

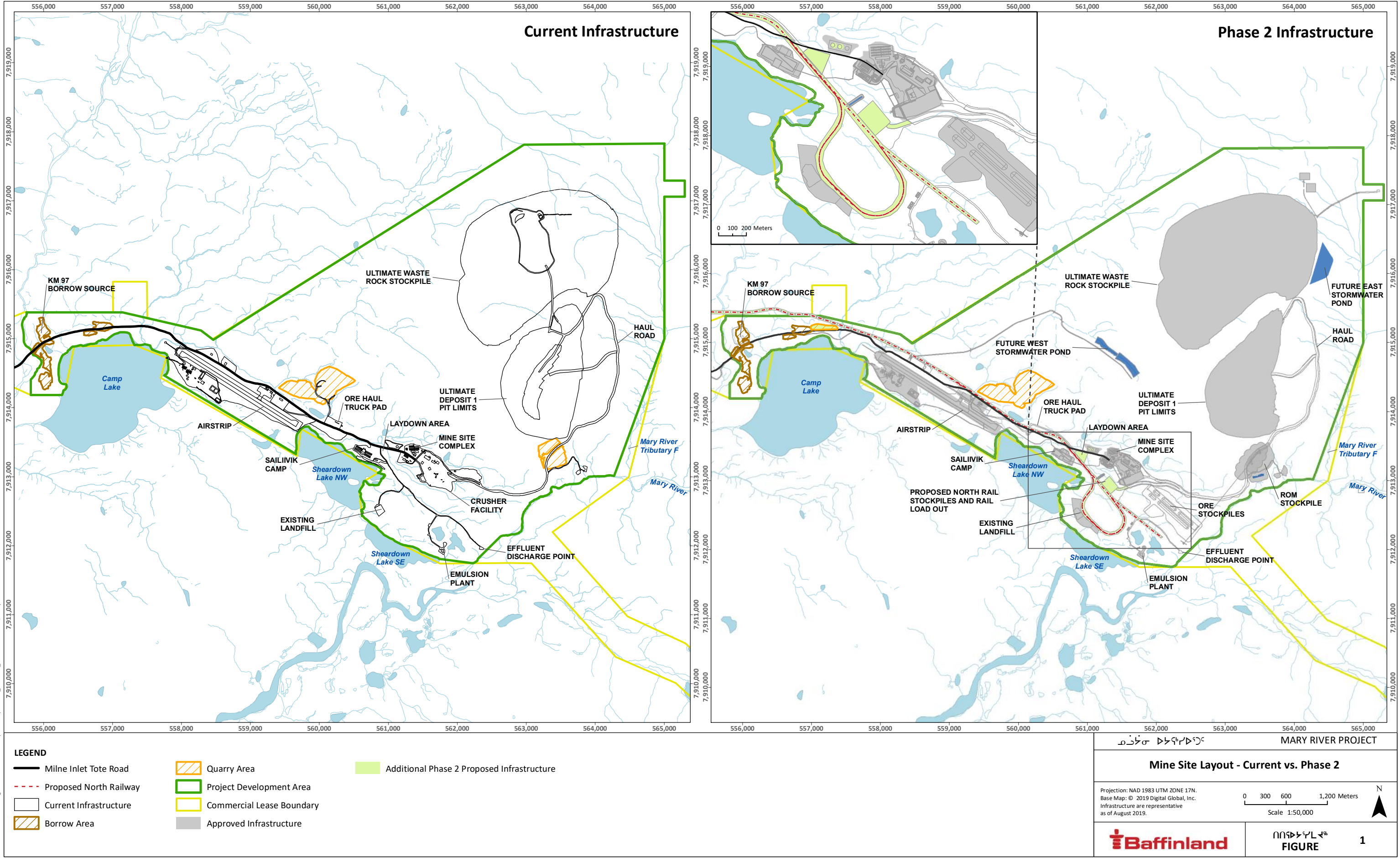


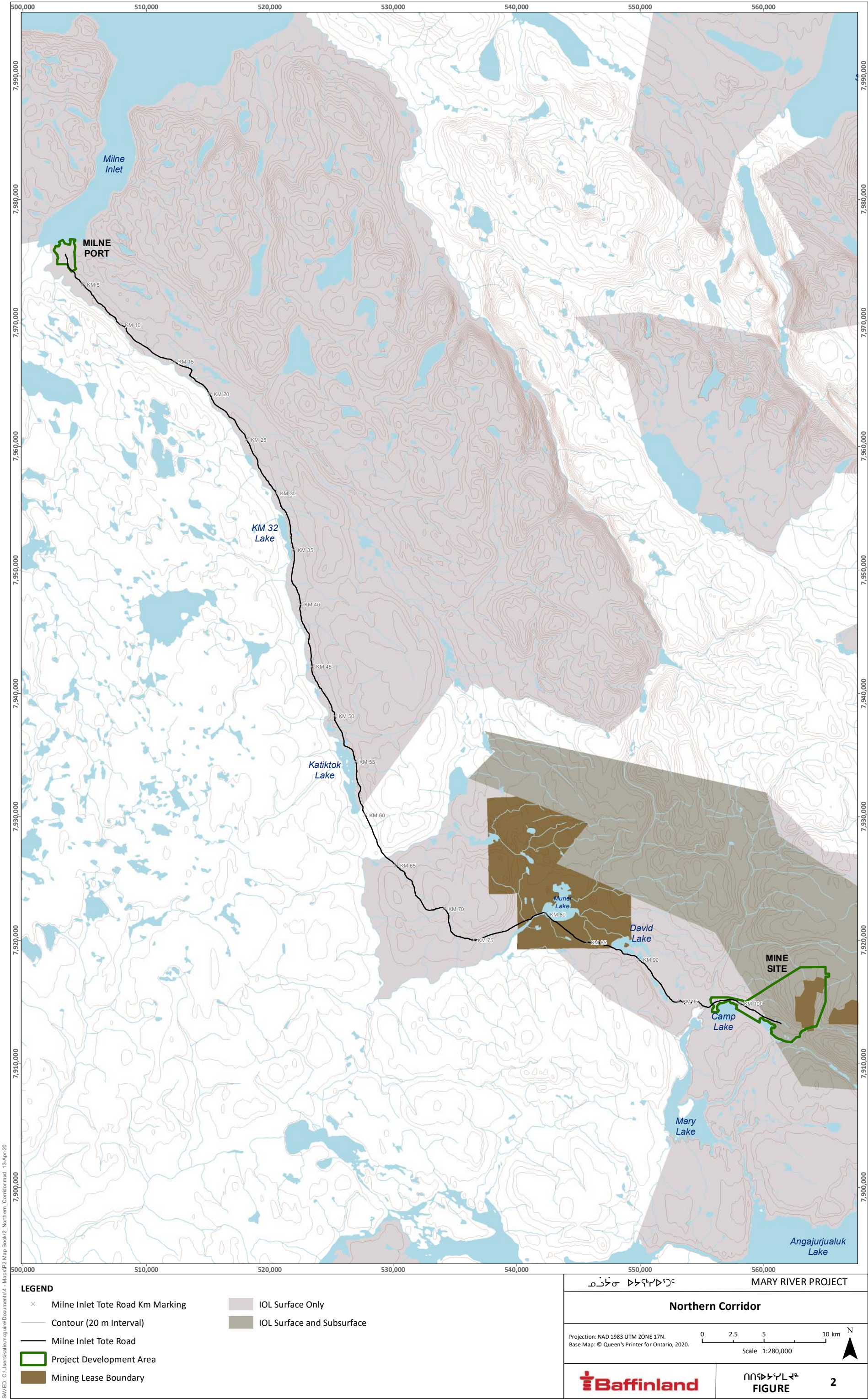
Supplementary Information –  
Technical Meetings April 2020  
Phase 2 Proposal – Mary River Project

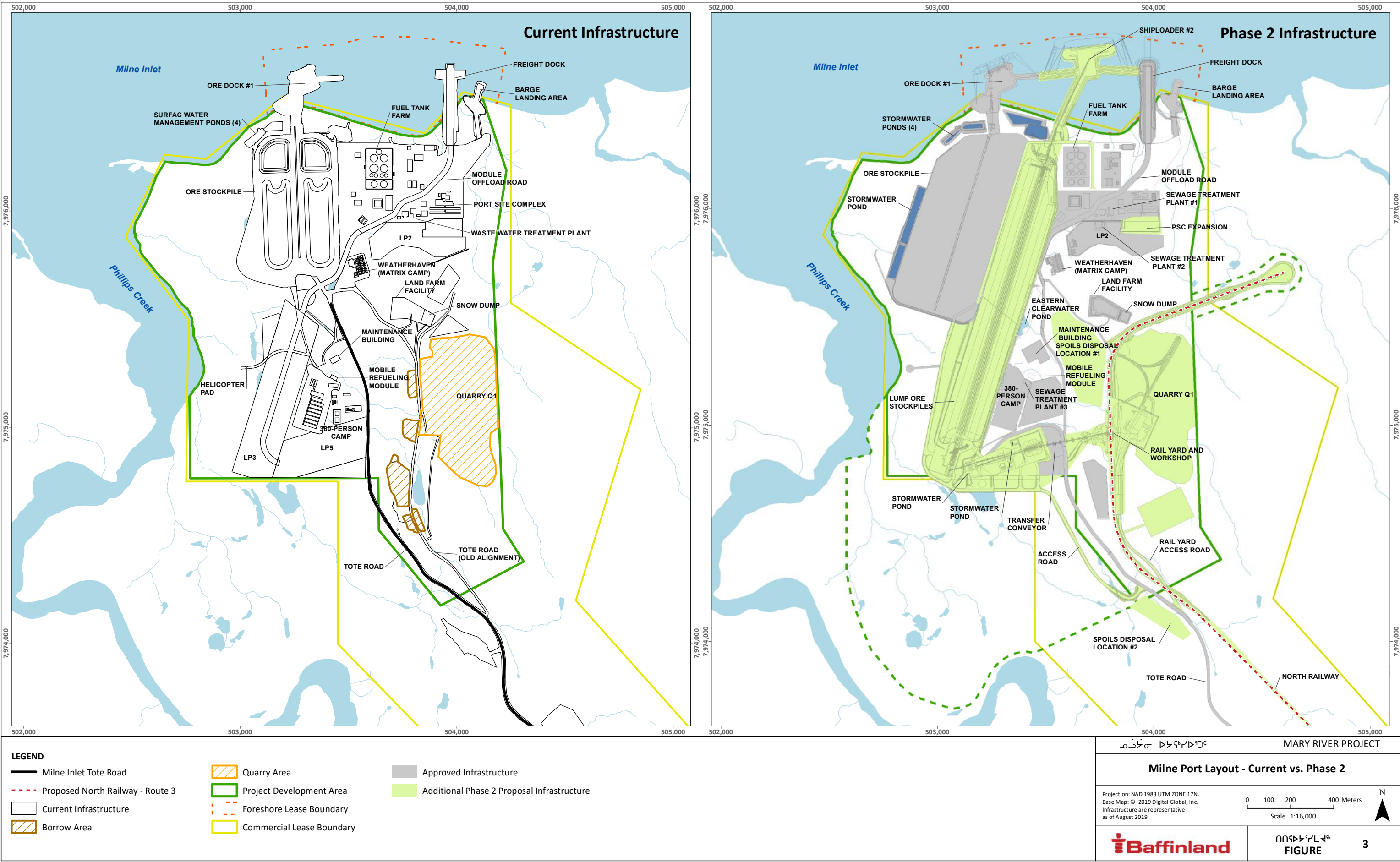
Baffinland Iron Mines Corporation  
Mary River Project  
NIRB File No. 08MN053



## ADDITIONAL FIGURES











- Gentle slopes. Approximately 65% of the alignment is built with gentle 1:2 slopes.
- Smooth fill. The entire alignment will be built using Type 8 (<150 mm) material for embankment fill.
- Level crossings will be built with a slope of 1:5 including the sides of the crossing to ensure a snowmobile and qamatiq can cross from any angle.
- During operation, crossings may be added based on community input and need.

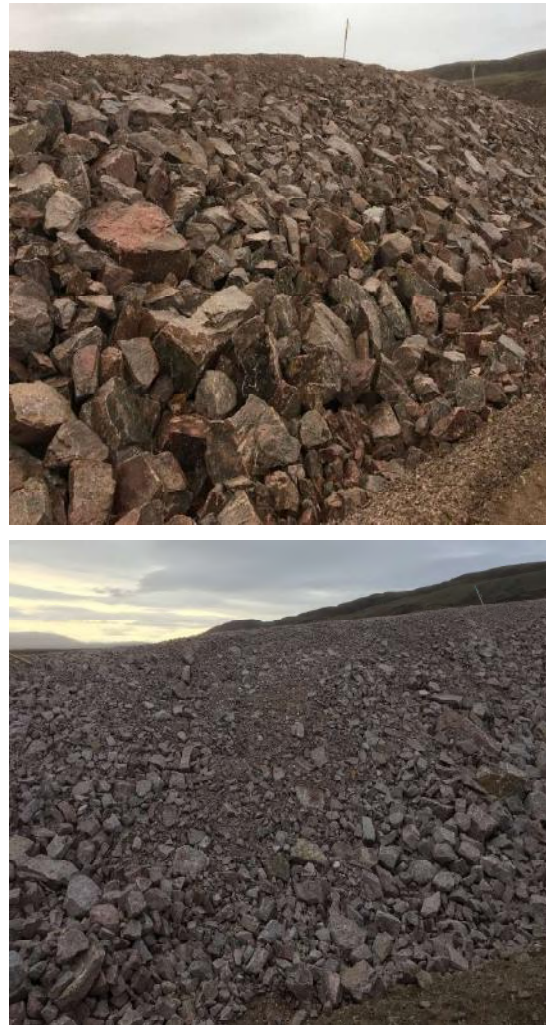


Photo depicts a 1:5 slope



<div> <div>ᓄᓗᓂᓐ ᐃᓕᓐᓴᓐᓴᓐᓴᓐᓴᓐ</div> <div>MARY RIVER PROJECT</div> </div>	
<div>Caribou Protection by Design</div>	
<div>  </div>	<div> <div>ᓂᓂᓐᓴᓐᓴᓐᓴᓐᓴᓐ</div> <div>FIGURE 6</div> </div>

## MARINE – SUPPLEMENTARY INFORMATION

# Modelling Worst Case Scenario

✚ Consider Eclipse Sound modelling location (i.e. the furthest propagation)

✚ Rmax to 120 dB re 1  $\mu$ Pa in compact ice:

- 1 Icebreaker (Scenario 3): 55 km
- 1 Icebreaker and 1 Cape size ore carrier (Scenario 15): 55 km
- 1 Icebreaker and 2 Cape size ore carriers (Scenario 27): 54 km
  
- 2 Icebreakers (Scenario 9): 60 km
- 2 Icebreakers and 1 Cape size ore carrier (Scenario 21): 60 km
- 2 Icebreakers and 2 Cape size ore carriers (Scenario 34): 59 km

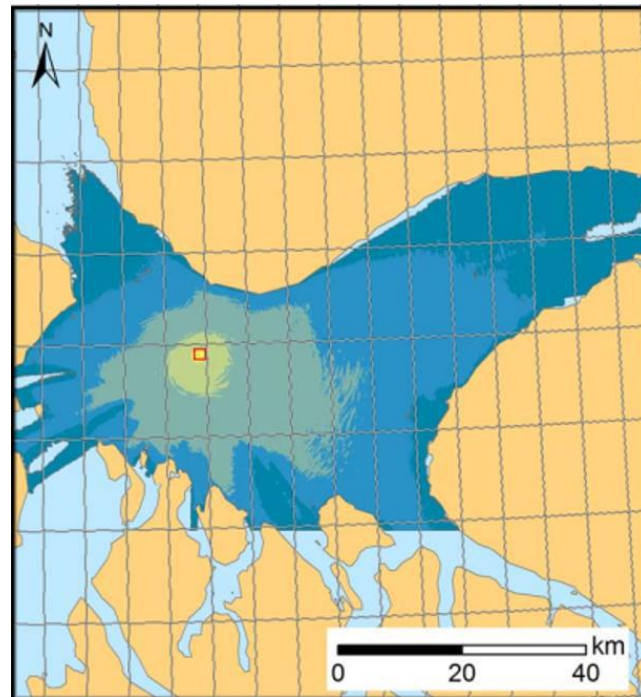
# Modelling Worst Case Scenario

✚ Consider Eclipse Sound modelling location (i.e. the furthest propagation)

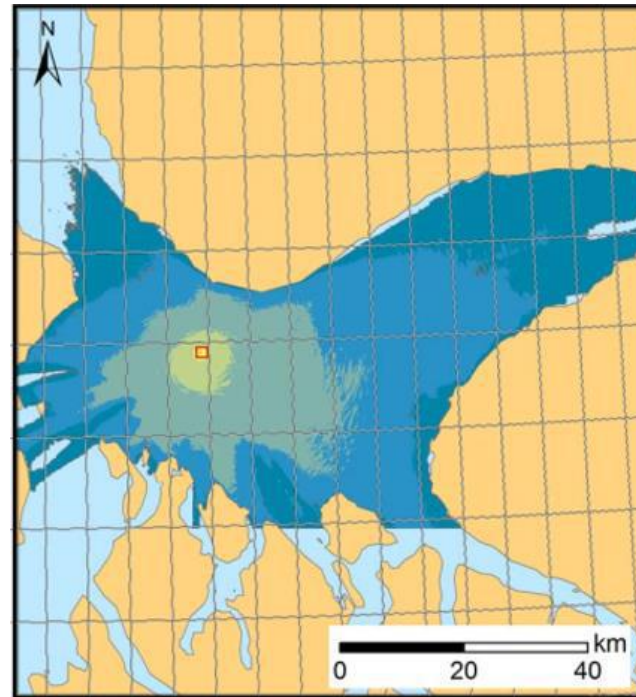
✚ Rmax to 120 dB re 1  $\mu$ Pa in compact ice:

- 1 Icebreaker (Scenario 3): 55 km
- 1 Icebreaker and 1 Cape size ore carrier (Scenario 15): 55 km
- 1 Icebreaker and 2 Cape size ore carriers (Scenario 27): 54 km
  
- 2 Icebreakers (Scenario 9): 60 km
- 2 Icebreakers and 1 Cape size ore carrier (Scenario 21): 60 km
- 2 Icebreakers and 2 Cape size ore carriers (Scenario 34): 59 km

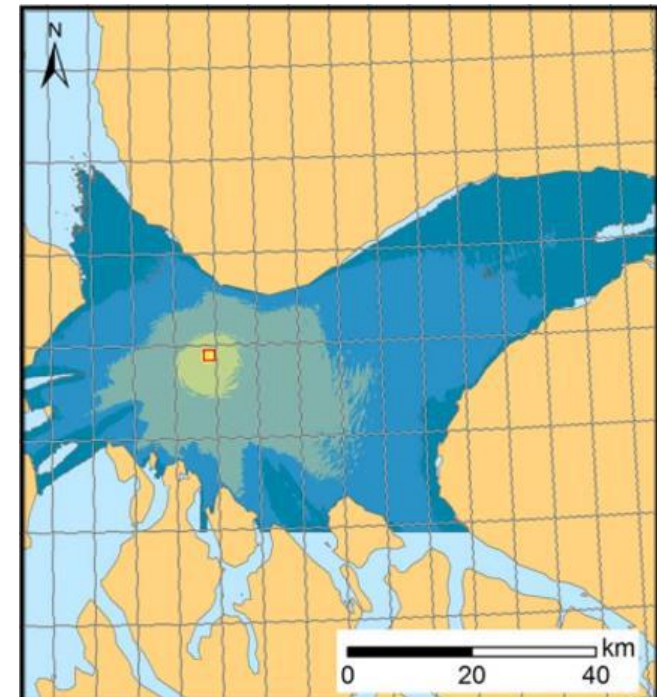
# Modelling Worst Case Scenario<sup>12</sup>



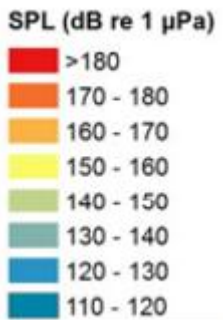
2 icebreakers



2 icebreakers and 1 capsized carrier



2 icebreakers and 2 capsized carriers



# 24h Sound Exposure Modelling for Worst Case Scenario

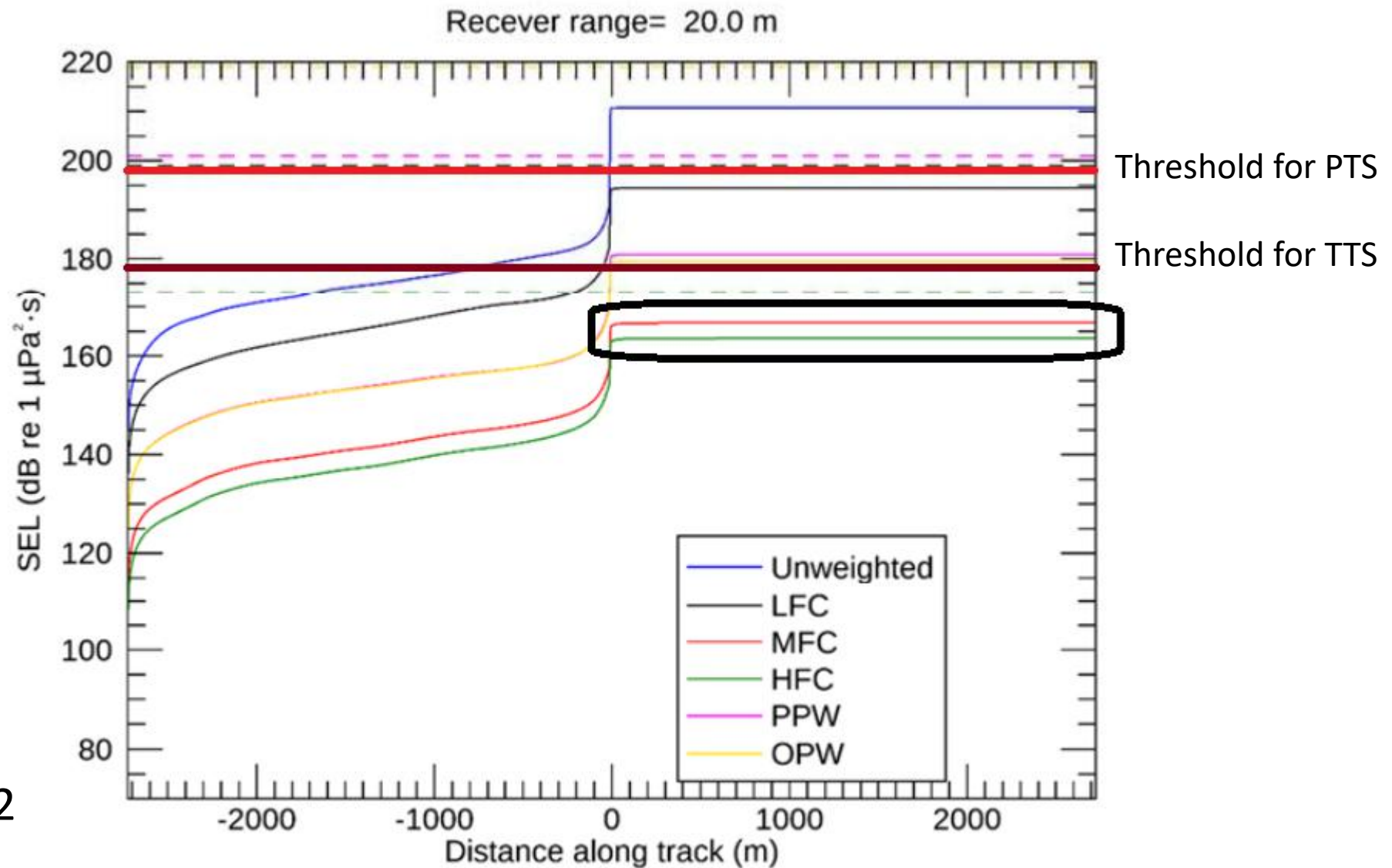


Figure D-72

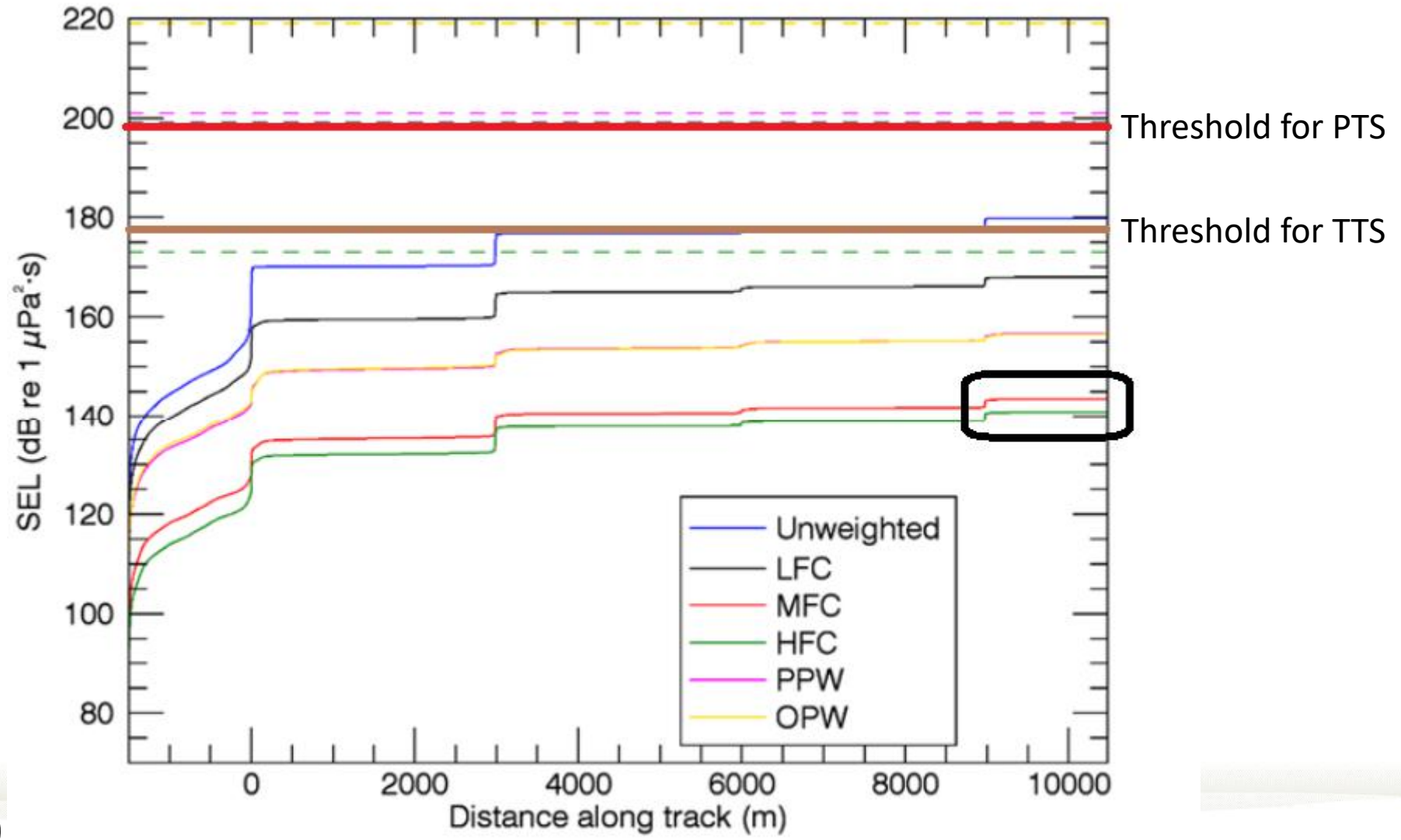


Figure E-50

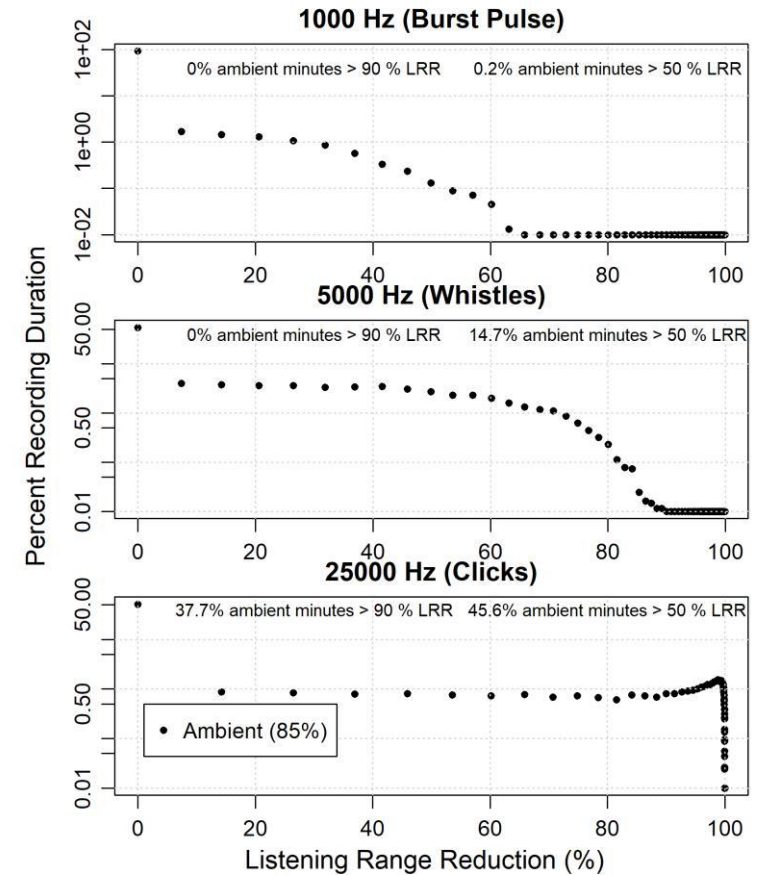
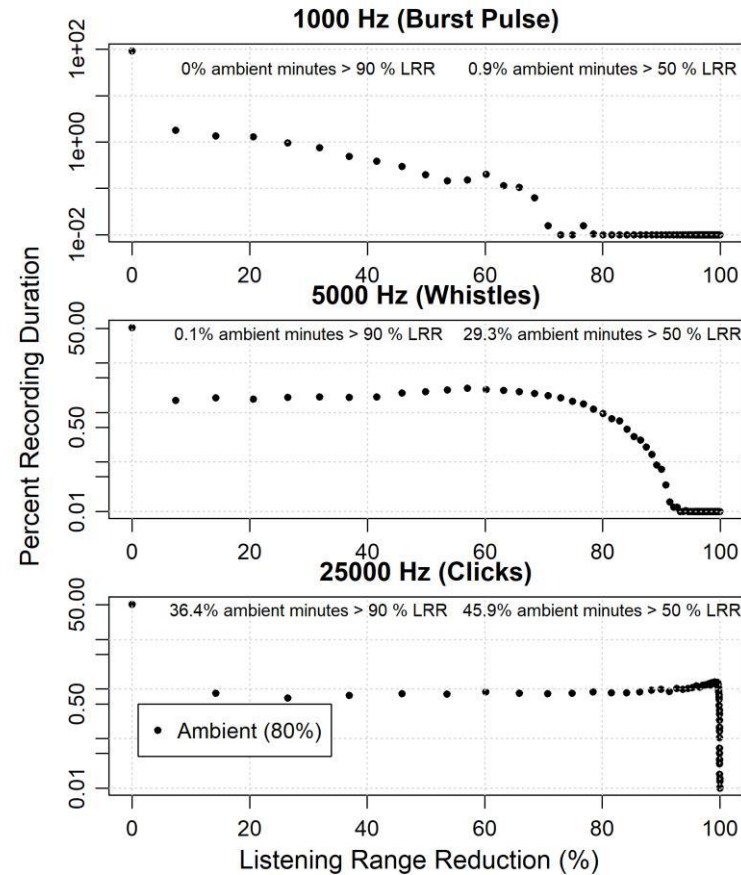
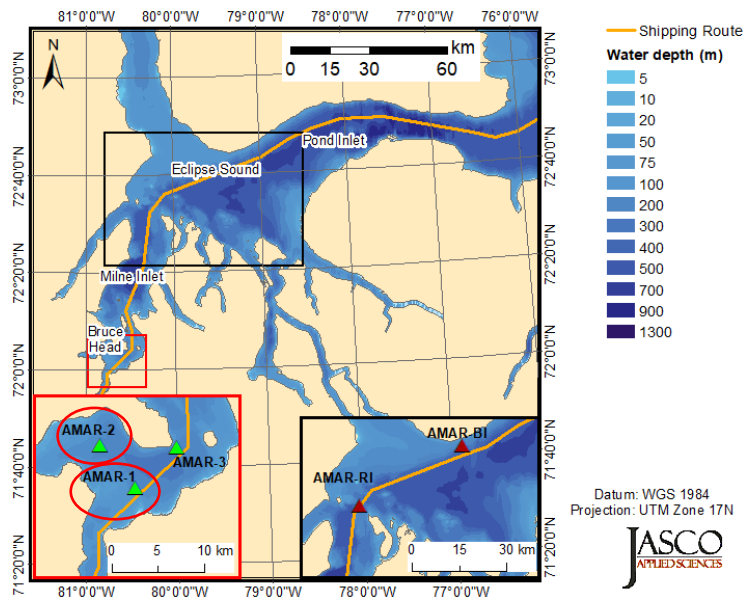
# Modelling Worst Case Scenario

- ‡ It would take 17.5 hours of continuous exposure at 130 dB to illicit TTS
- ‡ The maximum distance from a cape size ore carrier to 130 dB is 6.87 km, so an animal could be exposed at a level of 130 dB for the amount of time that it takes a vessel to sail 13.74 km.
- ‡ Travelling at 9 knots (16.7 km/h), it would take ~1 hour to cover this distance

# Listening Range Reduction (Ambient Noise Only)

## AMAR 1

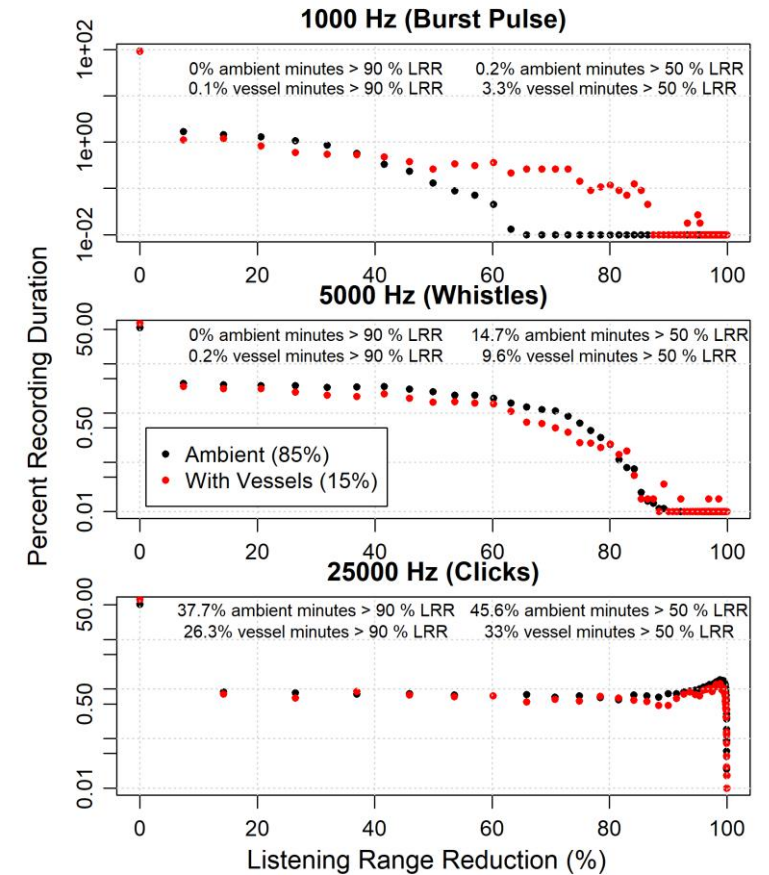
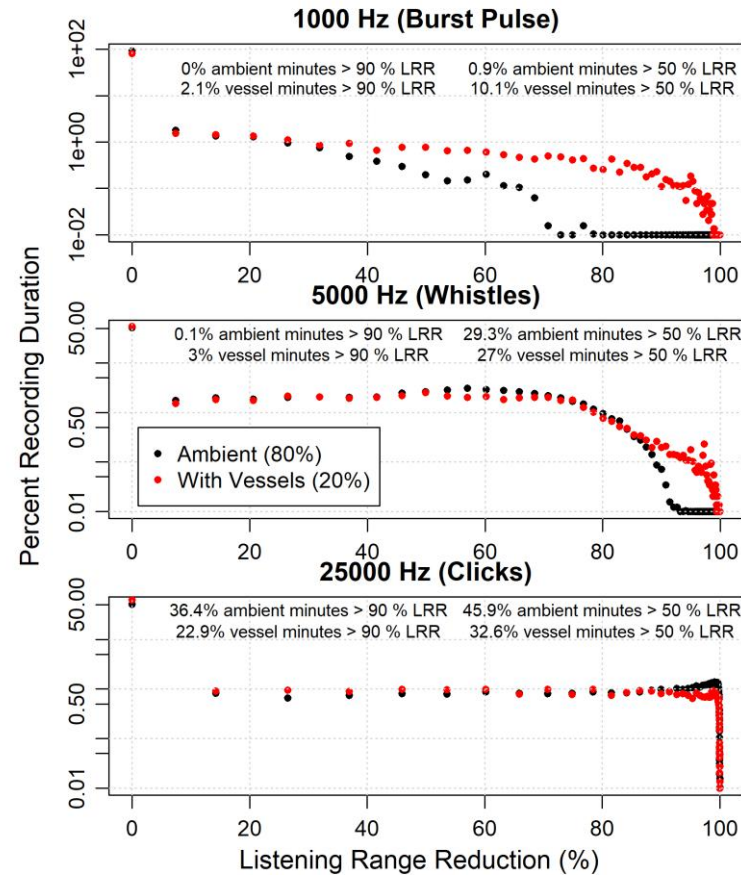
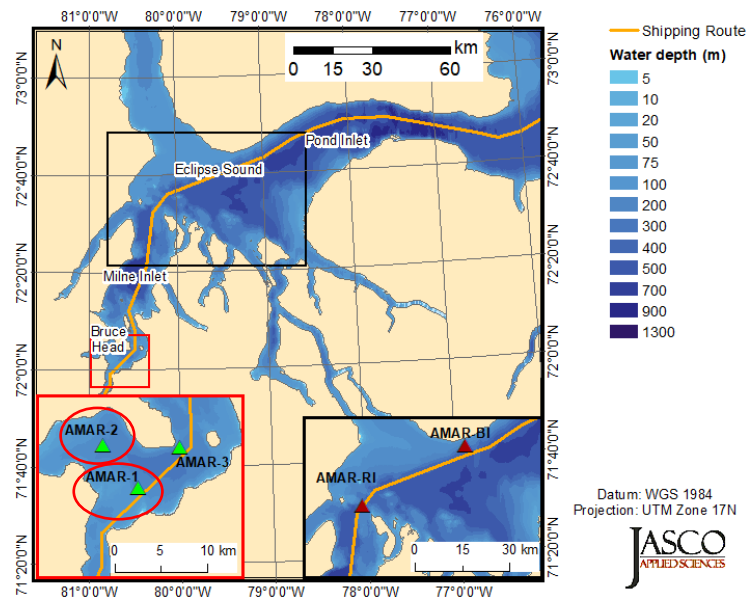
## AMAR 2



# Listening Range Reduction (Vessel Noise)

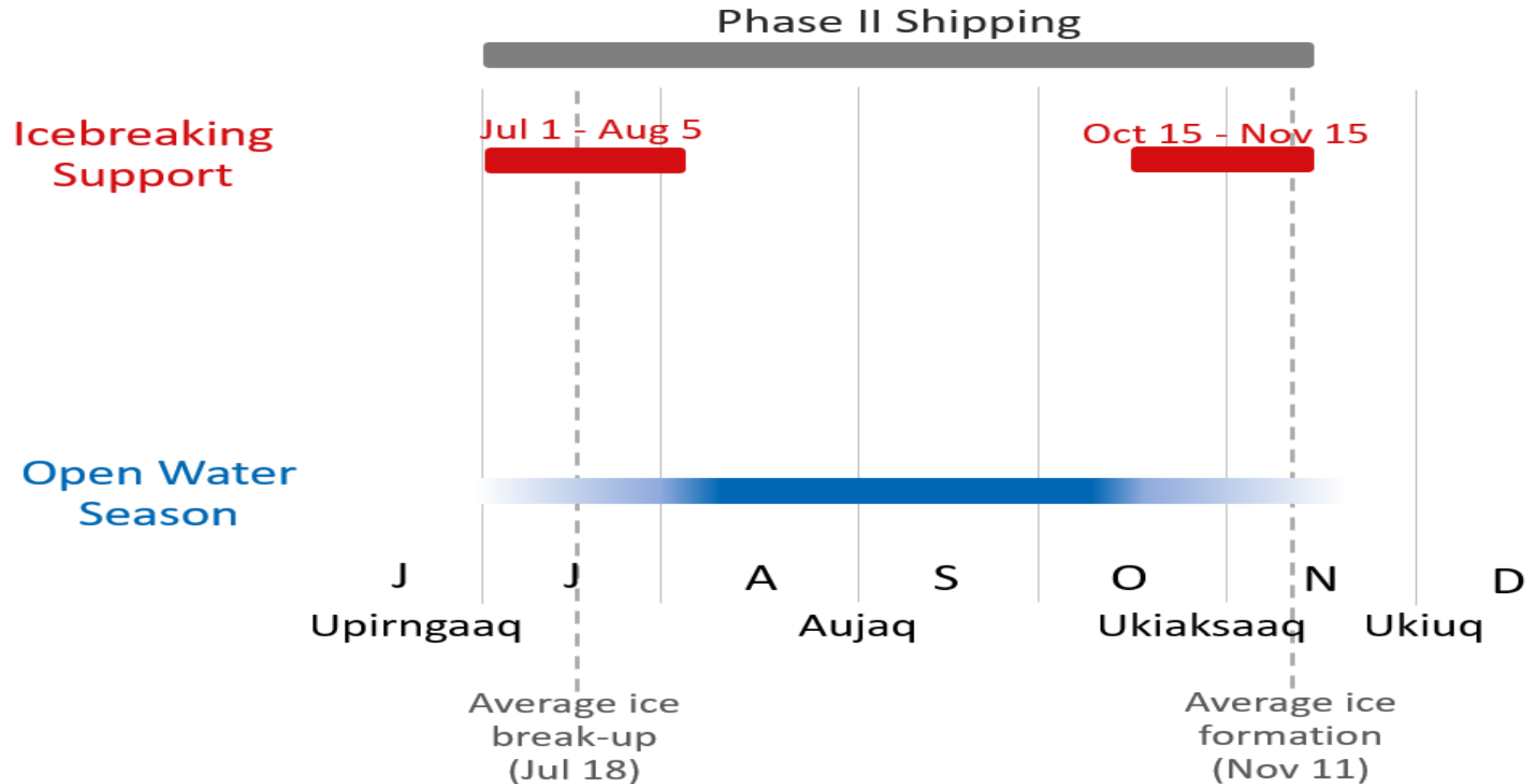
## AMAR 1

## AMAR 2



# Shipping Activity Overview – Shipping Season

18



# Shipping Activity Overview – Route

- Modified based on input from Pond Inlet
- Route & speed restrictions monitored by Baffinland using satellite technology
- Notifications triggered when vessels:
  - Deviate off route
  - Enter no-go zones
  - Speeds exceed voluntary 9 knots
  - Drifting in Eclipse Sound



# Adaptive Management

Recommendations made by MEWG that have been incorporated by Baffinland:

- ✚ MEEMP and AIS Program:
  - Completed power analysis to inform sampling design, increased sampling effort for benthic/sediment (5 to 15 stations per transect) to increase power of detection
  - Addition of benthic infauna as indicator
  - Addition of new transect extending north off freight dock
  - Establishment of permanent belt transects for evaluating potential Project effects on epifauna/epifloral community
  - Modifications to Fukui traps to increase catch rate
  - Addition of hoop/fyke nets to fish sampling program to compensate for low catch in Fukui traps
  - Adding bottom trawls to fish sampling program (QIA, DFO) to target potentially missed species (e.g. Arctic cod)
  - Increased jigging and gill net sampling effort to allow for more consistent and repeatable fish sampling
  - For any potential changes to study design, continue sampling at old locations for minimum of 3 years to facilitate comparison of old and new methods / results
  - Added species (sculpin and shellfish) other than char for tissue/body burden analysis
  - Ageing of char using appropriate otolith experts
  - Ageing of shellfish (*H. arctica*) as they are known to be long-lived such to appropriately interpret changes in growth and metal uptake.
  - Changed indicator threshold for fish tissue analysis (i.e., use of 0.2 mg/kg as threshold for mercury rather than 0.5 mg/kg)
  - Improved video surveys by using higher resolution video equipment for hull monitoring
  - Geographical expansion of the AIS monitoring program to Ragged Island
  - Use of an independent secondary taxonomic lab for taxonomic verification of potential
  - Deployment of AIS settlement plates in sets so their recovery can be staggered to allow for longer soak duration
  - Undertook literature review of Phillips Creek Geomorphology to determine influence of Phillips Creek on MEEMP results
  - Expanded ballast water salinity test sampling to all vessels calling to port
  - Installation of oceanographic moorings in study area and more CTD depth profiling to better understand physical oceanographic conditions in Milne Inlet
  - Additional work on ballast water dispersion model including a sensitivity analysis

# Adaptive Management

## Recommendations made by MEWG that have been incorporated by Baffinland:

### ✚ Marine Mammal Monitoring Programs

- Completed simultaneous aerial surveys of Eclipse Sound and Arctic Bay stock summering grounds to account for exchange between stocks.
- Integrated recommendations from DFO/QIA into aerial survey study design and data collection methodology
- Installation of physical oceanography mooring at Bruce Head to correlate narwhal behavior with tide /current levels
- Developed a study component to assess detection ability in furthest offshore strata of Bruce Head
- Expanded Bruce Head survey effort to capture more ship transit events and increase overall samples size
- Deployed additional acoustic recorders in other parts of RSA to better understand ship noise levels along corridor
- Improved automated vocalization detector to better refine calls from different species (e.g. orca vs. narwhal).
- Installed additional shore-based MOTE stations to increase tag data recovery for narwhal tagging study
- Complied with request to include daily ice charts in SBO report to compare sightings data with ice conditions
- Modified behavioral data collection methods for SBO program to include movement characteristics relative to vessel
- Adoption of Environment Canada Seabird at Sea (CSAS) survey protocol for seabird surveys - SBO program
- General feedback incorporated into finalization of Early Warning Indicators and adaptive management measures

# Adaptive Management

✚ Enhanced mitigation and monitoring incorporated by Baffinland in response to regulator and community concerns:

- 9 knots maximum speed limit (from former 7 to 10 knots) – precedent setting
- Adjustment of shipping lane to avoid shoreline in Milne (i.e., hunting camp) and Eclipse Sound (visible areas from Pond Inlet)
- Adjust shipping lane to pass closer to Poirier Island
- Never more than 3 ships in shipping corridor or anchored at Ragged at a time
- No drifting in Navy Board and Eclipse Sound
- Vessels standing by to enter RSA to stay in Baffin Bay – in set-back area 40km beyond floe edge
- Guardian Program (shipping monitors) in Pond Inlet (live vessel tracking and VHF traffic control)
- Start of season aerial surveys prior to icebreaking
- Community consultation prior to icebreaking
- Clearance survey for narwhal at end of icebreaking season (entrapment)
- Reduced icebreaker transits when ice conditions over 3/10 present
- Start of season aerial surveys prior to icebreaking
- Community consultation prior to icebreaking
- Ballast water compliance testing on all vessels calling to Milne Port
- Ship hull surveys of ore carriers

# Canadian Shipping Project Precedence: Marine Mammal Mitigation & Monitoring

Description	Mary River Phase 2 (n=176)	Northern Gateway (n=220)	LNG Canada (n=350)	Trans- Mountain (n=408)	Roberts Bank Terminal 2 (n=252)	Agnico Eagle Meliadine (n=<10 freight)	Agnico Eagle Amuraq Whale Tail (<10 freight)
Protected Species	X	✓	✓	✓	✓	X	X
MWOs on Project Vessels	✓	X	X	X	X	✓	✓
Ship Speed Restrictions to Prevent Marine Mammal Ship Strikes	✓	X	X	X	X	X	X
Early Warning Indicators	✓	X	X	X	X	X	X
Aerial Monitoring	✓	X	X	X	X	X	X
Shore-Based Monitoring	✓	X	X	X	X	X	X
Acoustic Monitoring	✓	✓	✓	✓	✓	X	X

# Canadian Shipping Project Precedence: Summary

- ✦ Phase 2 proposes more extensive monitoring and mitigation than other Canadian shipping project, including those with potential impacts on protected (i.e., SARA-listed) species (narwhal are not a listed species)
- ✦ Phase 2 to implement speed restrictions and icebreaker mitigation to specifically avoid and or minimize adverse effects on marine mammals
- ✦ Phase 2 will be only Canadian shipping project that will have MWOs on Project-related vessels (icebreakers)
- ✦ No other Canadian shipping project has used EWIs for follow-up monitoring
- ✦ Mary River Phase 2 represents an expansion to an existing project = prior site-specific experience with mitigation and monitoring

# Canadian Marine Ports Precedence: Ballast Water/AIS Management

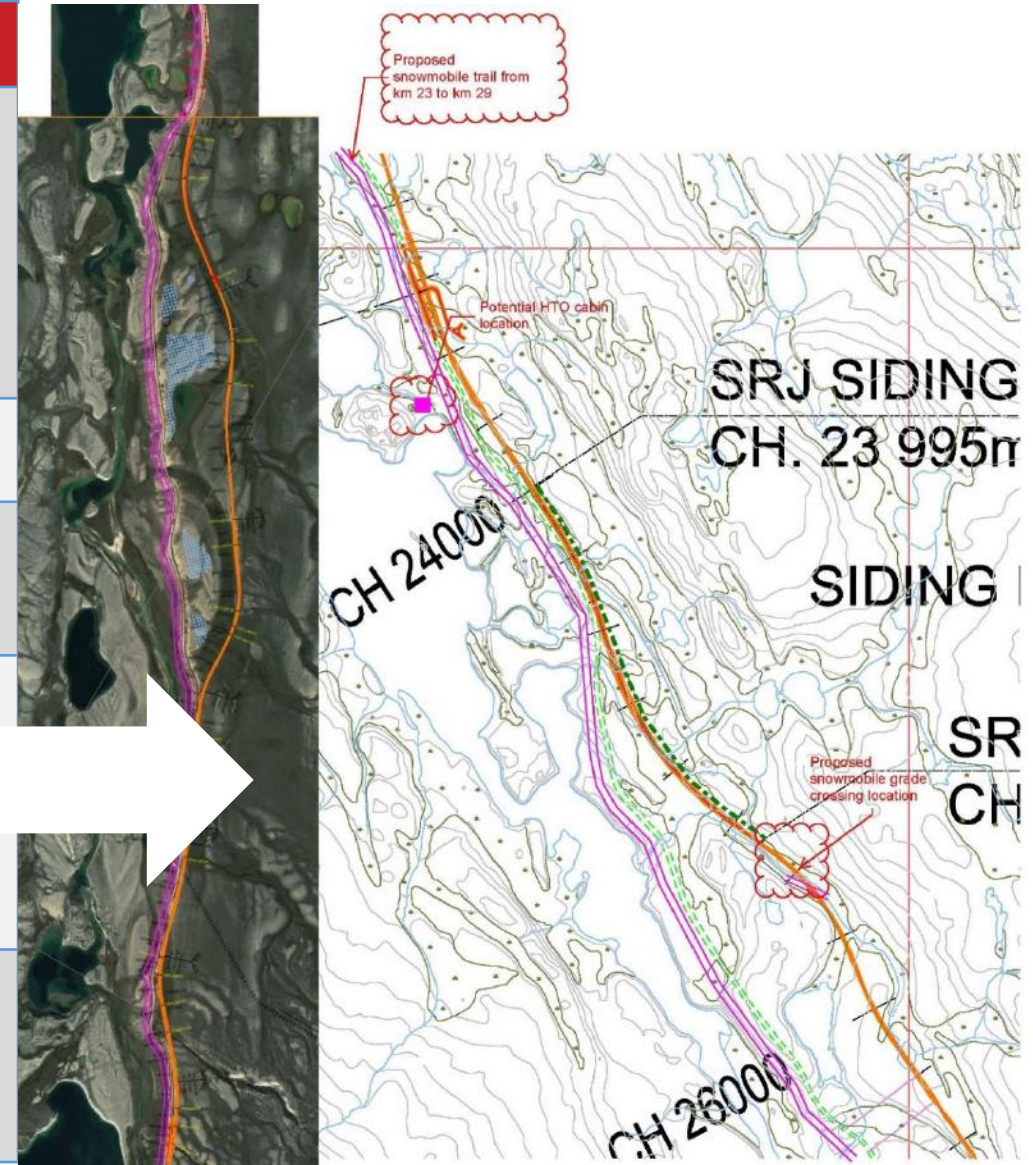
Description	Milne Port	Prince Rupert	Vancouver	Saguenay	Saint John	Halifax	Thunder Bay	St. John's	Trois-Rivieres	Toronto	Nanaimo	Churchill	Rankin Inlet	Baker Lake
Ballast Water Exchange Verification Monitoring	✓	X	X	X	X	X	X	X	X	X	X	X	X	X
Exchange + Treatment	✓	X	X	X	X	X	X	X	X	X	X	X	X	X
AIS Monitoring	✓	±	±	X	±	X	X	X	X	X	X	X	X	X
AIS Rapid Response Plans	✓	X	X	X	X	X	X	X	X	X	X	X	X	X

# Canadian Marine Ports Precedence: Summary

- ✚ Baffinland is a leader with respect to BW and AIS management, with measures far exceeding those implemented by other Port authorities nationally.
  - No other Marine Port Authority exceeds Transport Canada's guidelines (e.g., employs both D1 and D2 standards)
  - No other Marine Port Authority conducts ballast tank monitoring to verify that exchange has occurred
  - Where AIS monitoring exists, it is less comprehensive (i.e., no regular multi-trophic sampling and surveillance) and in the form of funding support to external groups or participation in regional initiatives (e.g., PlateWatch, green crab initiatives)
  - No other Marine Port Authority develops AIS Rapid Response Plans – all defer to DFO as lead agency

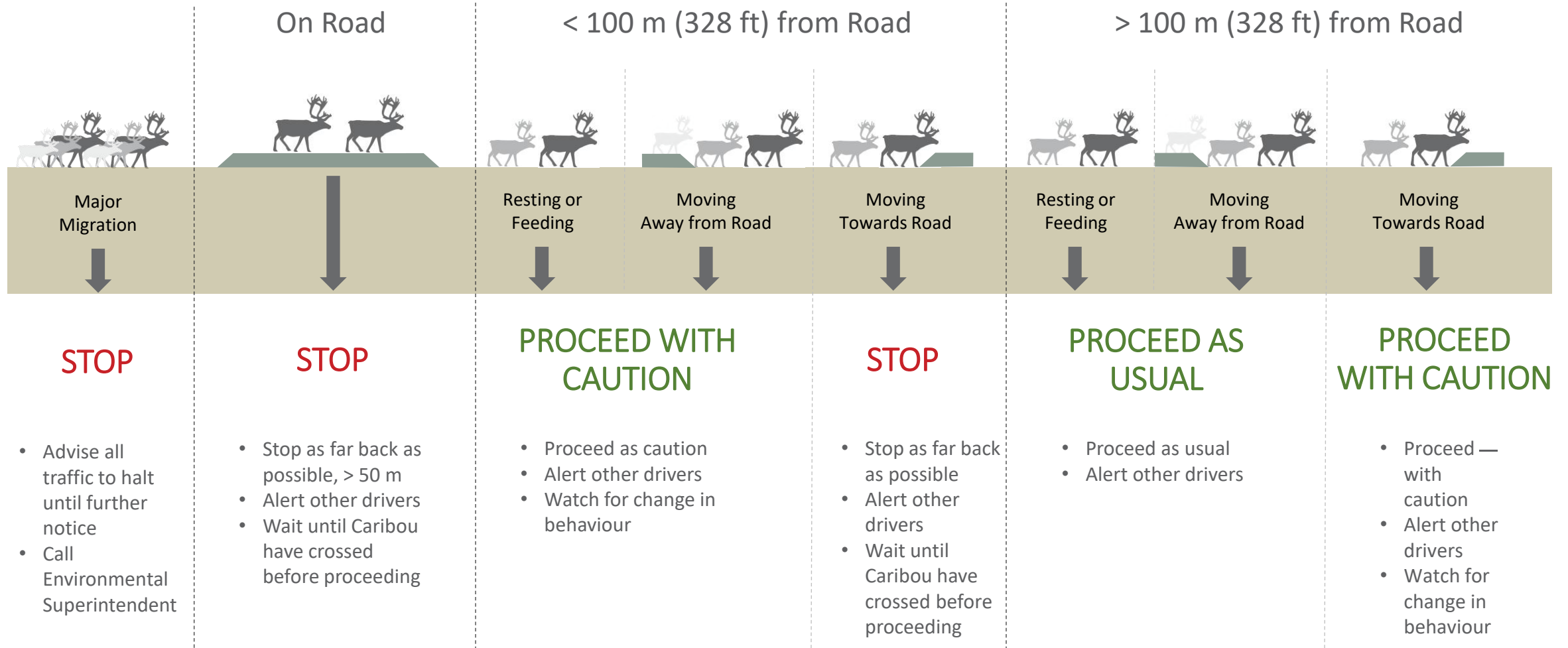
## TERRESTRIAL – SUPPLEMENTARY INFORMATION

Rail Km	Point of Interest Note	Baffinland Mitigation Notes
Km 32	Identified caribou movement and human crossing.	Consider what can be proposed. There are two culvert underpasses at Km 34 and Km 34.5. Provide a snow mobile trail between Km 29–33. Propose a culvert underpass at Km 29.5
Km 29	MHTO requested a snow machine crossing.	Underpass proposed at Km 29.5
Km 26.5	MHTO recommends a snow machine crossing.	Build a snow machine crossing. Propose a snow mobile trail between Km 23 and Km 29
Km 25 – Km 24.8	MHTO requests a snow machine crossing — in the winter, snowbanks are too high here. Two underpasses would be required in this area.	Another corridor for movement and consider options for travel route. Propose an HTO cabin in this area
Km 12	Snow machine travel around the falls on Phillips Creek.	Baffinland consider alternatives to ensure safe travel, propose the provision of a snow mobile trail between Km 11.5 and 12.5

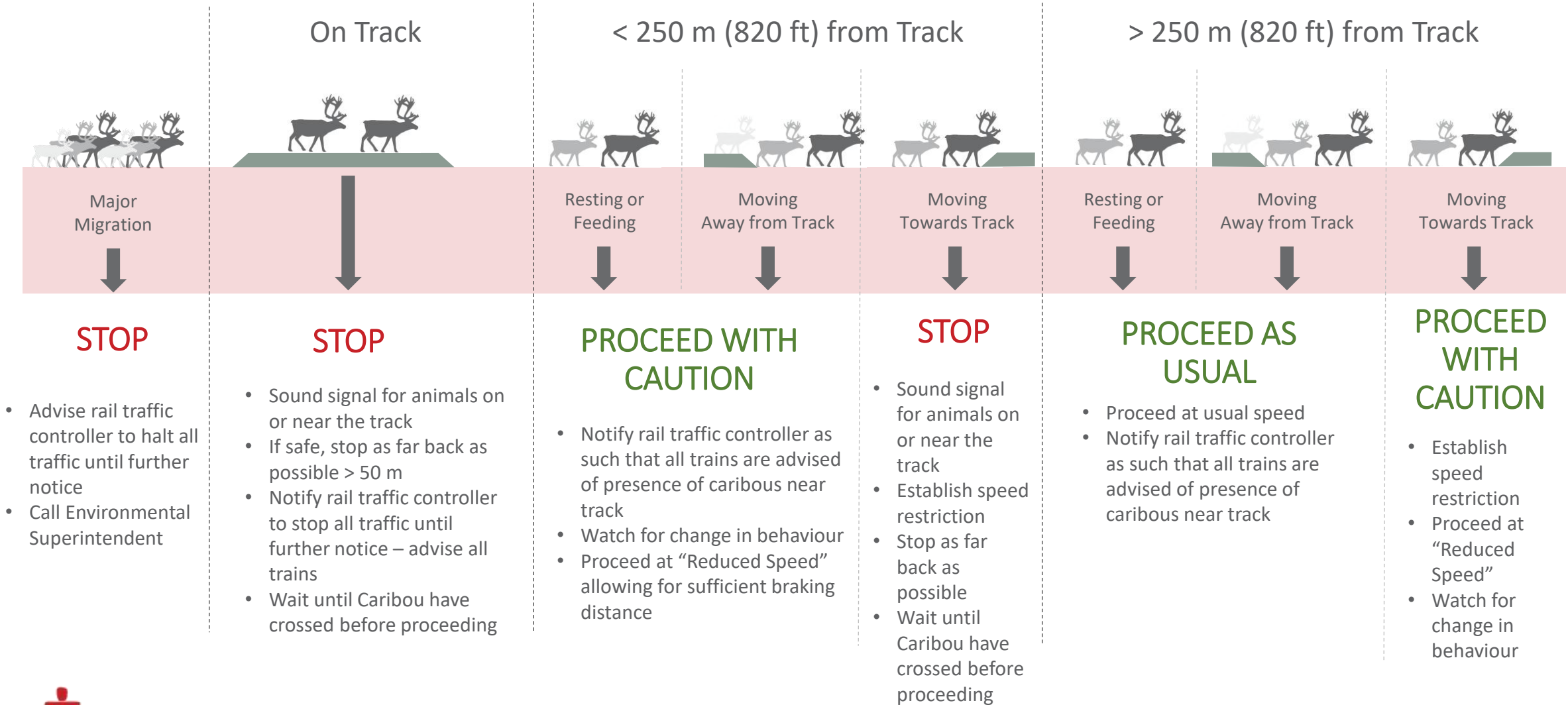




# Caribou Decision Framework — Road



# Caribou Decision Framework — Rail



# Habitat Loss Magnitude Criteria

Baffinland Phase 2 Proposal  
Technical Meeting  
Iqaluit, Nunavut April 2019



Andrén, H. 1994. *Effects of Habitat Fragmentation on Birds and Mammals in Landscapes with Different Proportions of Suitable Habitat: A Review*. *Oikos* 71(3):355–36

Theoretical study

- Considered patch size (i.e., contiguous habitat) and distribution
- Effects occur at **70–90%** disturbance (10–30% suitable habitat remaining)



Fahrig, L. 1997. Relative effects of habitat loss and fragmentation on population extinction. The Journal of Wildlife Management 61(3):603. DOI: 10.2307/3802168

Theoretical study

- *“The results suggest that when breeding habitat covers more than 20% [80% disturbance] of the landscape, survival is virtually ensured no matter how fragmented the habitat is.”*
- *...”for large landscapes, the 20% rule [80% disturbance] is probably realistic.”*

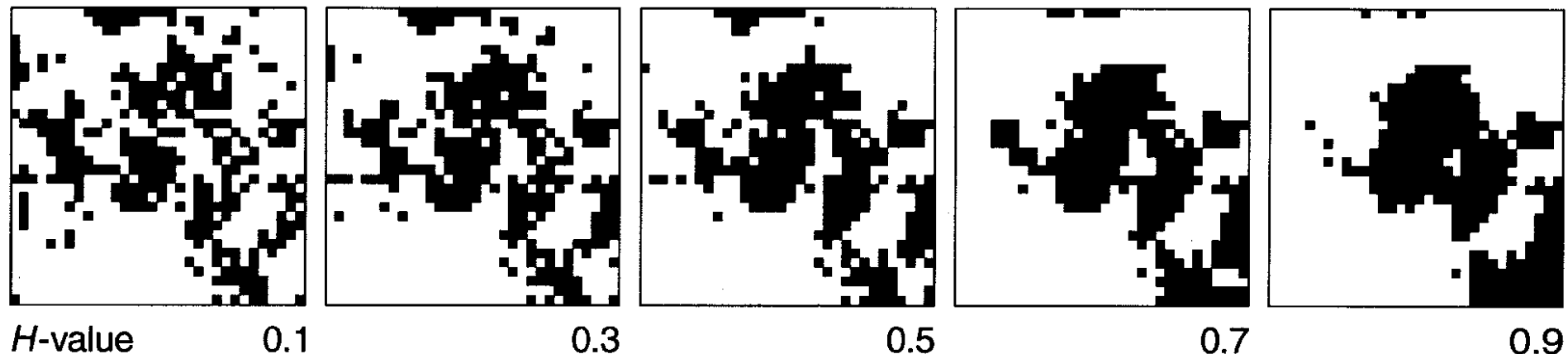


Flather, C.H. and Bevers, M. 2002. *Patchy Reaction-Diffusion and Population Abundance: The Relative Importance of Habitat Amount and Arrangement*.  
The American Naturalist 159(1):17

Theoretical study

- A plot of persistence probability against habitat amount and arrangement (fig. 4A) indicated that persistence decayed rapidly once habitat dropped below 50% for low degrees of aggregation ( $H \leq 0.3$ ) and below 40% for high degrees of aggregation ( $H \geq 0.7$ ). Moderate levels of habitat aggregation ( $0.4 \leq H \leq 0.6$ ) showed moderate declines in persistence in the 40%–50% habitat range but declined rapidly below 40%.

Habitat proportion = 0.3



**Swift, T.L. and Hannon, S.J. 2010. *Critical thresholds associated with habitat loss: a review of the concepts, evidence, and applications*. Biological Reviews 85:3 5–53**

- Reviewed theoretical and empirical evidence for critical thresholds in species' responses to habitat loss as proportion in the landscape.
- “Threshold level” — where abundance of a species in a landscape may decrease more steeply with habitat loss once the amount of remaining habitat falls below some proportion of the total landscape area
- Simulation studies (Table 1)
  - 1–99% (most **10–50%**) disturbed threshold
- Empirical Studies
  - ...“Higher critical habitat threshold levels have occasionally been reported, notably for fungal spread in a percolation-like laboratory model with random habitat (**60%**, Otten et al., 2004), for total moth abundance (**40–50%**, Schmidt & Roland, 2006), and for amphibian occurrence with urban/suburban disturbances (up to **55** or **60%**, Gibbs, 1998; Homan et al., 2004).”
  - ...“There is also a need for the use of statistical methods to detect and estimate threshold levels, both to increase objectivity within individual studies, and to facilitate comparison among studies.”



Environment Canada. 2011. Scientific Assessment to Inform the<sup>37</sup>Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada. 2011 Update. Canadian Wildlife Service, Ottawa, Ontario. 102 pp.

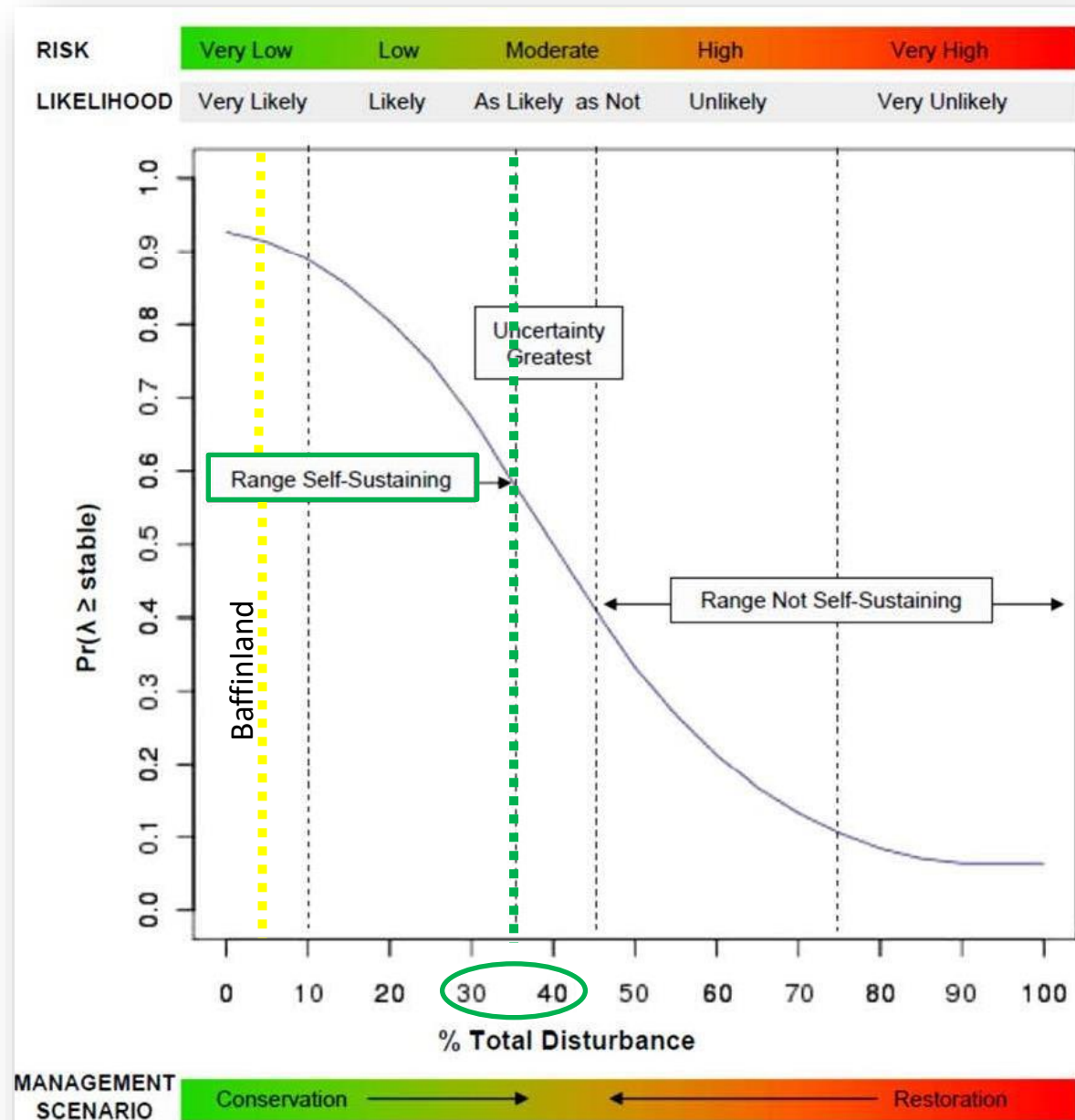


Figure 11 (Pg. 37).  
Probability of observing stable or positive growth of caribou populations over a 20-year period at varying levels of total range disturbance...

# IQ in Terrestrial Discipline

Baffinland Phase 2 Proposal  
Technical Meeting  
Iqaluit, Nunavut April 2019





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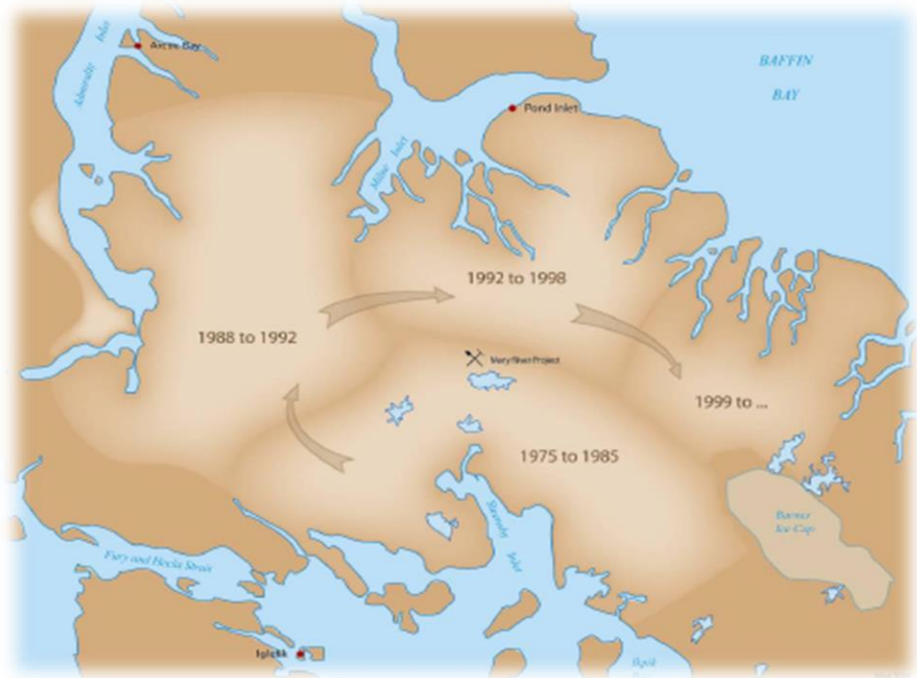
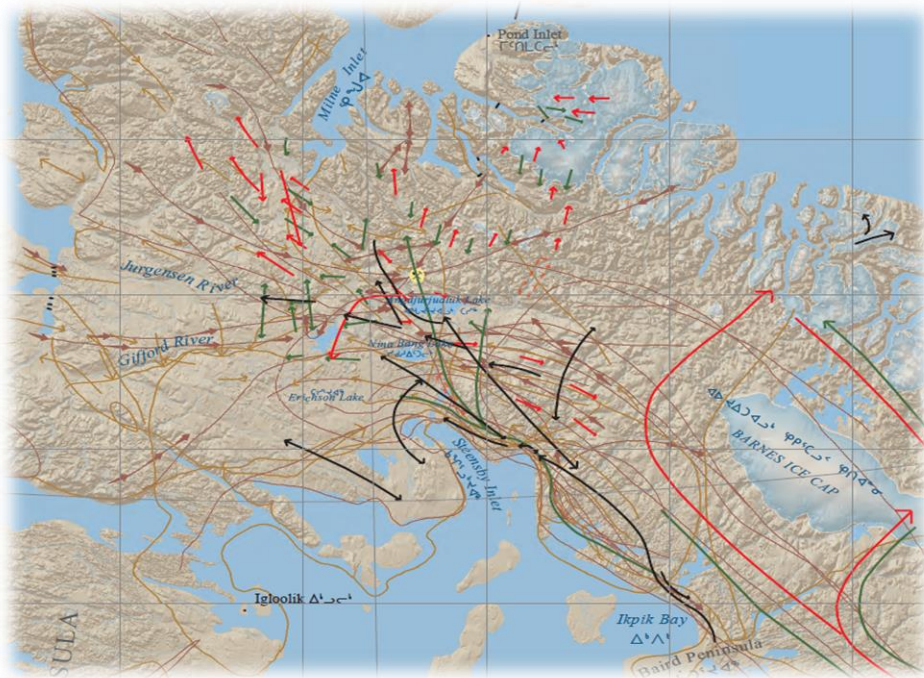
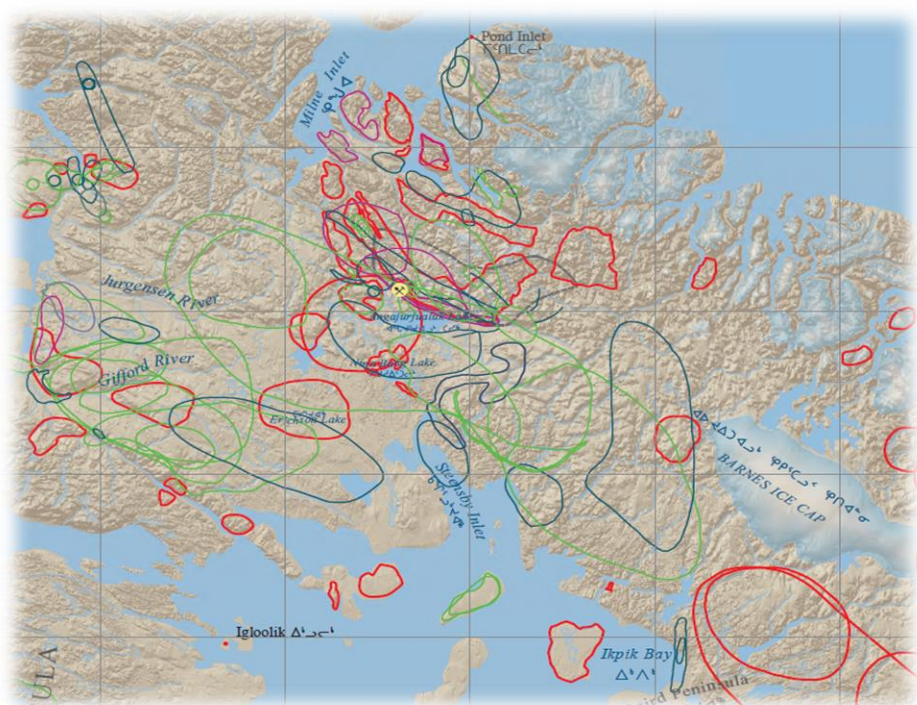
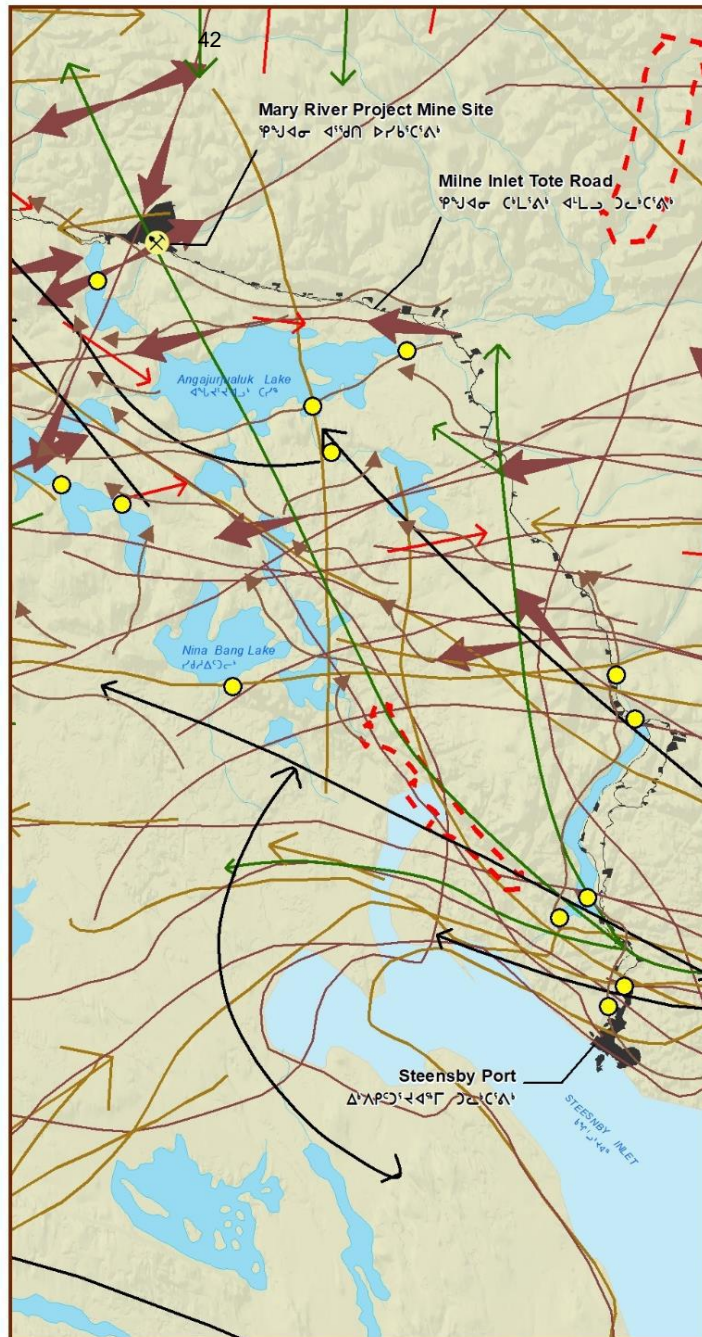
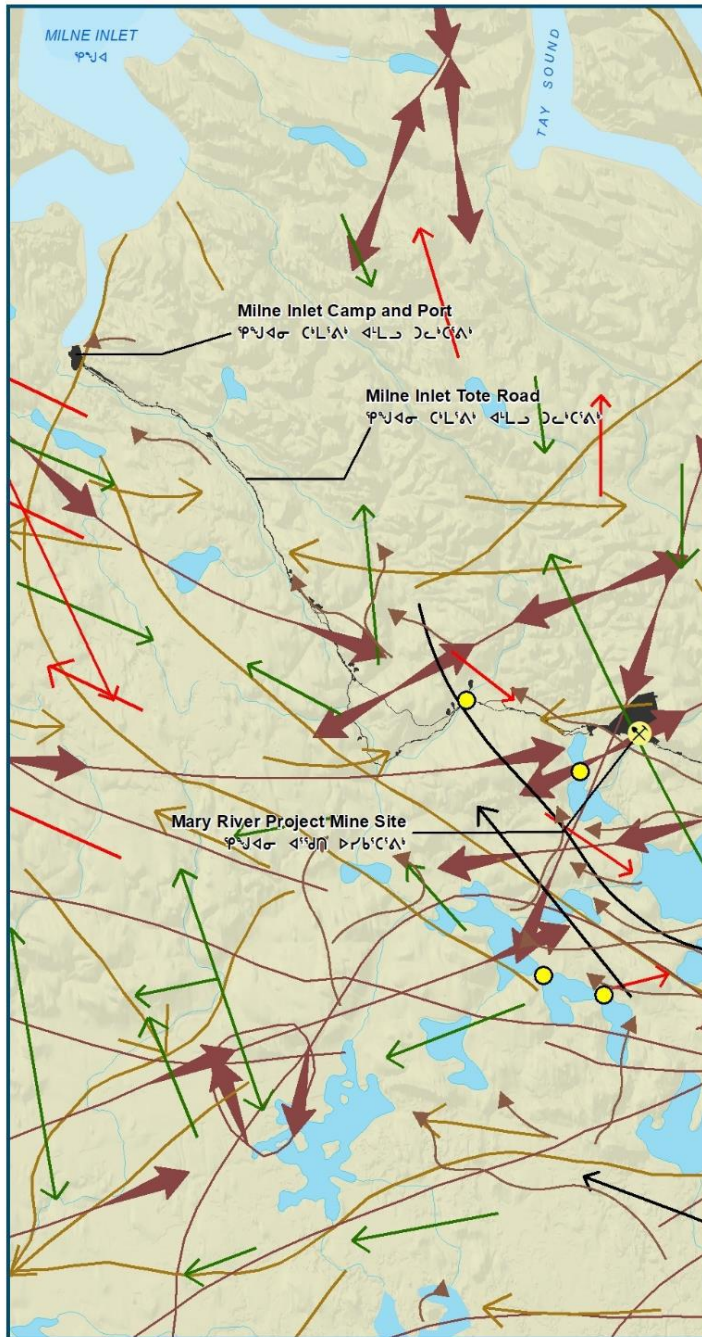




Figure 3. Summary of reported or estimated caribou harvest for Pond Inlet, Nunavut, 1932–2006.

Note: Data are summarized as per capita caribou harvest (top) and total caribou harvested (bottom) by year.





#### LEGEND ᑭᓯᓴᓴᓴ

- Community ᑭᓯᓴᓴᓴ
- Mary River Project ᑭᓯᓴᓴᓴ ᑭᓯᓴᓴᓴ ᑭᓯᓴᓴᓴ
- Potential Development Area  
ᑭᓯᓴᓴᓴ ᑭᓯᓴᓴᓴ ᑭᓯᓴᓴᓴ ᑭᓯᓴᓴᓴ ᑭᓯᓴᓴᓴ
- Caribou Movement (Based on 2006 Aerial Survey)
  - Caribou Water Crossing
  - Caribou Movement - Survey (2006)
- Caribou Migration (Traditional Knowledge Workshop 2007) ᑭᓯᓴᓴᓴ ᑭᓯᓴᓴᓴ ᑭᓯᓴᓴᓴ ᑭᓯᓴᓴᓴ
  - Non-specified Migratory Route
  - Fall Migratory Route
  - Spring Migratory Route
  - Caribou Migration (NLUIS 1980)
- Caribou Migration (Traditional Knowledge Interviews)
  - Migration Route
  - Movement Over Time

#### NOTES ᑭᓯᓴᓴᓴ

Proposed Rail Alignments provided by Canarail September 2008 and 2010.

Study Areas 2006-2007: Adapted from V. Banci.

Milne Inlet Tote Road: Knight Piesold (2007).

Updated PDA provided by Hatch (25 April 2013).

Map Projection: Canada Albers Equal Area Conic.



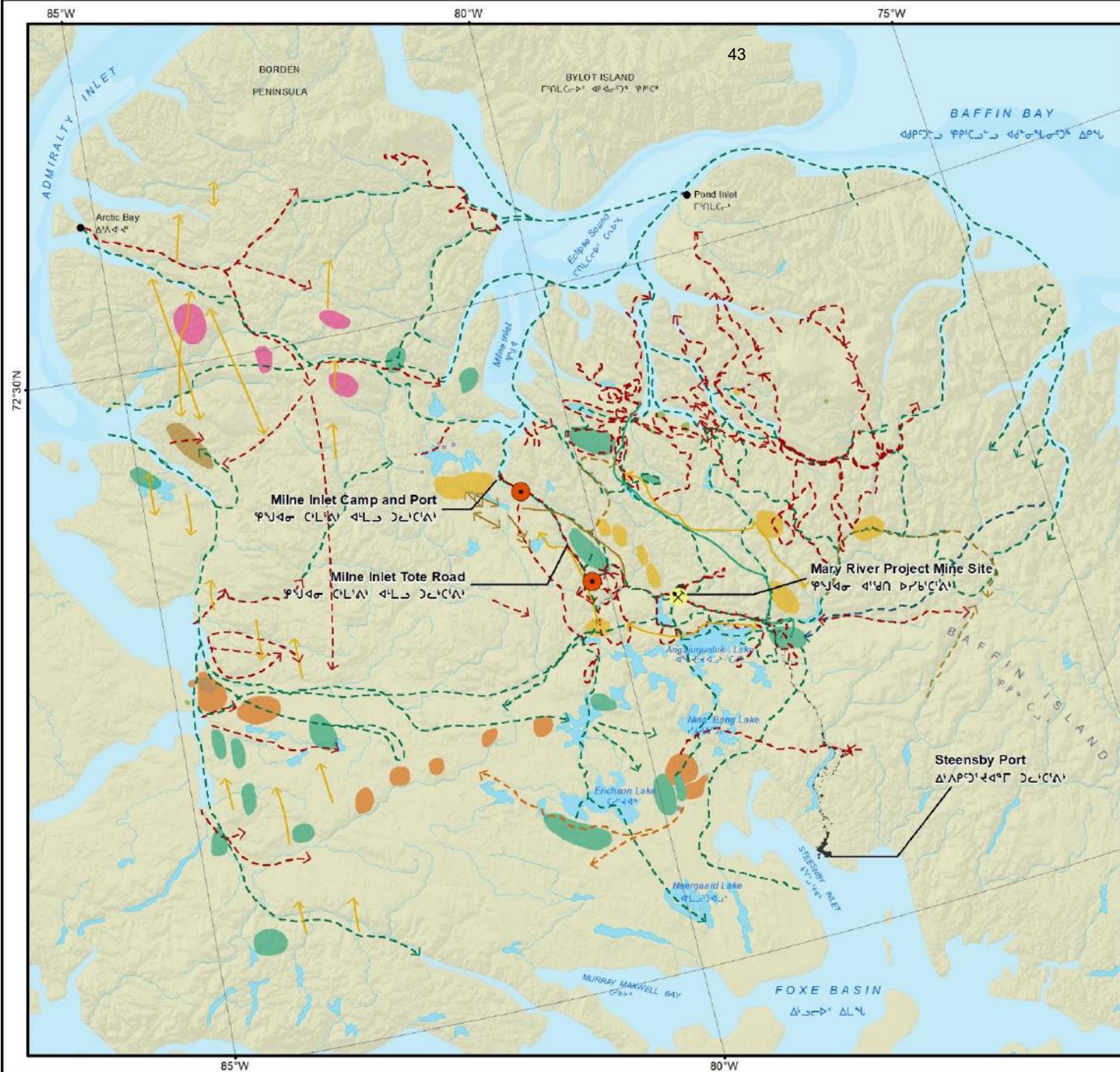
Caribou movement based on IQ and 2006 aerial survey



Date: 6/18/2018

MAP 7

Baffinland Iron Mines Corporation, 2018. All rights reserved. Map 7: Caribou Movement, 2006/2017 and 2018.



- LEGEND**
- Community
  - Mary River Project
  - Potential Development Area
  - Snow machine crossing
- Seasonal Movement by Caribou or Human**
- Caribou - Fall Movement
  - Caribou - Winter Movement
  - Caribou - Summer Movement
  - Human - Fall Travel
  - Human - Winter Travel
  - Human - Spring Travel
  - Human - Spring/Summer Travel
  - Human - Summer Travel
- Seasonal Caribou Locations**
- Fall
  - Winter
  - Spring
  - Summer
  - Summer and Winter
  - Year Round
  - Miscellaneous

**NOTES**

Point, line and polygon data are a representation of land use and ecological information collected in the Mary River Project region. The information was gathered at a caribou workshop in Pond Inlet in November 2015, and confirmed at Arctic Bay and Pond Inlet in April 2016.

Milne Tote Road Alignment Polyline and Project Areas Polygons [computer files]. Baffinland, 2013.



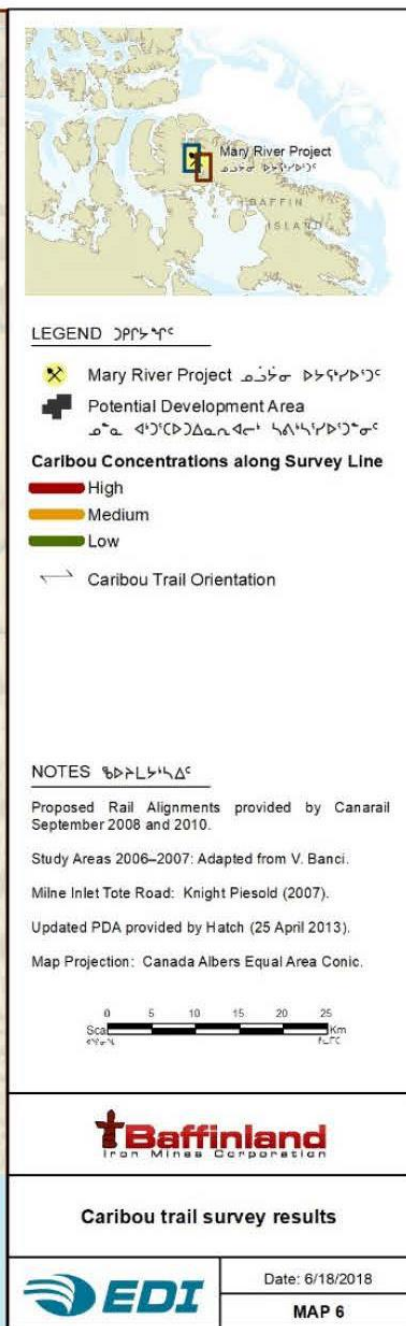
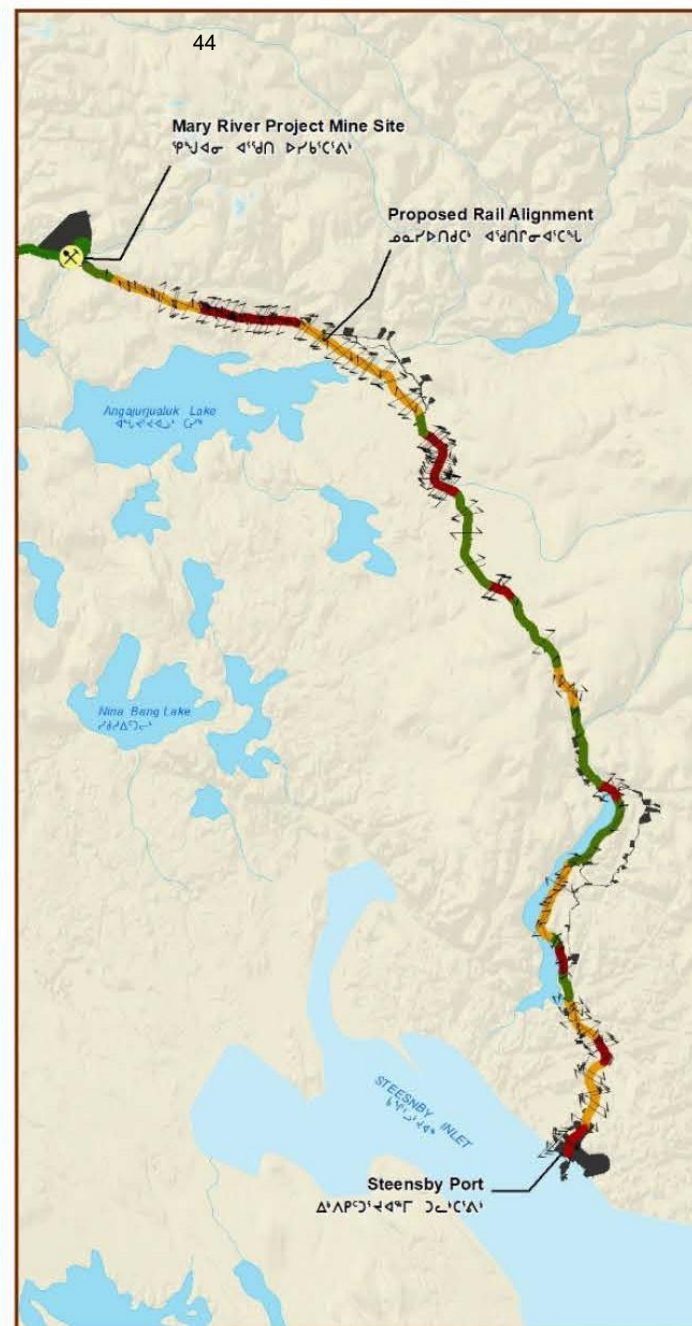
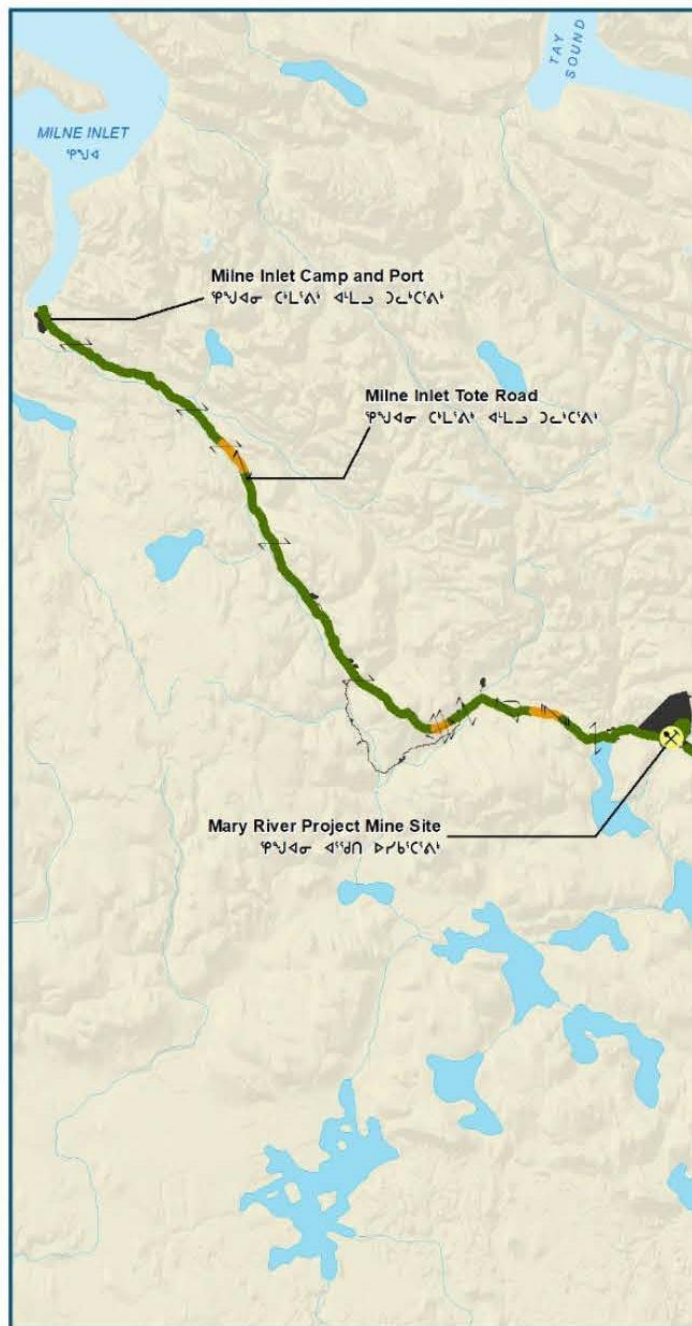
**Baffinland**  
Iron Mines Corporation

**Caribou Seasonal Movement and Occupation and Human Seasonal Movement Based on IQ**

EDI

Date: 6/18/2018

MAP 12



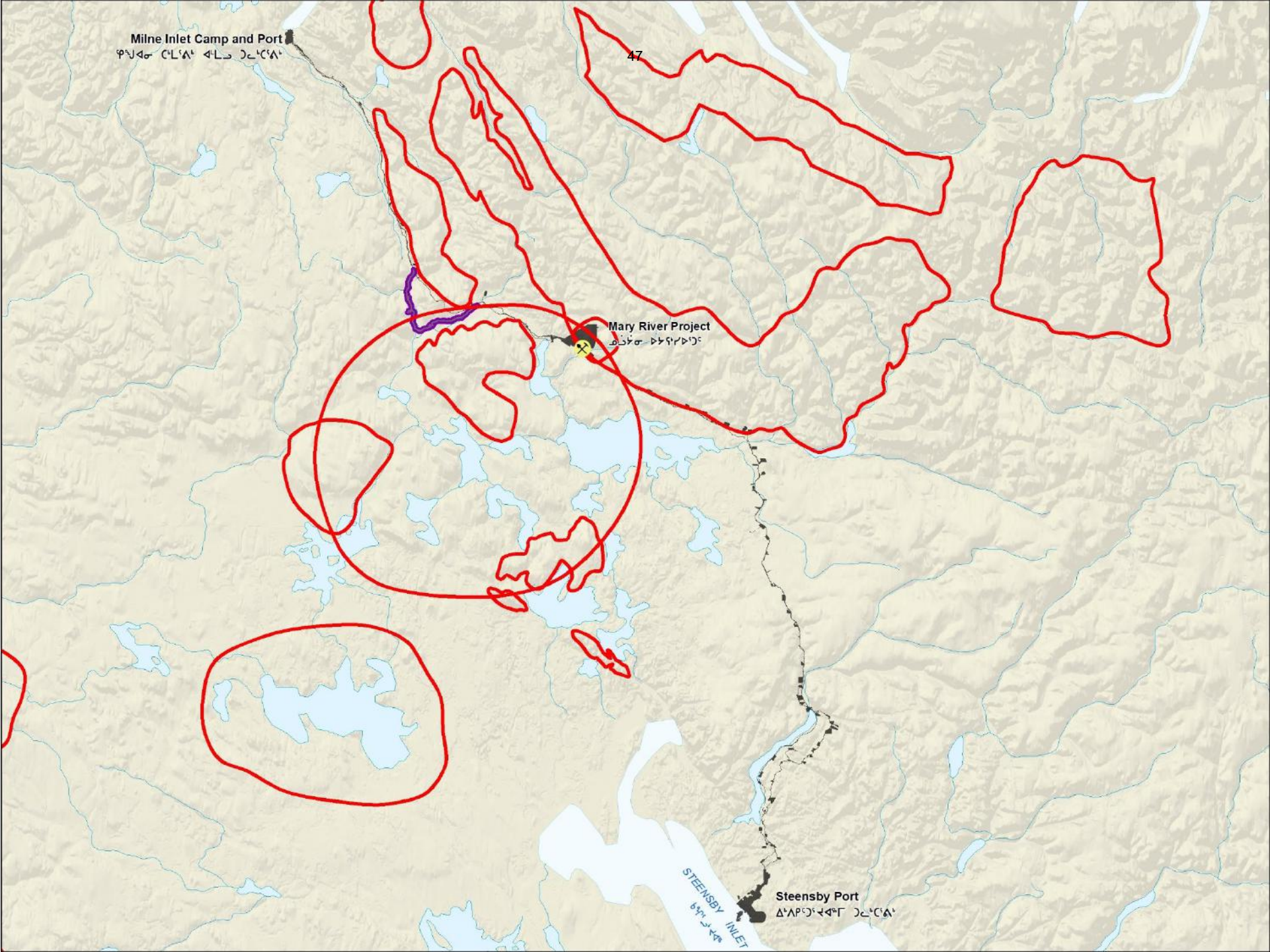
# Caribou Trails and Northern Rail

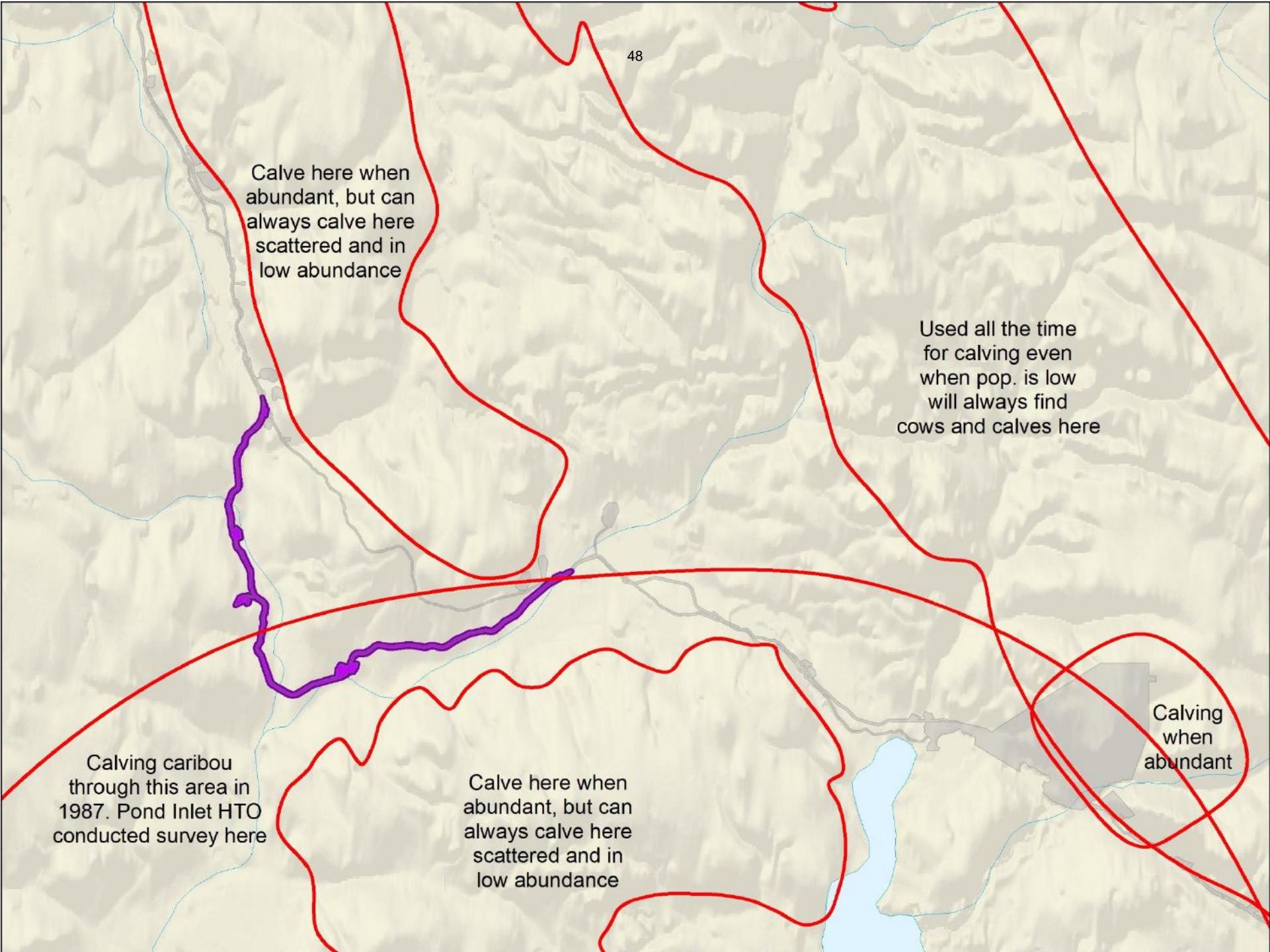
Baffinland Phase 2 Proposal  
Technical Meeting  
Iqaluit, Nunavut April 2019

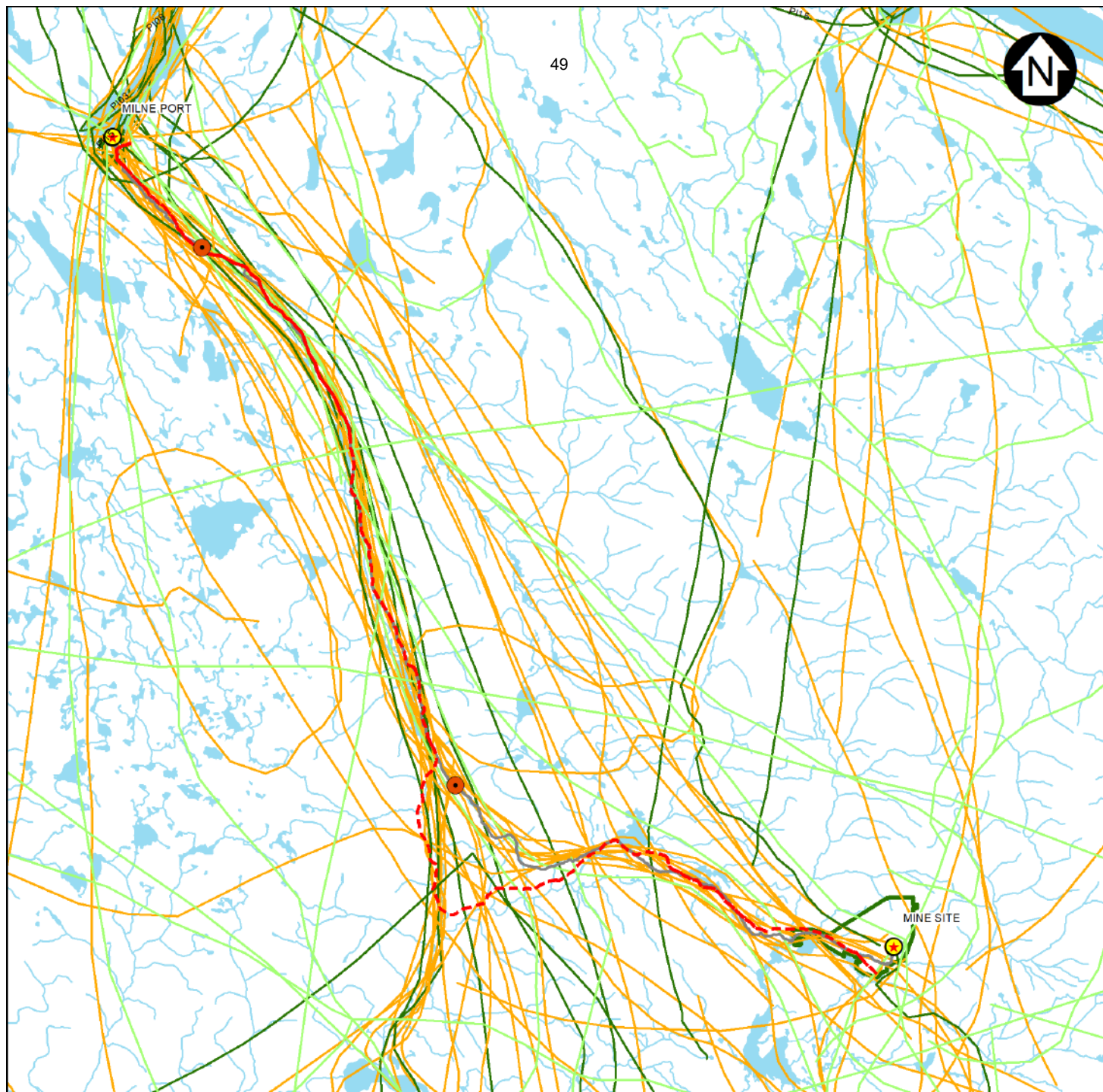


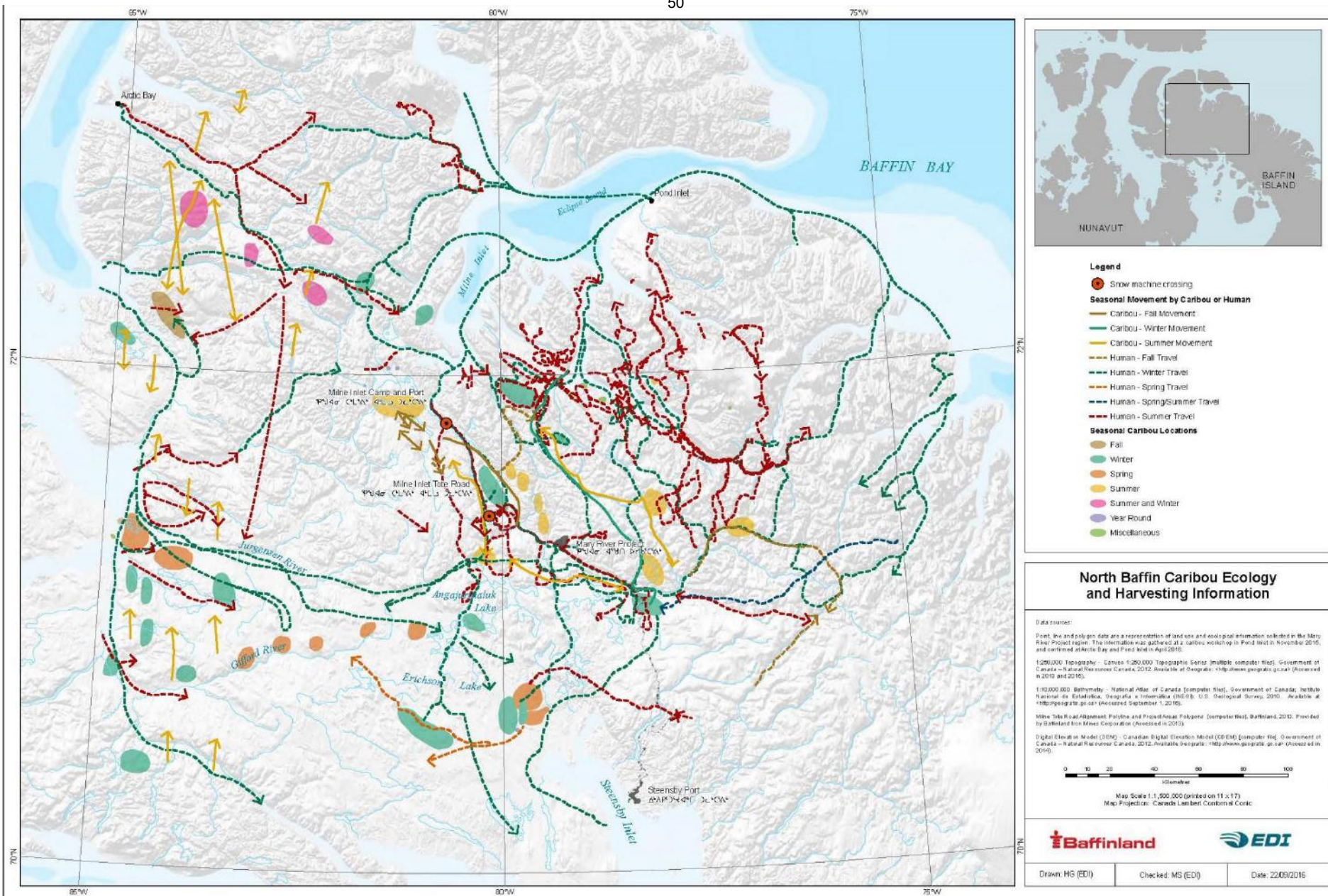


Map 6  
TSD-10









# RAIL PRESENTATION

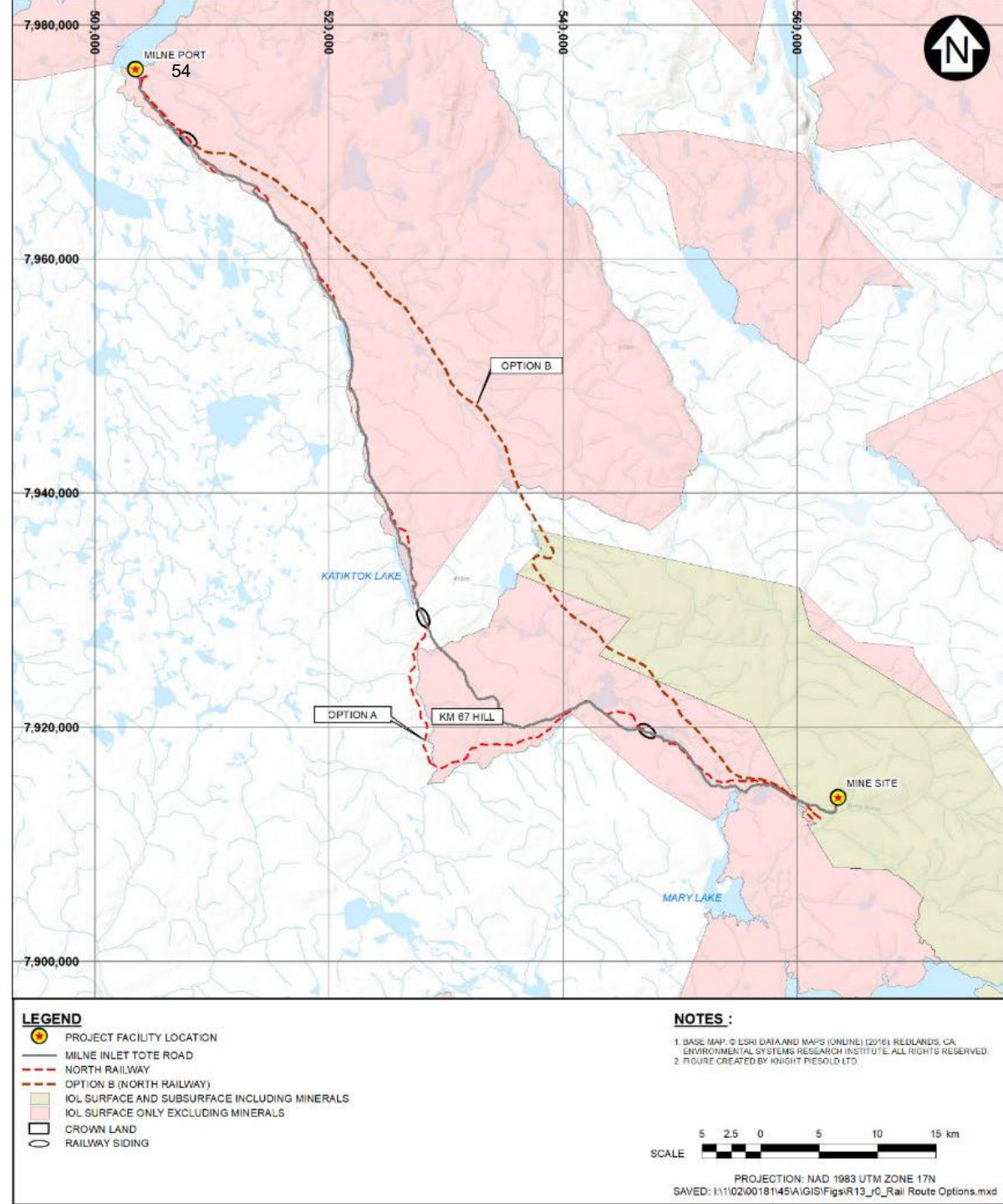


## Rail Presentation

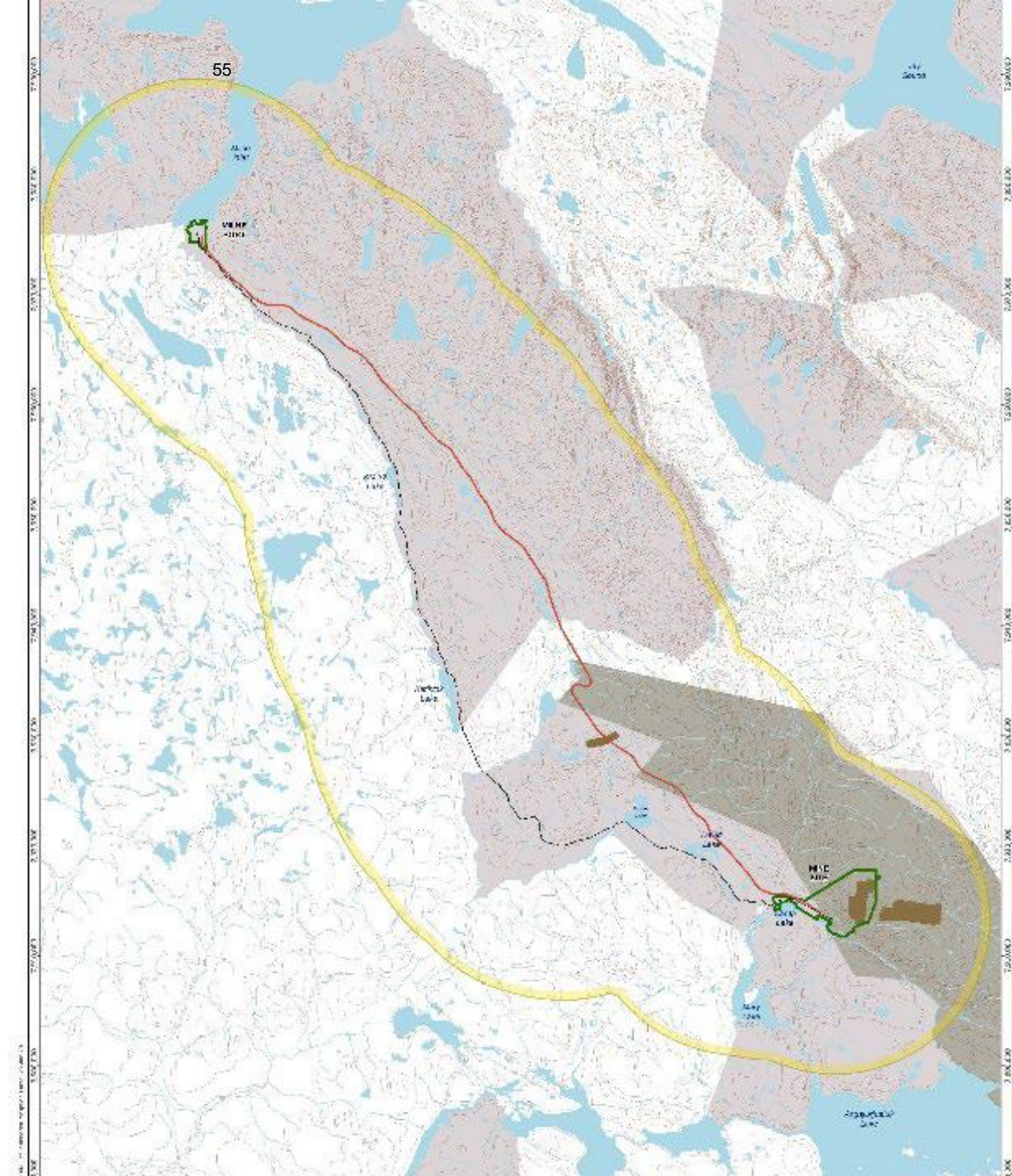


Alignment

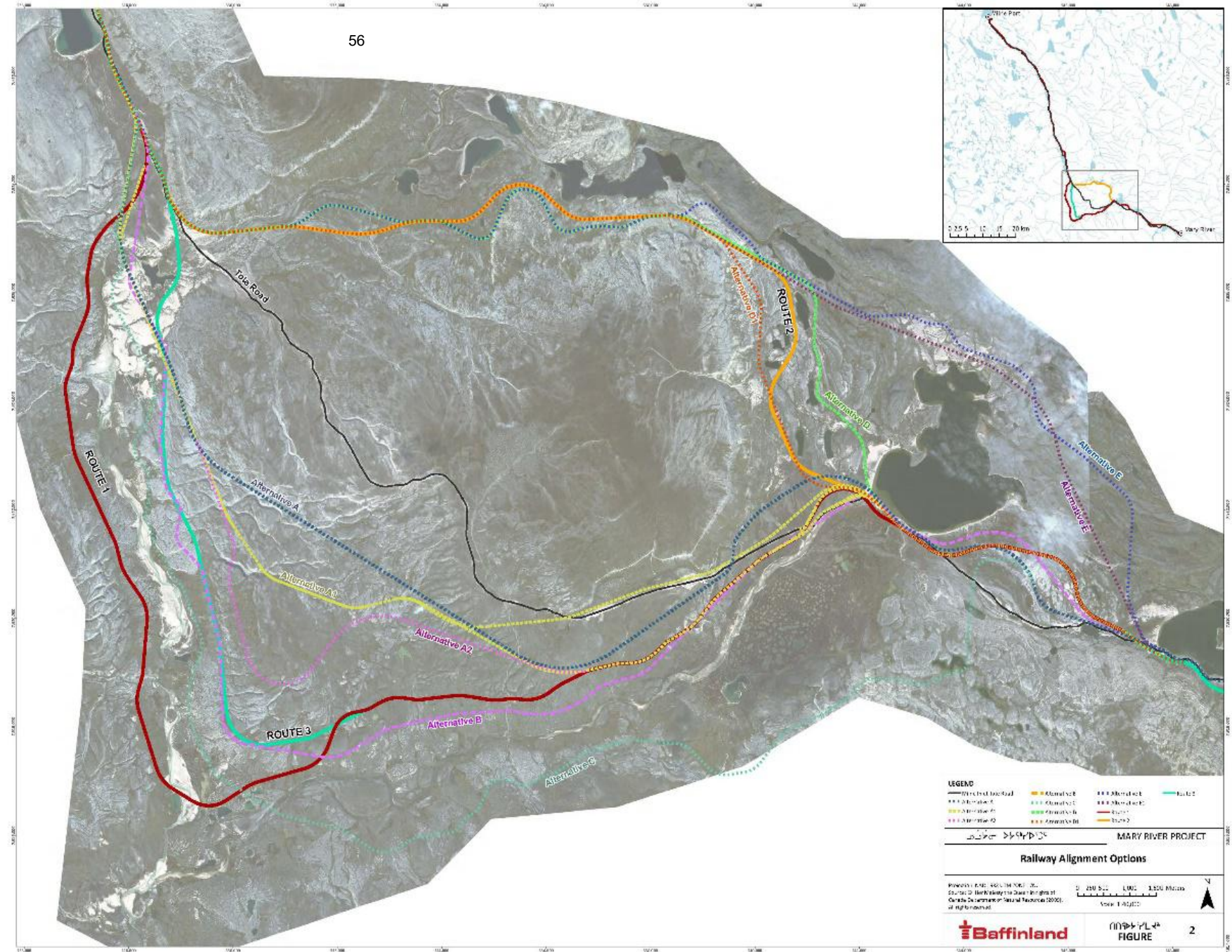
# Option A & B



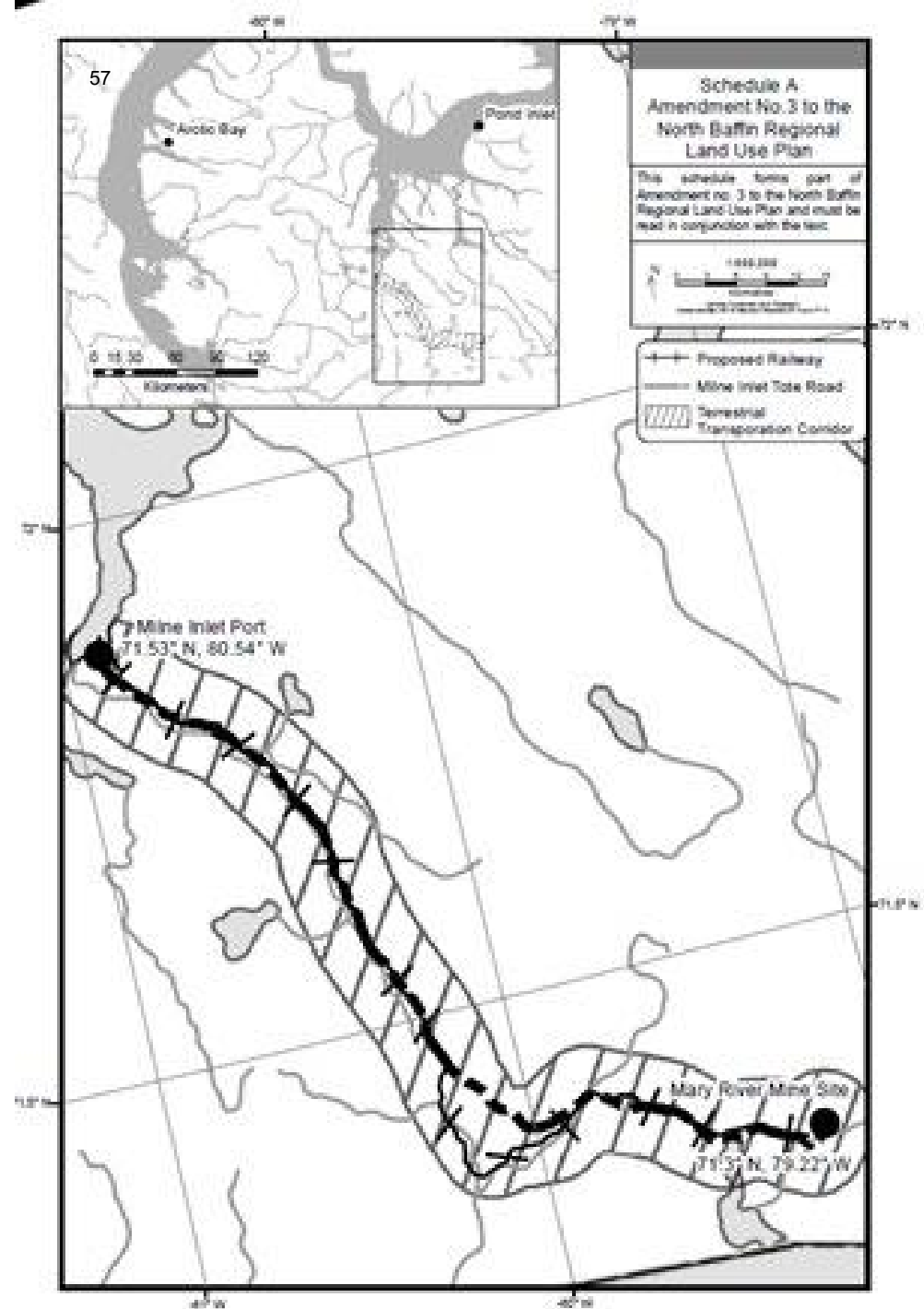
# Option B footprint

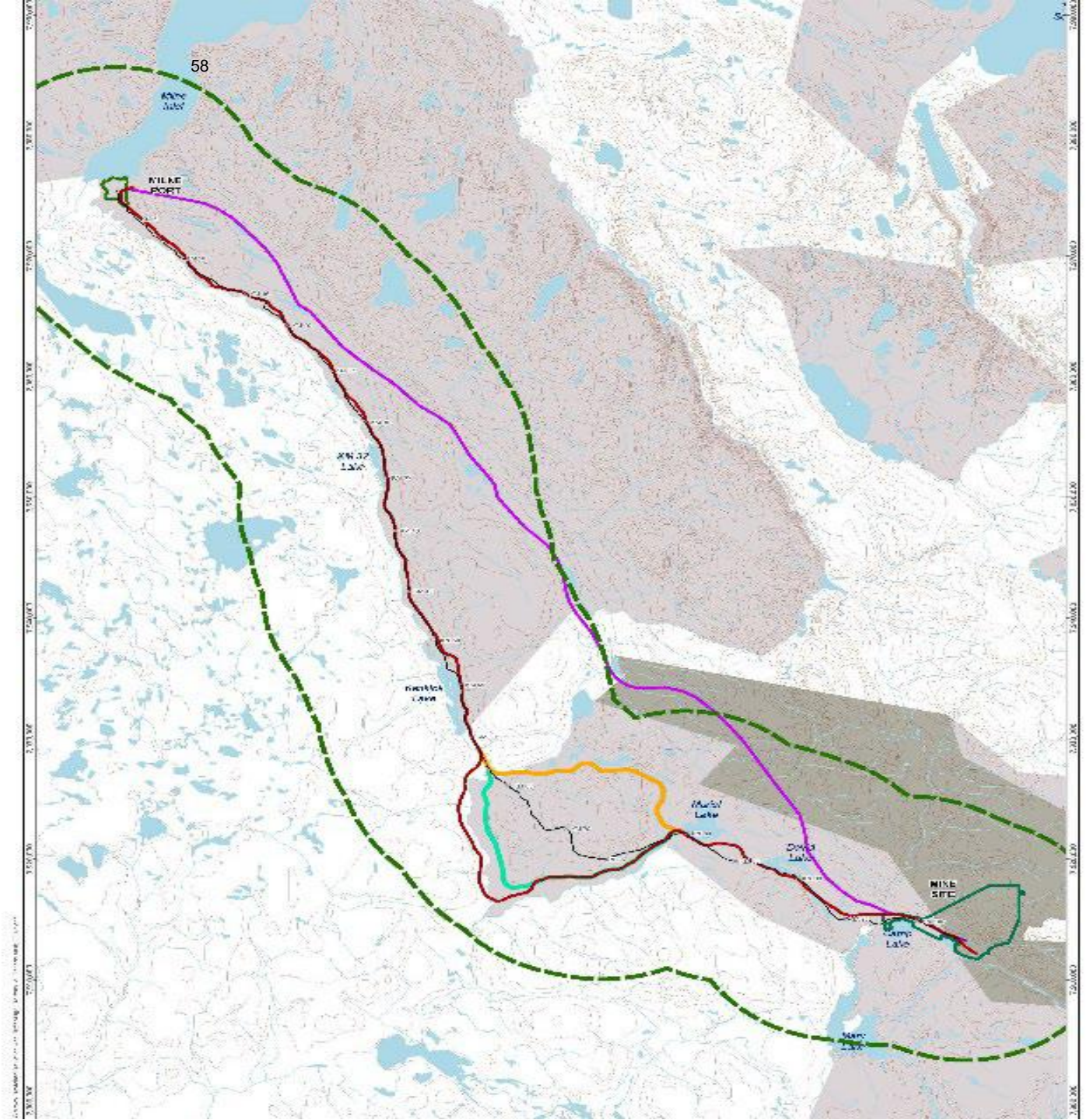


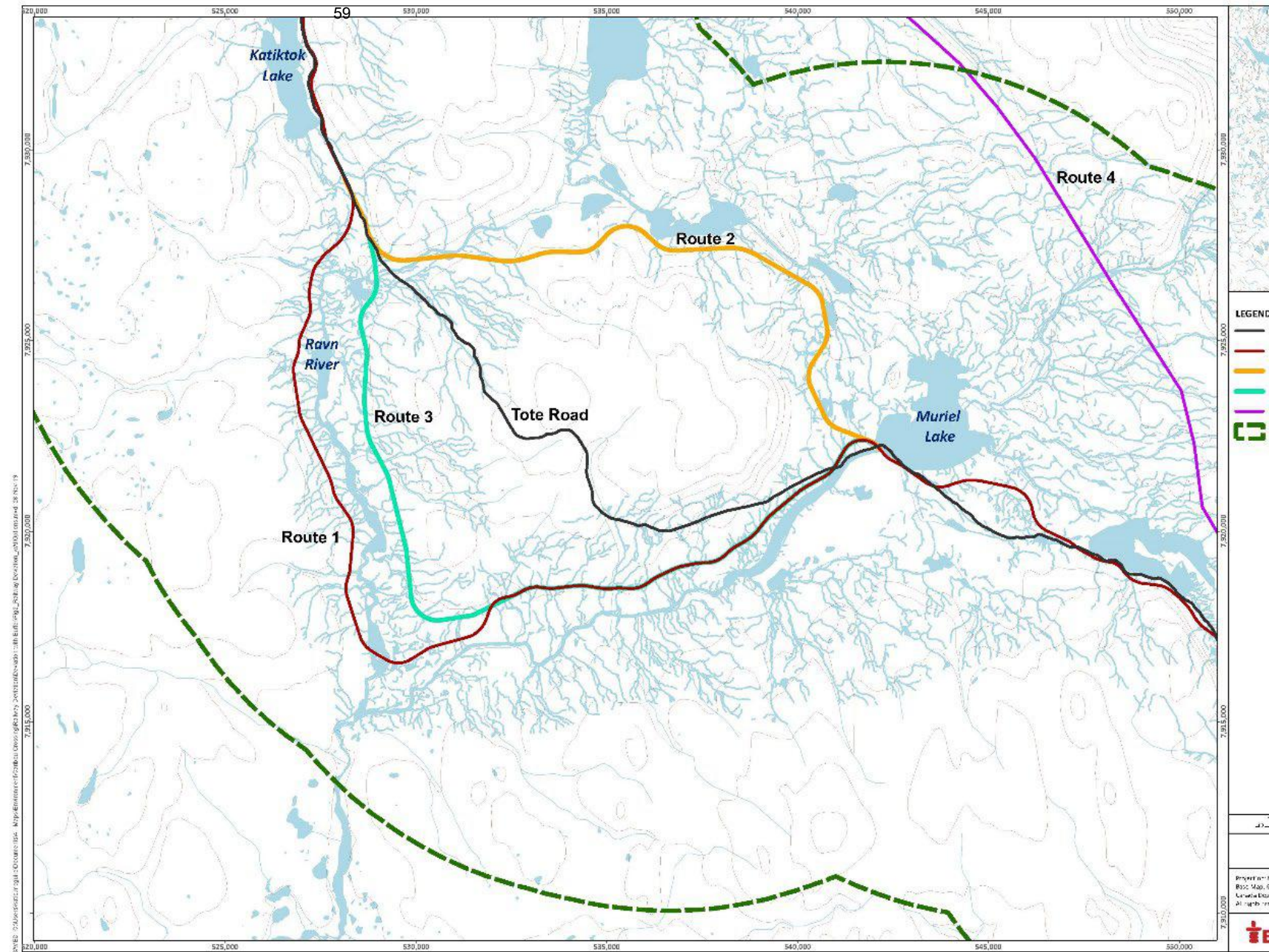
# Prefeasibility Study



# North Baffin Regional Land Use Plan



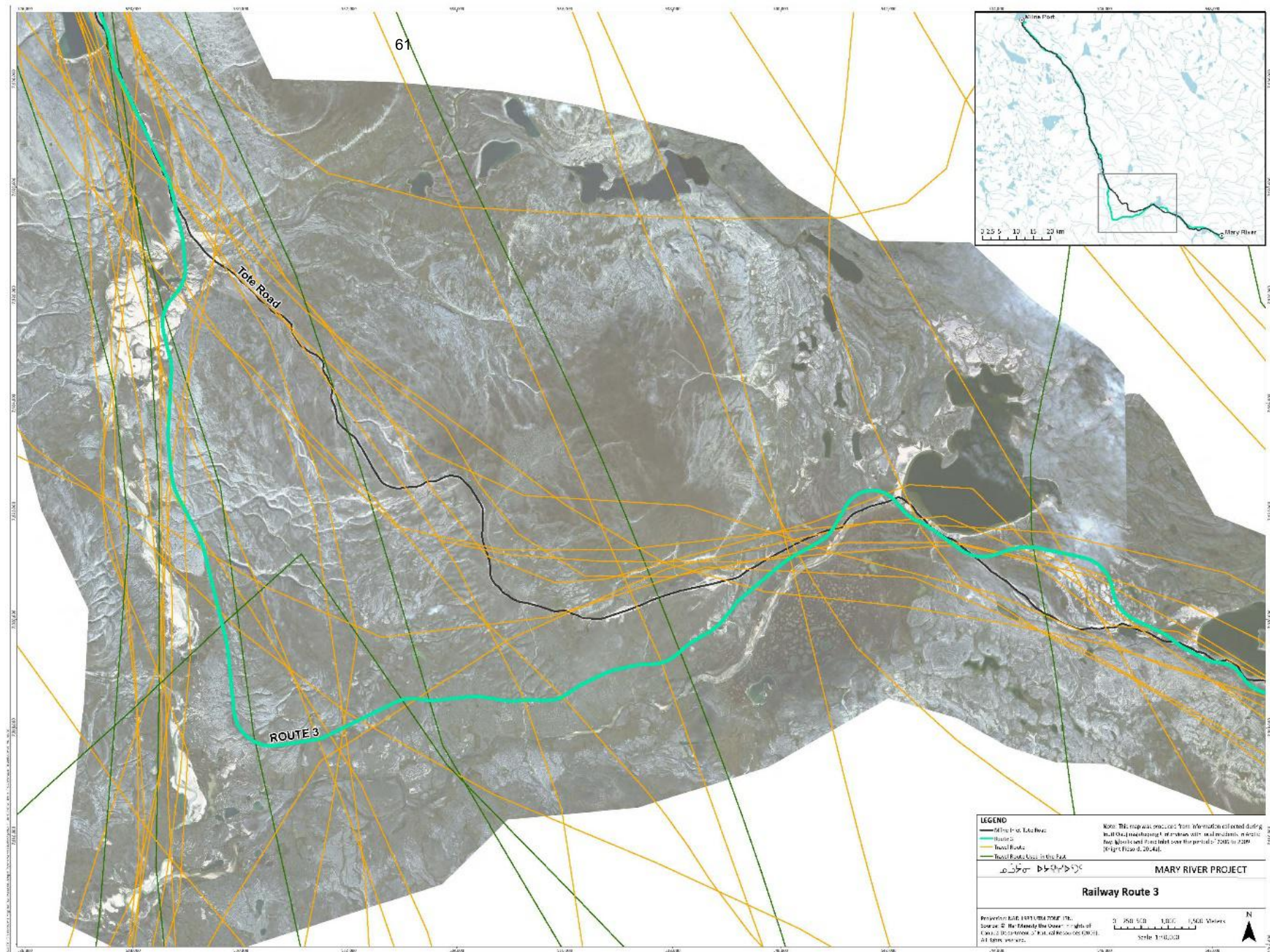




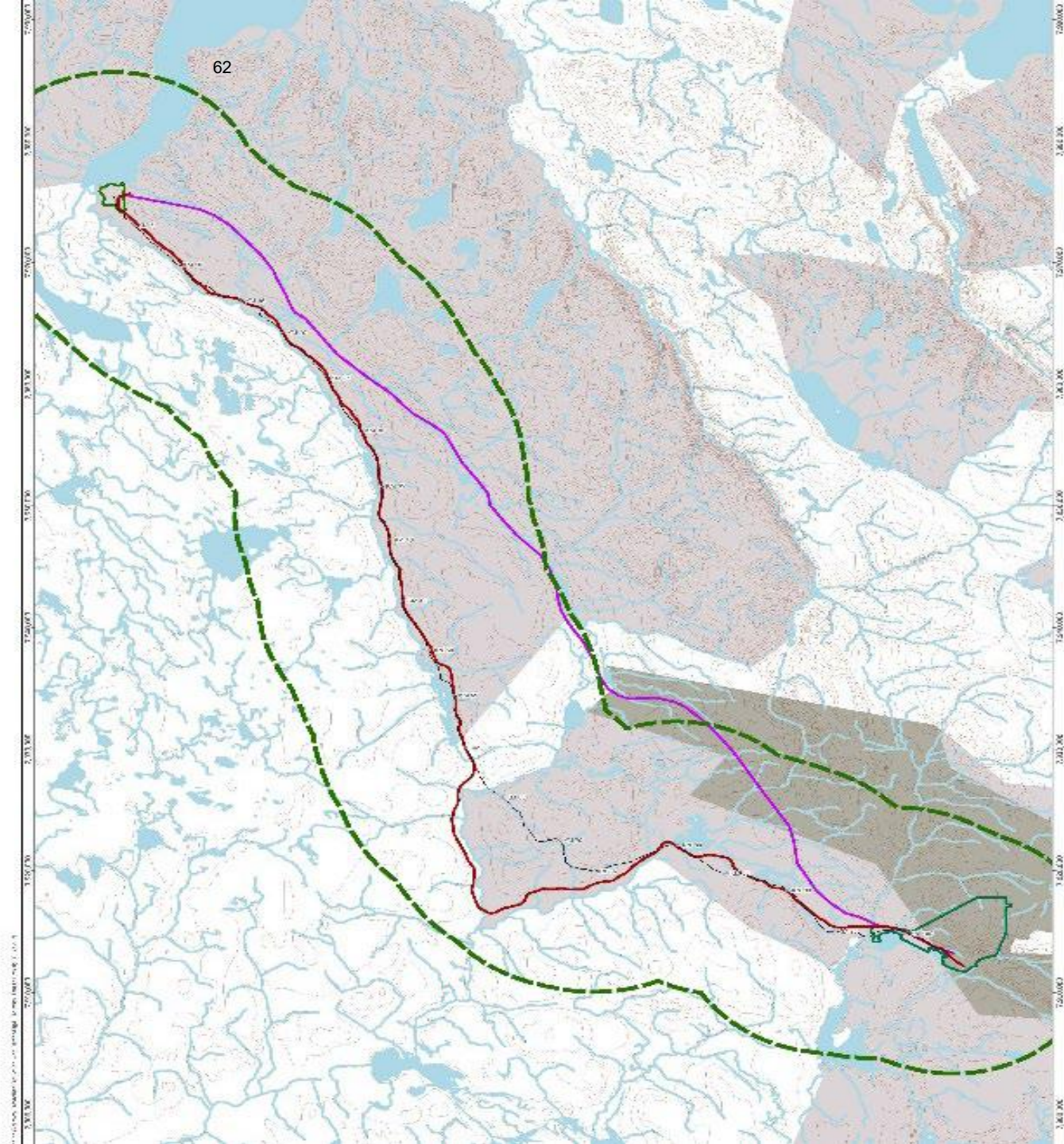
# Known Travel Routes



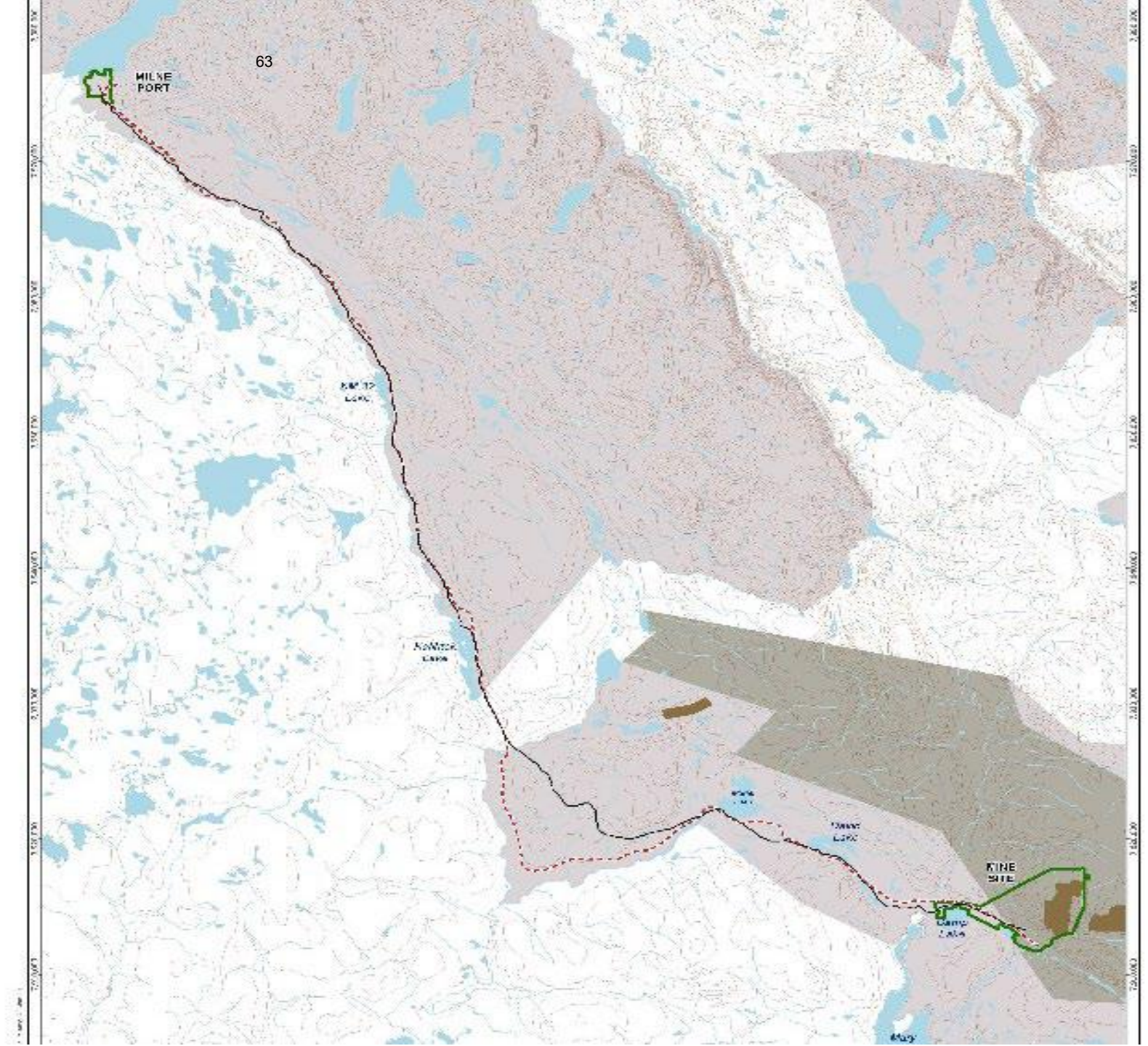
# Known Travel Routes - Deviation



# Option B+ (MHTO)



# Final Preferred Alignment





Mitigation

## ካሊፍራኒያ

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[illegible]

# Project Mitigation

## Design

- 1:2 slopes  $\geq 2$  m (6.6 ft)  $\leq 4$  m (12.1 ft)
- Type 8 (< 6 in) embankment material
- Level crossings (humans and wildlife)
- Plate arch culverts (humans and wildlife)
- ~66% of rail passable by caribou without further mitigation
- Reduced disturbance compared to truck traffic

## Operation

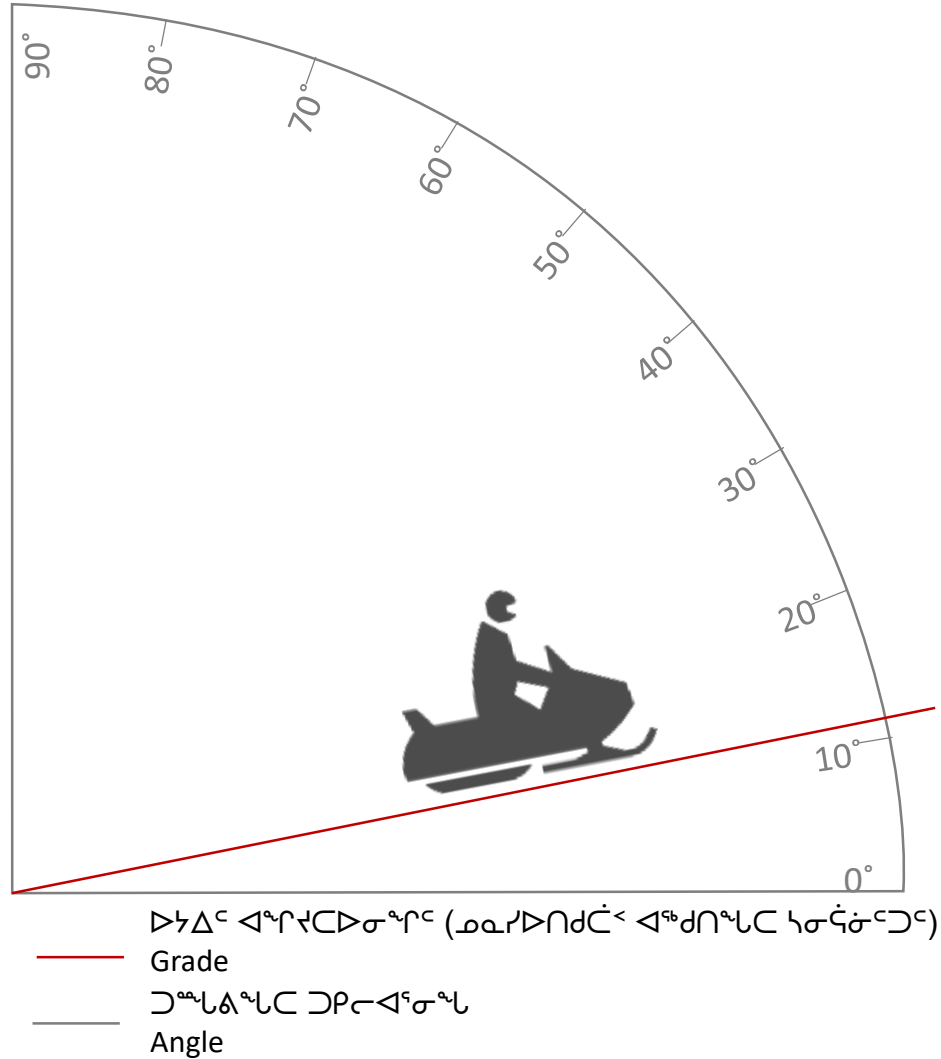
- Constant vigilance for animals and people
- Slow speeds and reasonable stopping distances
- Wildlife monitors present
- Hi-rail car used for monitoring
- Let the leaders pass
- Modify embankment as necessary





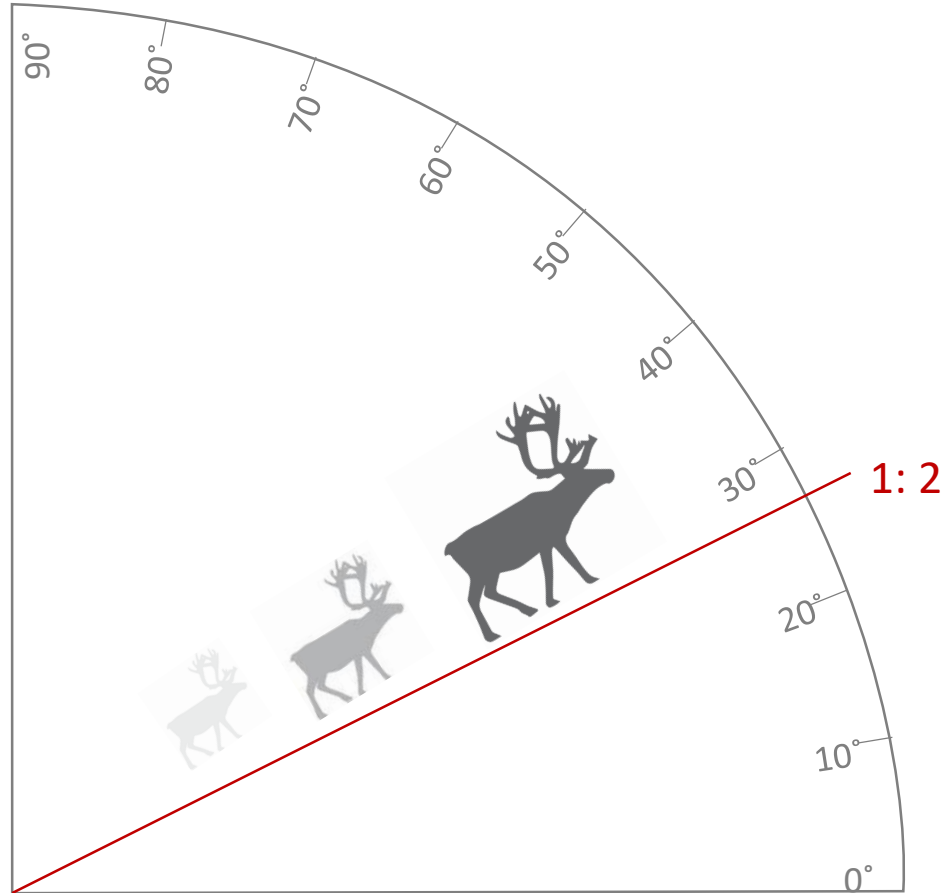
# ᑕᑦᑕᑦᑕ ᑕᑦᑕᑦᑕ ᑕᑦᑕᑦᑕ ᑕᑦᑕᑦᑕ ᑕᑦᑕᑦᑕ ᑕᑦᑕᑦᑕ

## Caribou Crossing Slope Ratios



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## Caribou Crossing Slope Ratios



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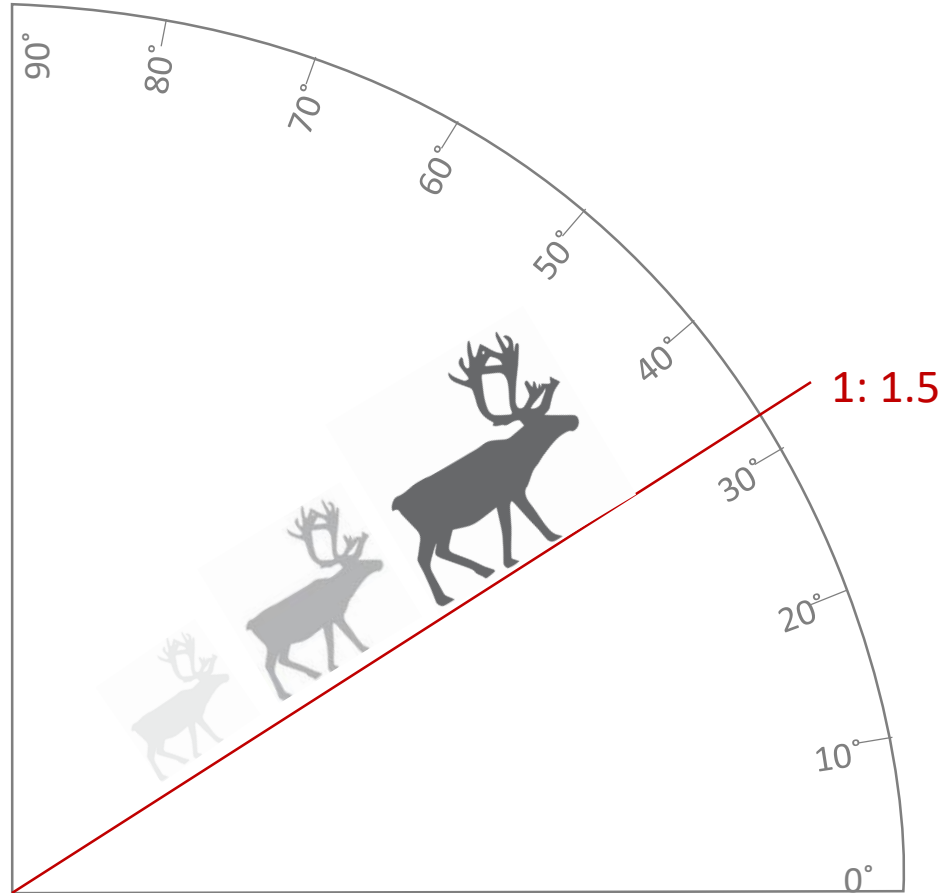
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Photo depicts a 1:1.5 slope

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## Caribou Crossing Slope Ratios



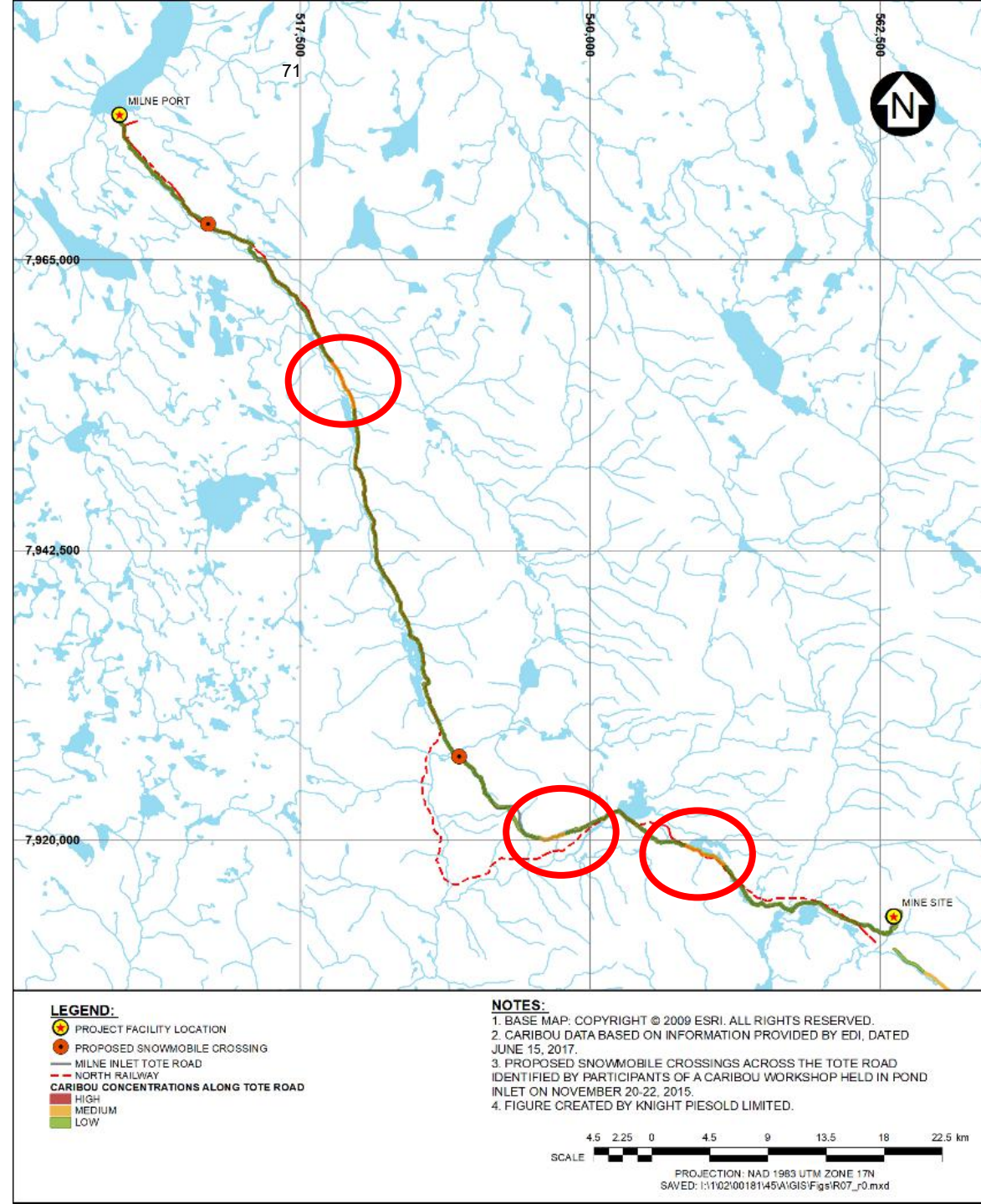
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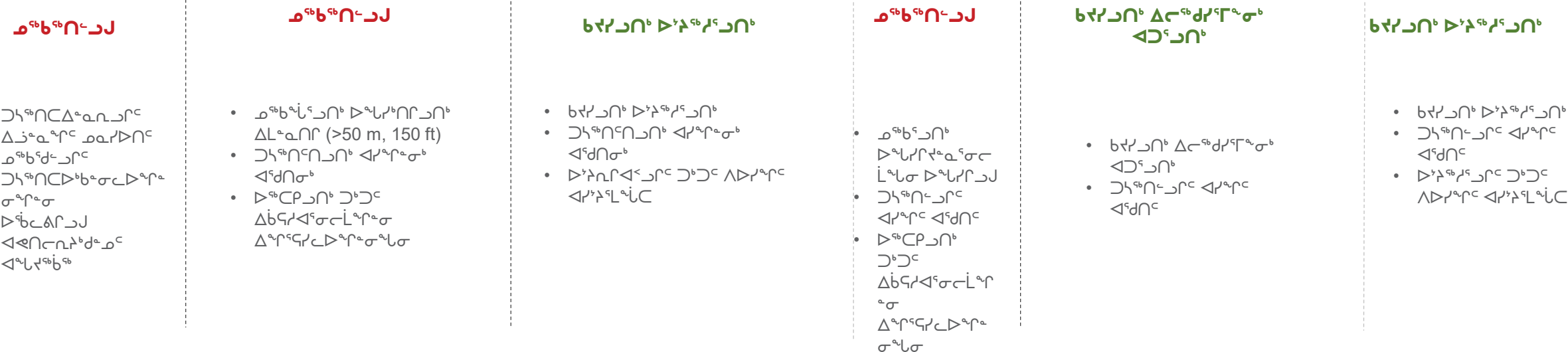
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— ᑕᑲᑲᑦᑕ ᑕᑲᑦᐃᑦᓂᑦ  
Angle



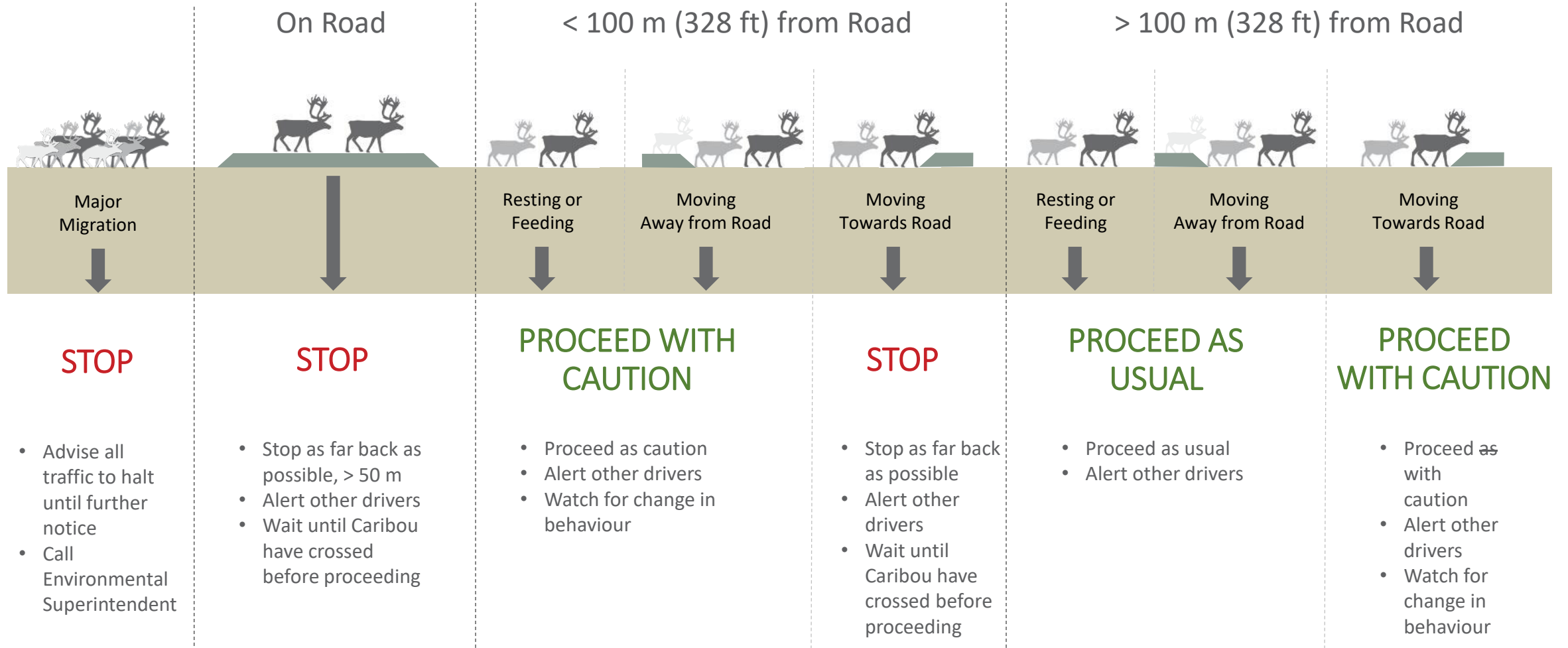
ᐃᑲᑦᑕᐅᑦᑕᑦ ᑦᓂᑦᑕᑦᑕᑦ 1:1.5 ᑭᐃᑦᓂᑦᓂᑦ  
Photo depicts a 1:1.5 slope

# Caribou Concentration Along Tote Road





# Caribou Decision Framework — Road





# Monitoring and Follow-up Programs

## Terrestrial Environment Mitigation and Monitoring Plan

(TSD 28, Appendix U)

### Vegetation

- Dust fall
- Metal uptake
- Abundance and diversity

### Birds

- Active migratory bird nest survey
- Contribution to regional bird monitoring
- Cliff-nesting raptor research

### Caribou

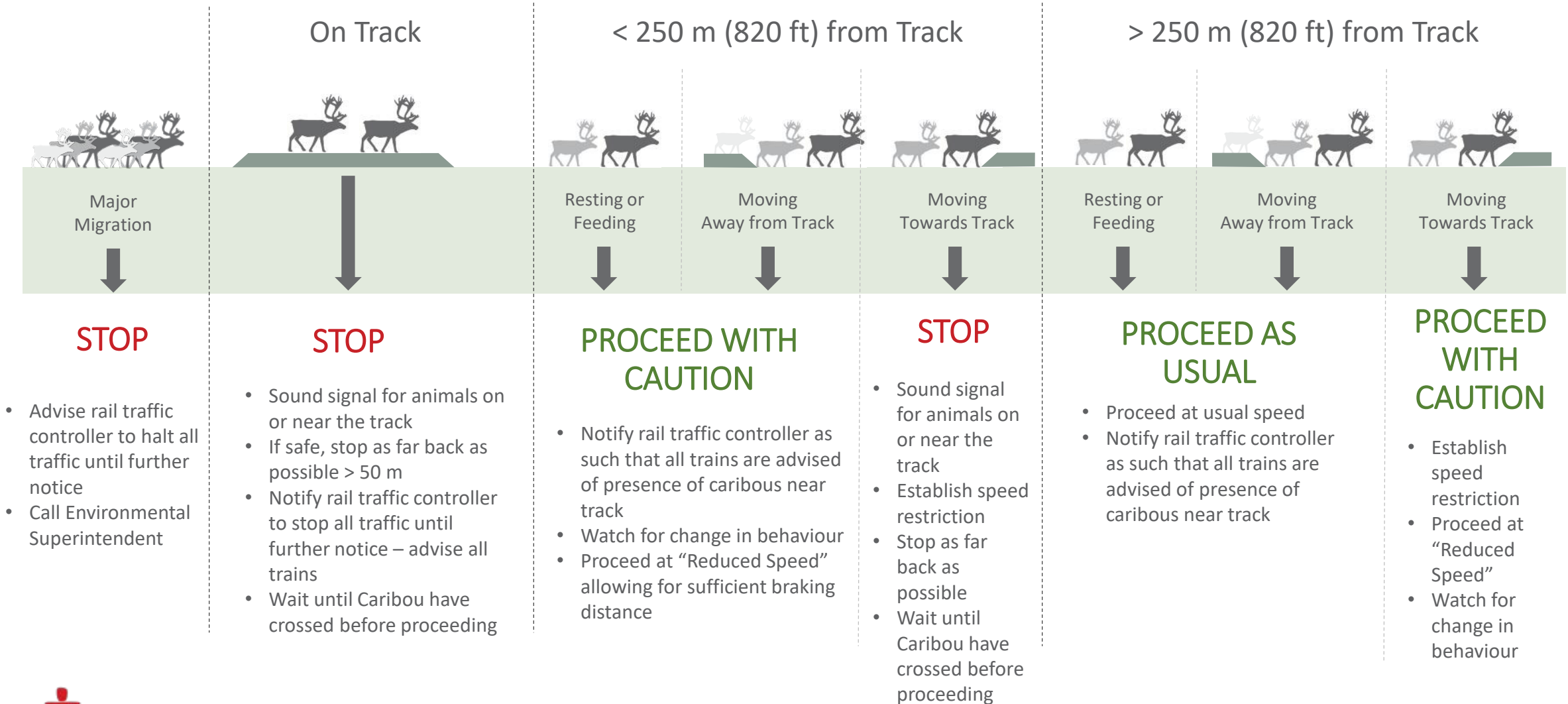
- Project-specific monitoring (height of land, snow tracks, constant vigilance, harvester observation)
- Crossing structure monitoring
- Contribution to regional caribou monitoring

### Terrestrial Environment Working Group

### Culture, Resource and Land Use Monitoring



# Caribou Decision Framework — Rail



# High Rail Truck



## 78

AP<sup>6b</sup>C

- $\geq \frac{1}{2} \log \frac{1}{\epsilon}$
- $\log \frac{1}{\epsilon}$
- $\log \frac{1}{\epsilon} \log \frac{1}{\epsilon}$

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Operation