, University of Colorado[19]

The danger of planning based on last year's weather

Iqaluit Marine Offload

Limited offloading facilities

Northern Air Cargo Routes



Northern Aviation

- Hubs often congested
- Short, gravel runways
- Few arctic-ready aircraft available
- Weather always an issue

Not just weather

Challenging Landings

ICE STRIPS

- Resource industry

GRAVEL RUNWAYS

- Most communities and mines

Air Freight: Resource Industry

Operating Mines – Northern Canada

Air Cargo Re-supply[14]

Mine	Point of Origin	Annual Air Cargo (tonnes)
Diavik (diamonds), NWT	Yellowknife	2,700
Snap Lake (diamonds), NWT	Yellowknife	1,900
Ekati (diamonds), NWT[15]	Yellowknife	3,476
Meadowbank (gold), Nunavut	Thompson, Man.	1,264
Cantung (tungsten), NWT[16]		Nil
Wolverine (copper, zinc), Yukon		nil
Minto (copper), Yukon[17]	Whitehorse	260

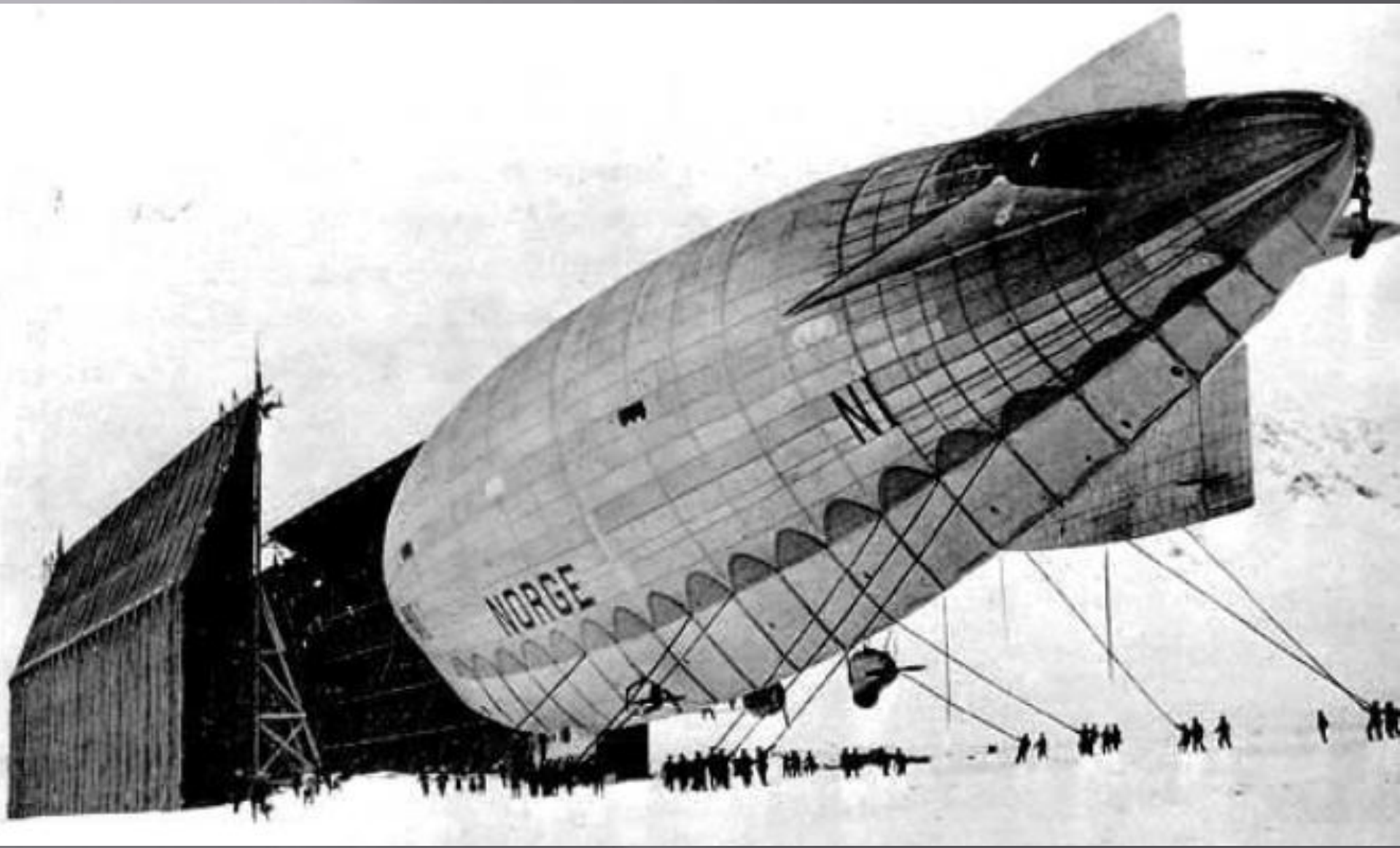
Northern Air Cargo Flows (tonnes)

Gateway	Destination	2009			Forecast	
		Food Mail	Gen Cargo	Total	2020	2030
Nunavut						
Iqaluit	Baffin	6,219	4,146	10,365	15,952	23,622
Rankin Inlet	Kivalliq	2,579	1,719	4,298	6,615	9,795
Yellowknife	Kitikmeot	1,587	1,058	2,645	4,071	6,028
		10,385	**6,923**	**17,308**	**23,638**	**39,445**
NWT						
Yellowknife & Inuvik	Beaufort-Delta	302				
Yellowknife	Sahtu	715				
Yellowknife	Great Slave Lake	3				
Fort Simpson & Hay River	Deh Cho	0				
		1,020	**680**	**1,700**	**2,353**	**3,162**
Yukon						
Whitehorse	Yukon	**106**	**950**	**1,056**	**1,178**	**1,301**

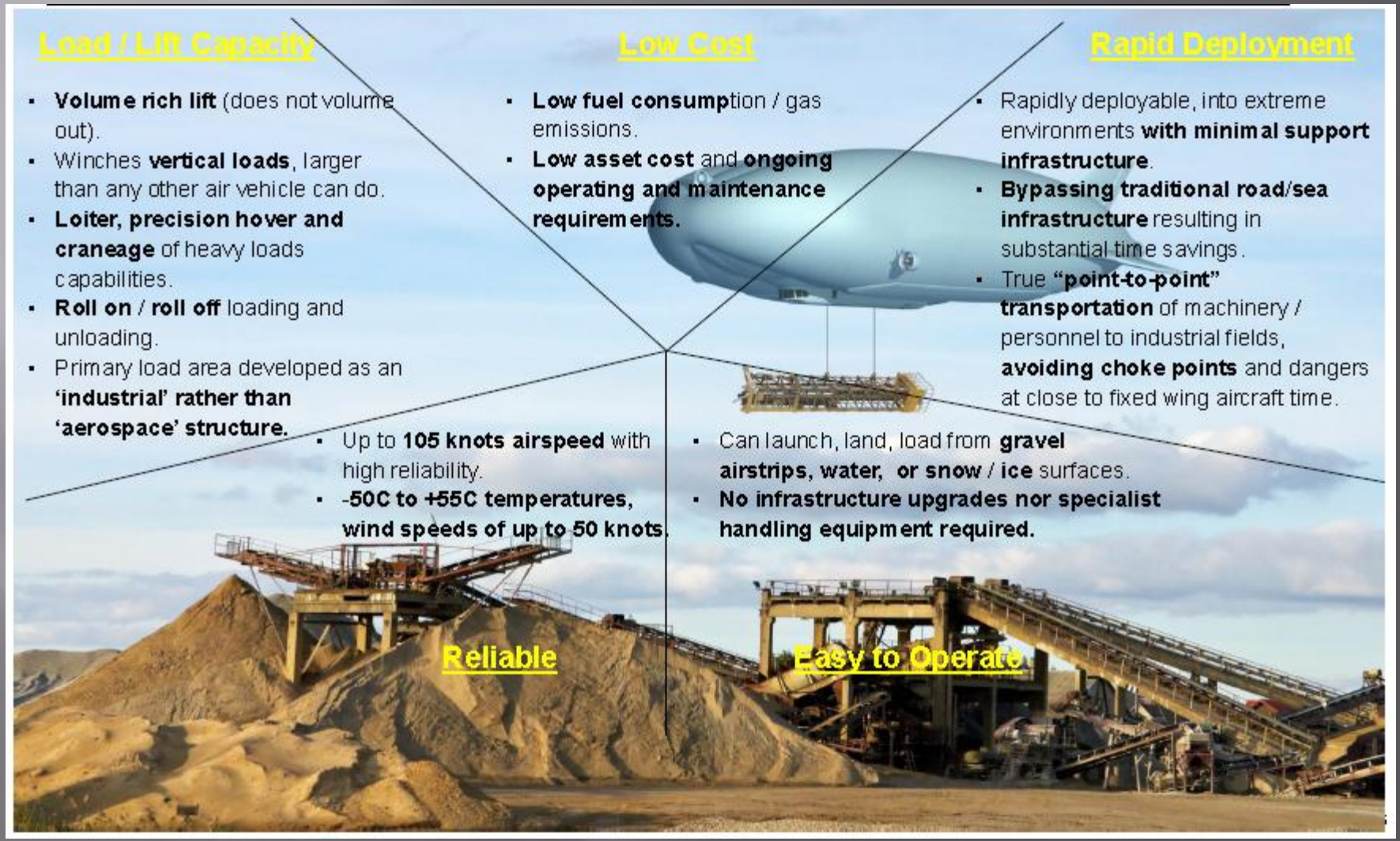
In the Arctic….

- Everything old is new again

Logistics solutions for the future?

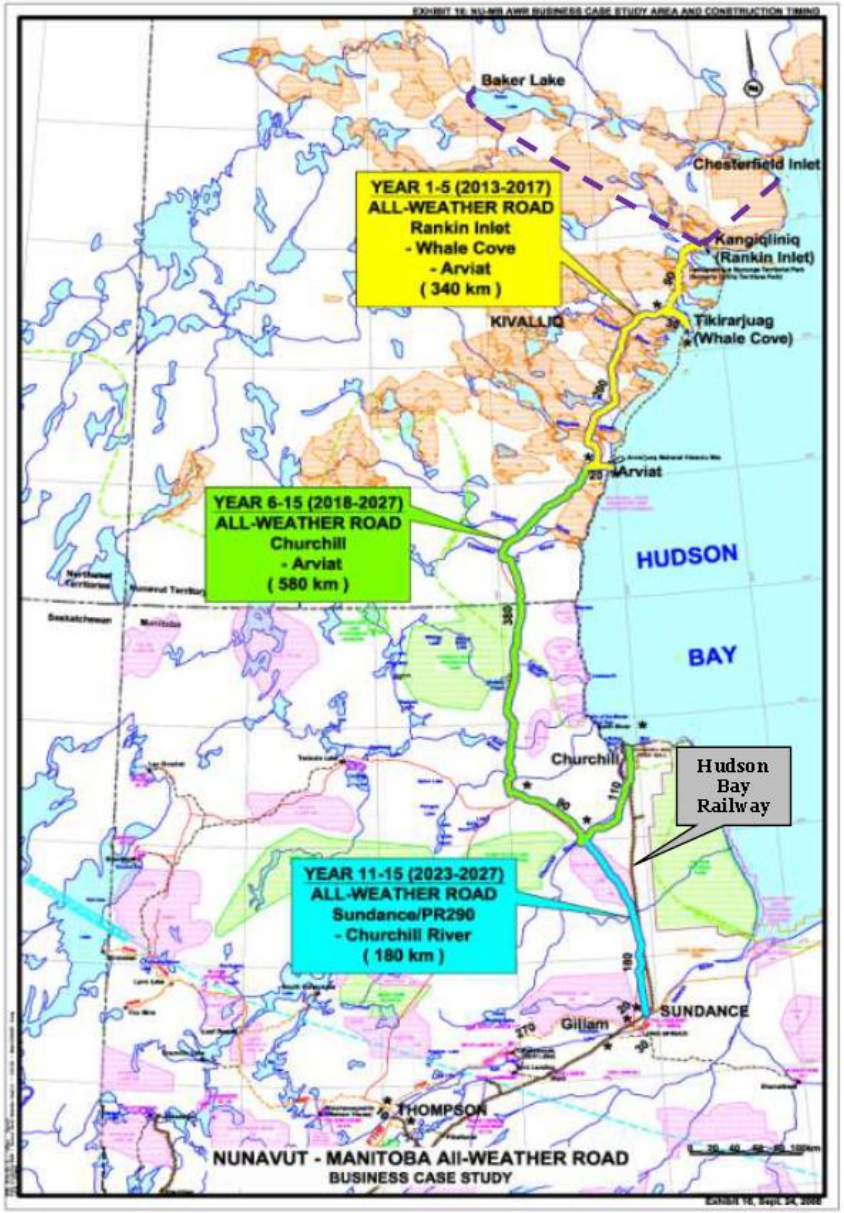


Heavy Airlift



The Future?

Manitoba Corridor



Arctic Bridge Between Churchill and Murmansk

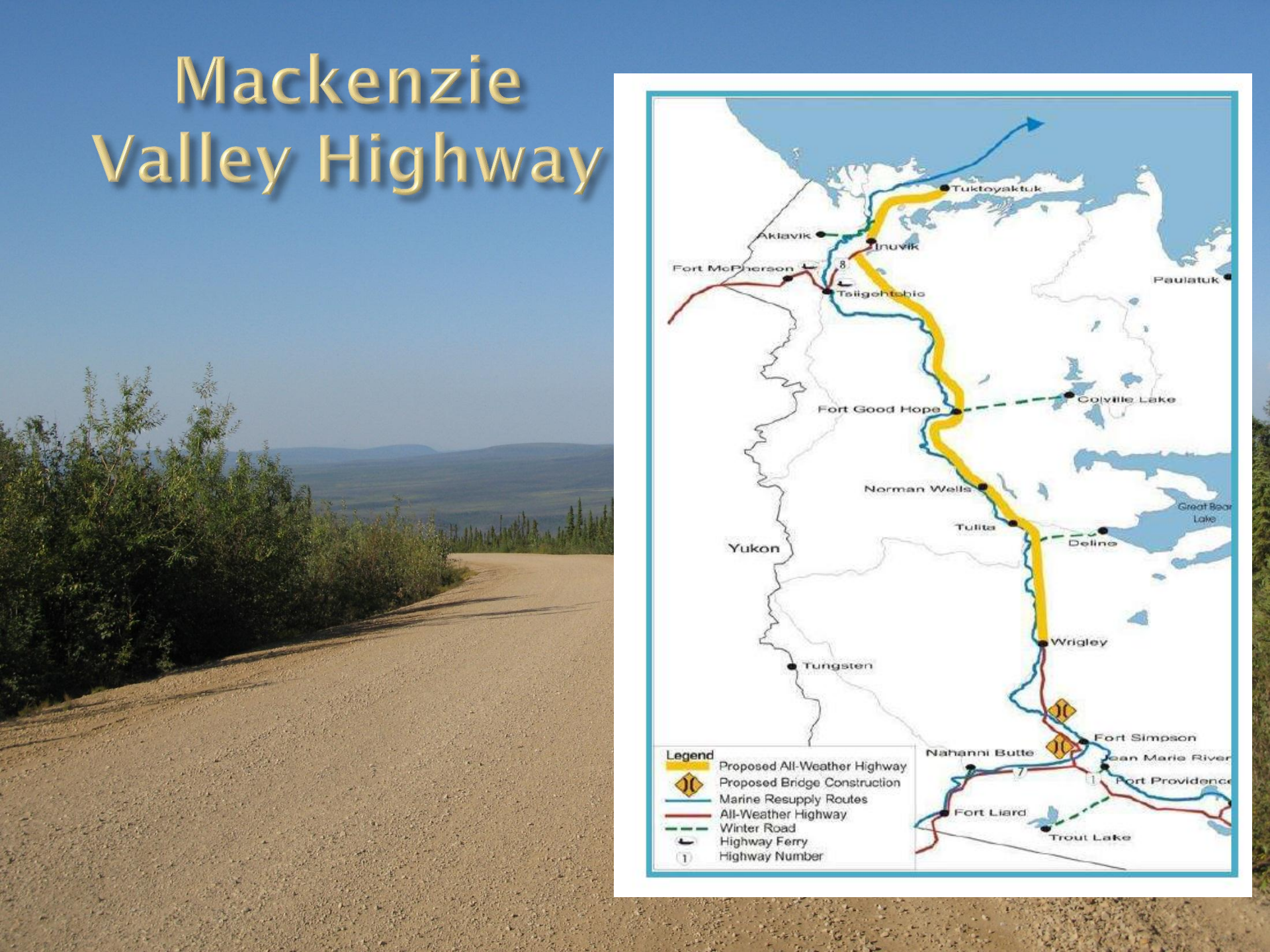
Sources: Government of Manitoba; The Conference Board of Canada.

Distance to European Ports, Port of Churchill vs. Port of Thunder Bay
(nautical miles)

	Distance from Churchill	Distance from Thunder Bay	Savings in distance
Rotterdam	3,344	4,325	981
Murmansk	3,763	5,210	1,447
Liverpool	2,992	4,035	1,043
Oslo	3,370	5,368	1,998

Source: Churchill Gateway Development Corporation.

Mackenzie Valley Highway



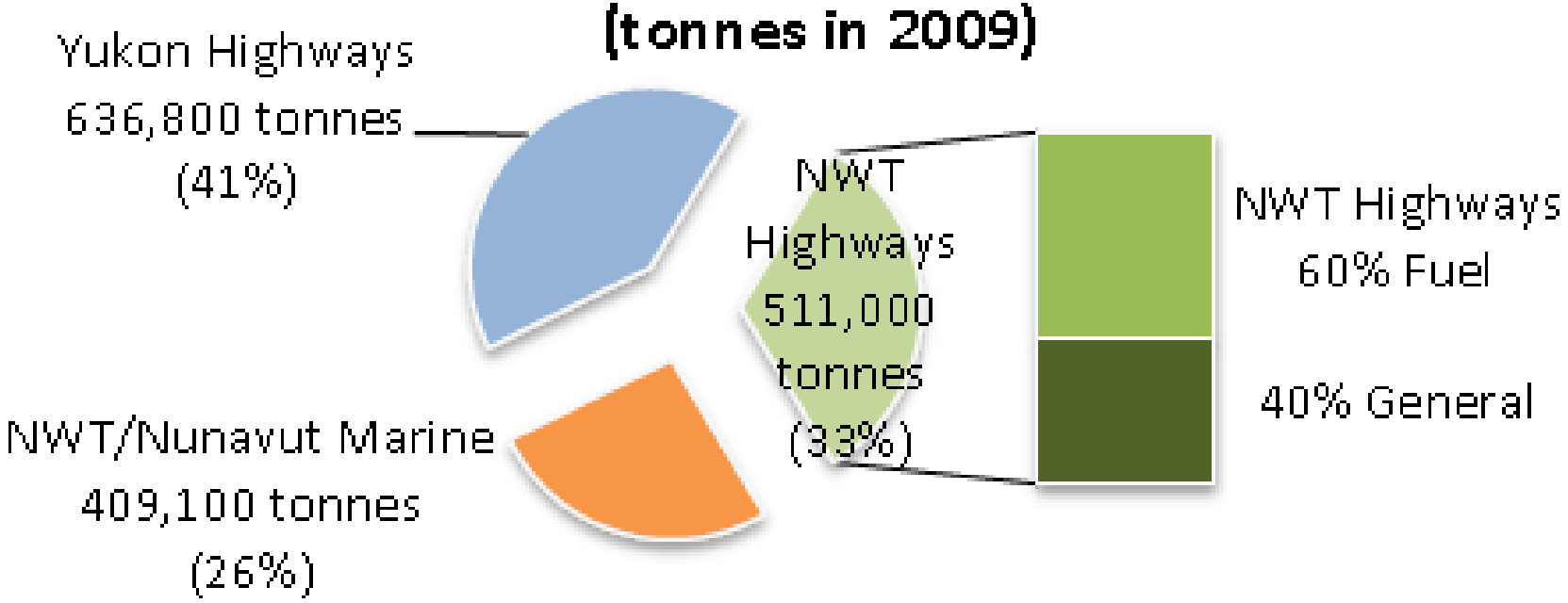
Northern Transportation Systems Demand (Tonnes in 2009)

Northern Transportation System	Community Resupply General	Resource Projects General	Bulk Fuel Supply	Total Inbound Tonnes
Eastern Sealift	54,500	39,100	139,900	233,500
Western Sealift	3,700	3,800	59,000	66,500
Mackenzie River	8,900	3,900	26,200	39,000
Hudson Bay	4,300	27,300	38,500	70,100
Inside Passage*	*59,400*	*24,100*	*64,000*	*147,500*
Yukon Highways	371,000	143,900	121,900	636,800
NWT Highways	163,000	48,000	300,000	511,000
TOTAL INBOUND	605,400	266,000	685,500	1,556,900
Northern Air Cargo				20,000
Resource Exports				54,000
TOTAL TONNES				**1,630,900**

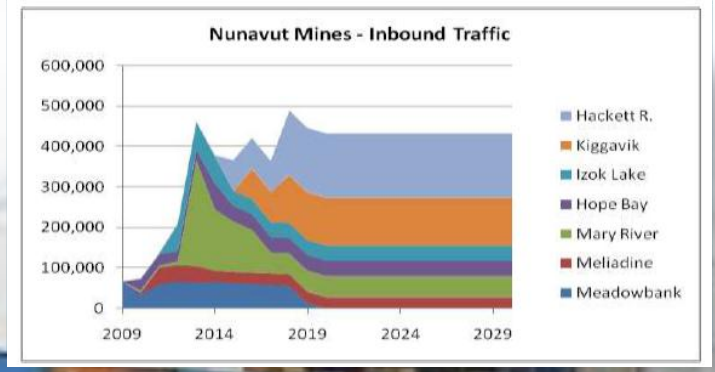
* Inside Passage Tonnes are included in Yukon Highways Tonnes and excluded from Total Tonnes.

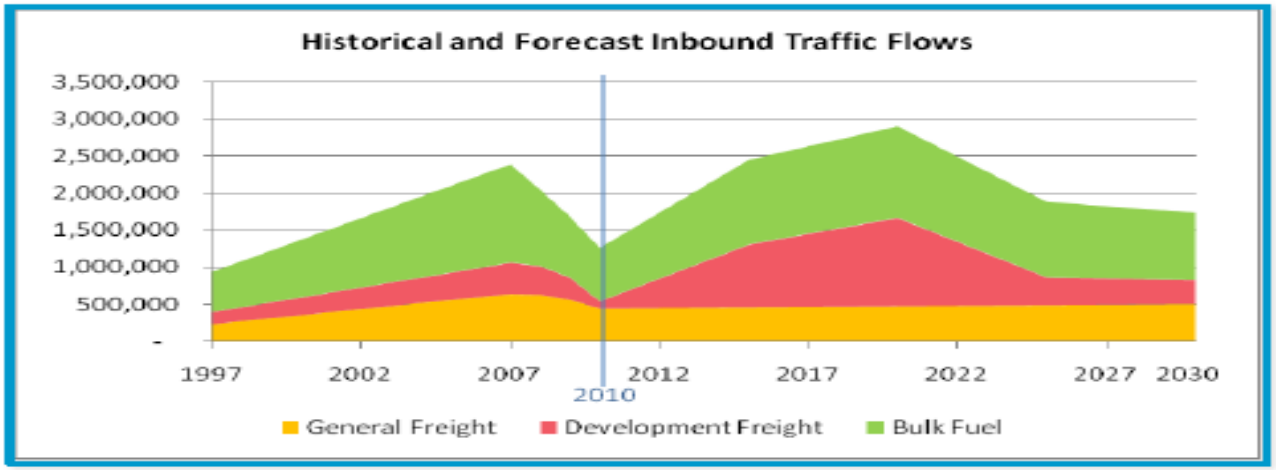
Current Inbound Freight Traffic Split

(tonnes in 2009)



Future Northern Cargo Trends

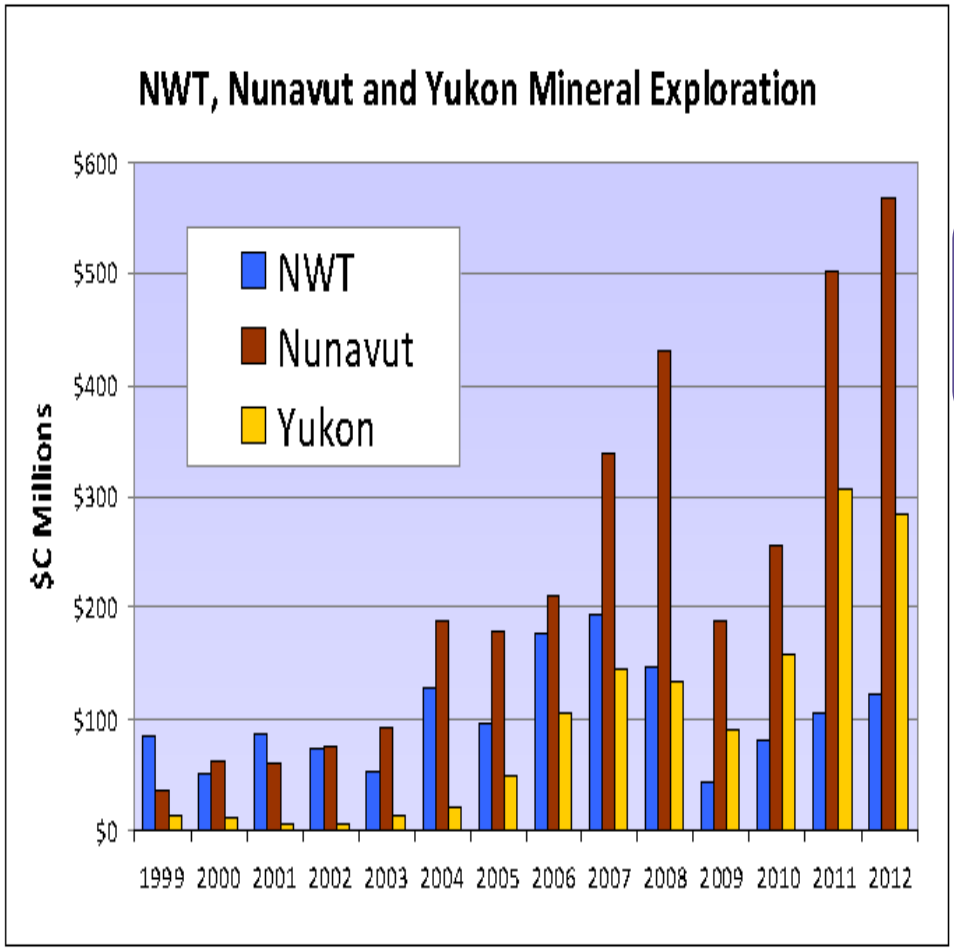


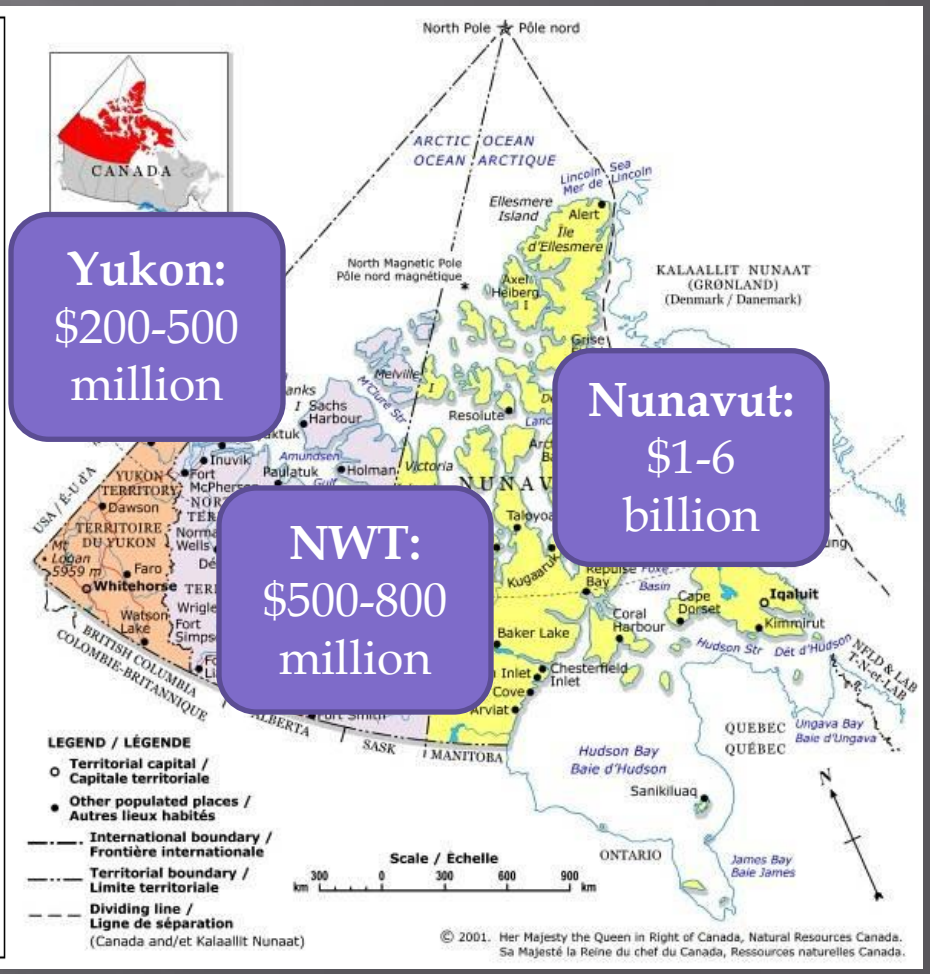


Impact of Mining Developments

Development Driven Increasing Demand (2006 to 2009)		
Region	*Development*	*Market Increase*
Qikiqtaaluk	Mary River Mine	53% increase
Kivalliq	Meadowbank Mine	46% increase
Kitikmeot	Hope Bay Mine	418% increase

Exploration Spending & Mine Construction Costs





The Mary River Project

ArcelorMittal

1. Mine

2. Land Transport

3. Shipping

4. Infrastructure

Northern Transportation

Climate Change

Rising temperature

⇩

Less ice

⇩

More traffic

BUT

Increased hazards

Loose ice, ships running aground, oil spills, etc.

Resource Development

Abundance of minerals

⇩

International interest

BUT

Volatile commodity prices mean high risk

Re-supply

Population growth

+

Resource development

⇩

Challenge existing infrastructure

Need easier and safer loading and unloading


Thank you!
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