September 11th, 2020

Executive Director Shelagh Montgomery
Mackenzie Valley Land and Water Board
PO BOX 2130
4922 48th Street
Yellowknife, NT X1A 2P6
Email: smontgomery@mvlwb.com

Dear Ms. Montgomery

Mount Gaudet Access Road (MGAR) Construction Application Package

The Government of the Northwest Territories Department of Infrastructure is submitting the attached Regulatory Application Package for construction of the Mount Gaudet Access Road located north of Wrigley, Northwest Territories (the Project).

The Regulatory Application Package includes the following documents:

- Project Description Report
  - Traditional Knowledge Summary
  - Land Use Permit and Water Licence Application
  - Quarry Permit Application and Draft Quarry Operations Plan
  - Draft Waste Management Plan
  - Draft Spill Contingency Plan
  - Environmental Overview
  - Letter of Support from Pehdzéh Kí First Nation
  - Engagement Plan and Engagement Record

Technical inquiries regarding the Project can be forwarded to Mr. Joe Acorn at Joe_Acorn@gov.nt.ca or via phone at 867-767-9081 ext. 31029. For all other inquiries, please contact me at Sonya_Saunders@gov.nt.ca or 867-767-9081 ext. 31035

Sincerely,

Sonya Saunders

Ms. Sonya Saunders
Director
Strategic Infrastructure
Department of Infrastructure

.../1

Attachment – MGAR Project Description Report

c. Mr. Joe Acorn
Manager
Mackenzie Valley Highway Project
Strategic Infrastructure

Mr. Kelly Bourassa
Senior Environmental Assessment Analyst
Strategic Infrastructure

.../2

Mount Gaudet Access Road

Project Description Report

Government of the Northwest Territories – Department of Infrastructure
September 2020

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Abbreviations

ARD/ML	Acid Rock Drainage and Metal Leaching
AIA	Archaeological Impact Assessments
AOA	Archaeological Overview Assessments
ARI	Aurora Research Institute
a.s.l	Above Sea Level
BC MOT	British Columbia Ministry of Transportation
CCME	Canadian Council of Ministers of the Environment
cm	centimetre
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CR	Conformity Requirements
CRA	Climate Resilience Assessment
D&B	Drilling and Blasting
dB	decibels
DFN	Dehcho First Nations
DFO	Department of Fisheries and Oceans Canada
DDLUP	Draft Dehcho Land Use Plan
DLUPC	Dehcho Land Use Planning Committee
ECCC	Environment and Climate Change Canada
ENR	Environment and Natural Resources- Government of the Northwest Territories
ESCP	Erosion and Sediment Control Plan
GIS	Geographic Information System
GNWT	Government of the Northwest Territories
ha	hectare
HSE	Health, Safety, and Environment
INF	Department of Infrastructure- Government of the Northwest Territories

km	kilometre
LiDAR	Light Detection and Ranging
LUP	Land Use Permit
MGAR	Mount Gaudet Access Road
m	metre
mm	millimetre
MVFOL	Mackenzie Valley Fibre Optic Line
MVH	Mackenzie Valley Highway
MVLUR	*Mackenzie Valley Land Use Regulations*
MVRMA	*Mackenzie Valley Resource Management Act*
MVWR	Mackenzie Valley Winter Road
NLUG	Northern Land Use Guidelines
NRCan	Natural Resources Canada
NTS	National Topographic System [of Canada]
NWT	Northwest Territories
O&M	Operations and Maintenance
PCAR	Prohibition Creek Access Road
PEP	Permafrost and Erosion Plan
PDR	Project Description Report
PKFN	Pehdzéh Kı́ First Nation
PWC	Public Works Canada
PWNHC	Prince of Wales Northern Heritage Centre
ROW	Right-of-Way
SARA	*Species at Risk Act*
SCP	Spill Contingency Plan
TAC	Transportation Association of Canada
TK	Traditional Knowledge

WMMP	Wildlife Management and Monitoring Plan
WMP	Waste Management Plan
WSCC	Workplace Safety and Compensation Committee

1 Introduction

The Government of the Northwest Territories Department of Infrastructure (INF) has developed the following Project Description Report (PDR) to support the Preliminary Screening by the Mackenzie Valley Land and Water Board (MVLWB) of a Type "A" Land Use Permit (LUP) and Type "B" Water Licence (WL) application for the proposed Mount Gaudet Access Road (MGAR) (the Project), an approximately 21 km all-season road from the end of the current all-season Mackenzie Valley Highway (MVH), at the community of Wrigley, to the existing Mount Gaudet Quarry along the current Mackenzie Valley Winter Road (MVWR) alignment.

The Project largely follows the MVWR and occurs within the proposed Pehdzéh Kį Ndeh Conservation zone, which is defined in the Draft Dehcho Land Use Plan (DDLUP) (DLUPC 2006). This conservation zone was designated to protect important natural resources which are harvested by Pehdzéh Kį First Nation (PKFN). The Pehdzéh Kį Ndeh area is noted in the DDLUP as an area of high ecological and cultural value. The area includes the old location of the Community of Wrigley as well as a large number of burial sites and traditional trails as described in this document. It is important to consider any potential impacts that the Project may have on culturally valuable lands and resources within the Pehdzéh Kį Ndeh that have been reported through local Traditional Knowledge (TK). INF has conducted ongoing engagement and consultation with PKFN as part of planning and design for this Project, and will continue to work with PKFN throughout the construction of the MGAR.

The purpose of this PDR is to provide information about the proposed Project, summarize baseline environmental conditions, including TK and Traditional Land Use, further discussed in Appendix A, to provide a preliminary screening for potential environmental impacts, and to identify impact mitigation measures.

1.1 Name and Contact Information - Applicant

1.1.1 Applicant Head Office Address

Applicant's Name
Sonya Saunders
Director
Strategic Infrastructure
Department of Infrastructure
Government of the Northwest Territories
P.O. Box 1320
Yellowknife NT X1A 2L9
Telephone 867.767.9081 x31025
Email sonya_saunders@gov.nt.ca

Alternate Contact
Joe Acorn
Manager
Mackenzie Valley Highway Project
Strategic Infrastructure
Department of Infrastructure
Government of the Northwest Territories
P.O. Box 1320
Yellowknife NT X1A 2L9
Telephone 867.767.9081 x31029
Email joe_acorn@gov.nt.ca

1.1.2 Name and Contact Information – Contractors and Subcontractors

The Contractor for the Project has not been selected as of the date of this PDR. Contact information for the Contractor will be provided to the MVLWB upon award of the contract.

1.1.3 Other Personnel

Where possible, INF will use Contractors, businesses and resources from Wrigley and the Dehcho Region. Specific names of businesses and individuals are not yet known but will be identified prior to the start of construction. The field personnel required for the Project are expected to include equipment operators, labourers, camp staff, engineering staff, surveyors, and environmental monitoring staff.

The maximum number of personnel who will be working on the Project and based out of the camp at any given time is estimated to be about 100 individuals. Personnel are expected to work 12 hours per day over 24-30 months.

2 Location of Activities with Map Coordinates

The Project includes an all-season access road following two possible alignments, a quarry, and two bridge locations (one existing and one alternate location for the same water crossing). To minimize environmental impacts, the Project will follow the existing MVWR alignment. A deviation of 2.77 km east of the MVWR may be required for the potential new Hodgson Creek Bridge location. The potential new Hodgson Creek Bridge location is being investigated to address problems of excess water and ice backup at the existing location.

Further geotechnical work, to be undertaken between now and the anticipated construction start date, will be required to determine the final alignment of the MGAR. The final alignment is dependent upon the review of the final report on the geotechnical work, further consultations with PKFN and applications for additional funding (in progress). As such, the alignment of the road is described as segments:

- Segment 1 – Starts approximately 1 km north of the existing Hodgson Creek Bridge and follows the existing MVWR alignment north to the Mount Gaudet Quarry for approximately 14.62 km.

- Segment 2 – Starts at Hodgson Creek Bridge - either from the current bridge location (Segment 2a) for 1.13 km or the potential new Hodgson Creek bridge location (Segment 2b) for 1.65 km – and continues north to the south end of Segment 1.

- Segment 3 – The Hodgson Creek Bridge would be raised at its current location (Segment 3a) or a new bridge will be installed further upstream (Segment 3b).

- Segment 4 – Starts at the final location of the Hodgson Creek Bridge and continues south to the end of Highway #1 – either from the current Hodgson Creek Bridge location following the current MVWR alignment (Segment 4a) for 5.07 km or on a new alignment from the potential new Hodgson Creek Bridge location (4b) for 1 km, from which point it will continue along the existing MVWR alignment for 3.92 km to the end of Highway #1.

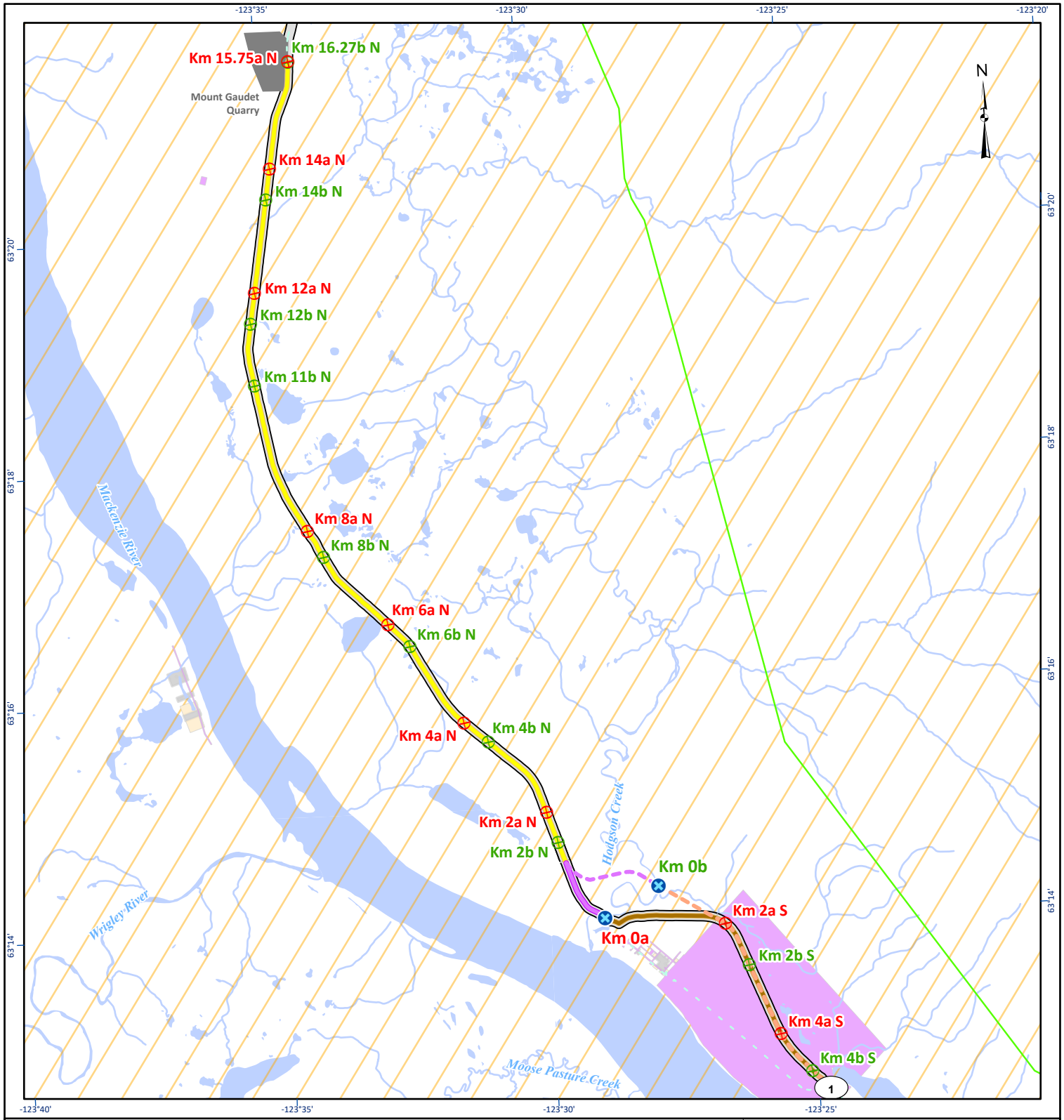
INF currently has construction funding secured for Segments 1, 2 and 3. Funding is being sought for Segment 4, and construction of this segment will not proceed until this funding has been confirmed.

The final, overall alignment of the MGAR is described in this PDR as two scenarios:

- Scenario 1: Represents a scenario where the existing Hodgson Creek Bridge is raised at its current location. Includes MGAR segments 1, 2a, 3a, and 4a. The total length of the MGAR in this Scenario is 20.81 km.
- Scenario 2: Represents a scenario in which a new Hodgson Creek Bridge is installed upstream of the existing one, and Segments 2b and 4b are constructed to align the MGAR with this new bridge. Includes MGAR segments 1, 2b, 3b, and 4b. The total length of the MGAR in this Scenario is 20.57 km.

In this PDR, the Project footprint refers to the total area covered by the 60 m right-of-way along the MGAR route under both construction scenarios, the area within Mount Gaudet Quarry boundaries, and the two bridge locations.

The locations of Project activities are shown in Figures 2-1 to 2-3.



LEGEND

- Bridge (S3)
- Kilometre Post (Scenario 1)
- Kilometre Post (Scenario 2)
- Enbridge Pipeline
- Highway 1 - Mackenzie Valley Highway
- Mackenzie Valley Fibre Link
- Mackenzie Valley Winter Road
- MGAR Segment 1
- MGAR Segment 2a
- MGAR Segment 2b
- MGAR Segment 4a
- MGAR Segment 4b

Land Authority Parcel

- Commissioner's
- Private
- Territorial
- Other
- Mount Gaudet Quarry
- Watercourse
- Waterbody

2 1 0 2
1:85,000 Kilometres

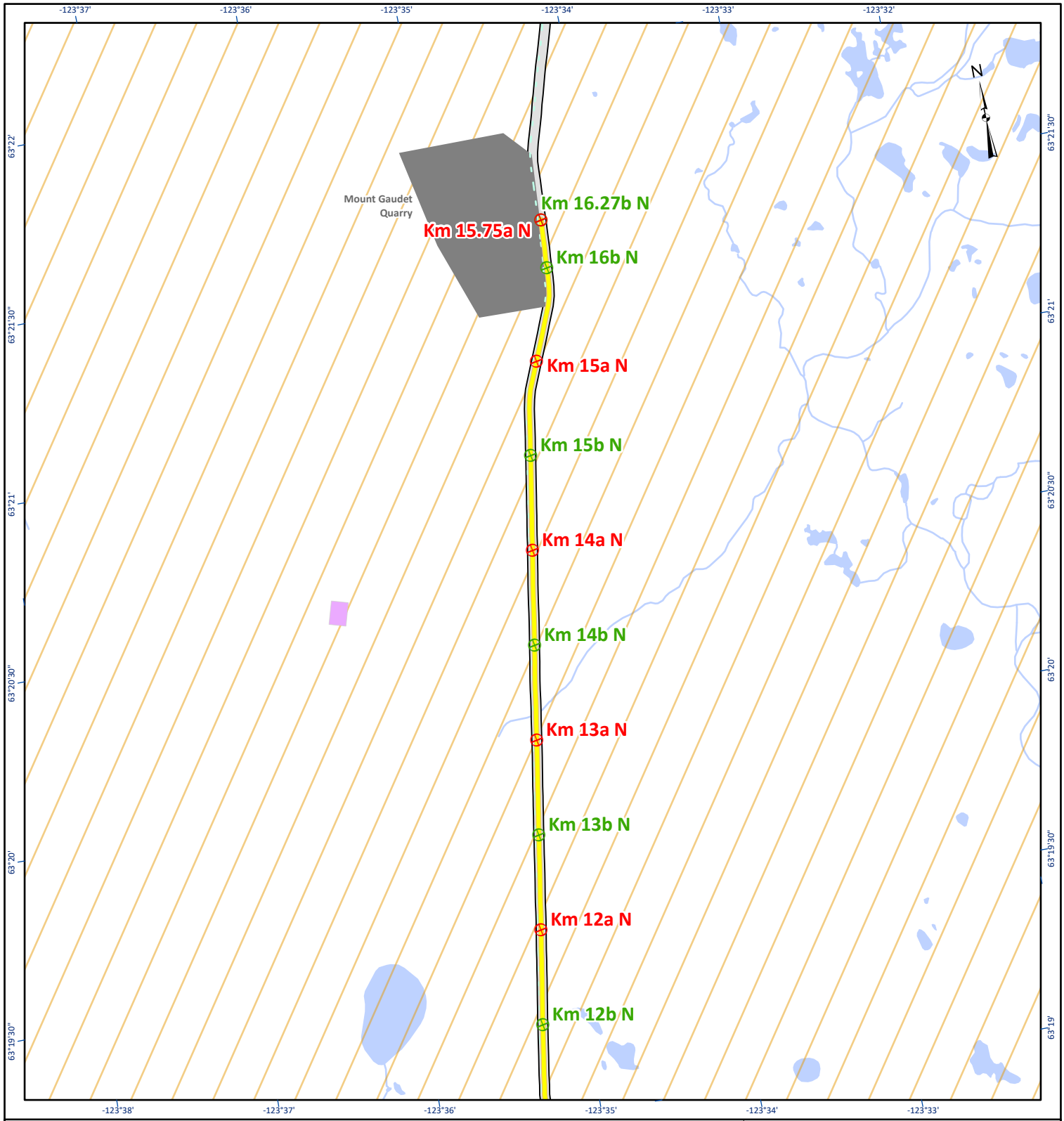
NOTES

Sources: Project Data: Government of Northwest Territories. Base Data: CanVec, Government of Canada; Government of Northwest Territories; NWT Centre of Geomatics
Spatial Reference: NAD 1983 Northwest Territories Lambert

Figure 2-1 - MGAR Project Overview
1 of 6

GIS	DR	2020-06-11	Doc ID: 144902910-3014_REVB
QA/QC	EV	2020-06-11	Government of the Northwest Territories

GOVERNMENT OF NORTHWEST TERRITORIES • GOUVERNEMENT DES TERRITOIRES DU NORD-OUEST



LEGEND

- Bridge (S3)
- Kilometre Post (Scenario 1)
- Kilometre Post (Scenario 2)
- Mackenzie Valley Fibre Link
- Mackenzie Valley Winter Road
- MGAR Segment 1
- MGAR Segment 2a
- MGAR Segment 2b
- MGAR Segment 4a
- MGAR Segment 4b

Land Authority Parcel

- Commissioner's
- Territorial
- Mount Gaudet Quarry
- Watercourse
- Waterbody

500 250 0 500
1:28,000 Meters

NOTES

Sources: Project Data: Government of Northwest Territories. Base Data: CanVec, Government of Canada; Government of Northwest Territories; NWT Centre of Geomatics
Spatial Reference: NAD 1983 Northwest Territories Lambert

Figure 2-1 - Access Road - MGAR Segments
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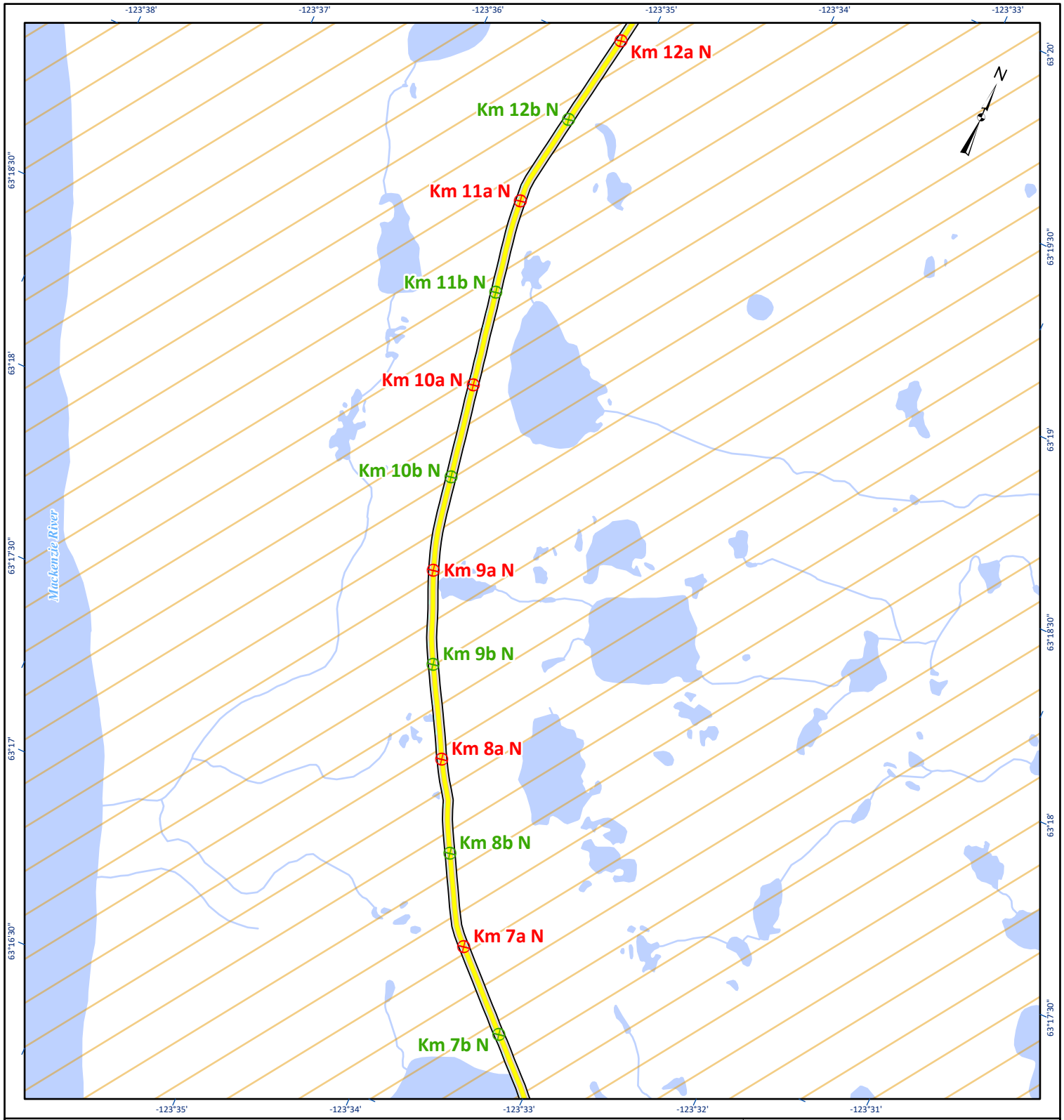
GIS	DR	2020-06-11	Doc ID: 144902910-3015 REVB
QA/QC	EV	2020-06-11	Government of the Northwest Territories

GOVERNMENT OF NORTHWEST TERRITORIES • GOUVERNEMENT DES TERRITOIRES DU NORD-OUEST



LEGEND

- Bridge (S3)
- Kilometre Post (Scenario 1)
- Kilometre Post (Scenario 2)
- Mackenzie Valley Fibre Link
- Mackenzie Valley Winter Road
- MGAR Segment 1
- MGAR Segment 2a
- MGAR Segment 2b
- MGAR Segment 4a
- MGAR Segment 4b

Land Authority Parcel

- Territorial
- Watercourse
- Waterbody

500 250 0 500
1:28,000 Meters

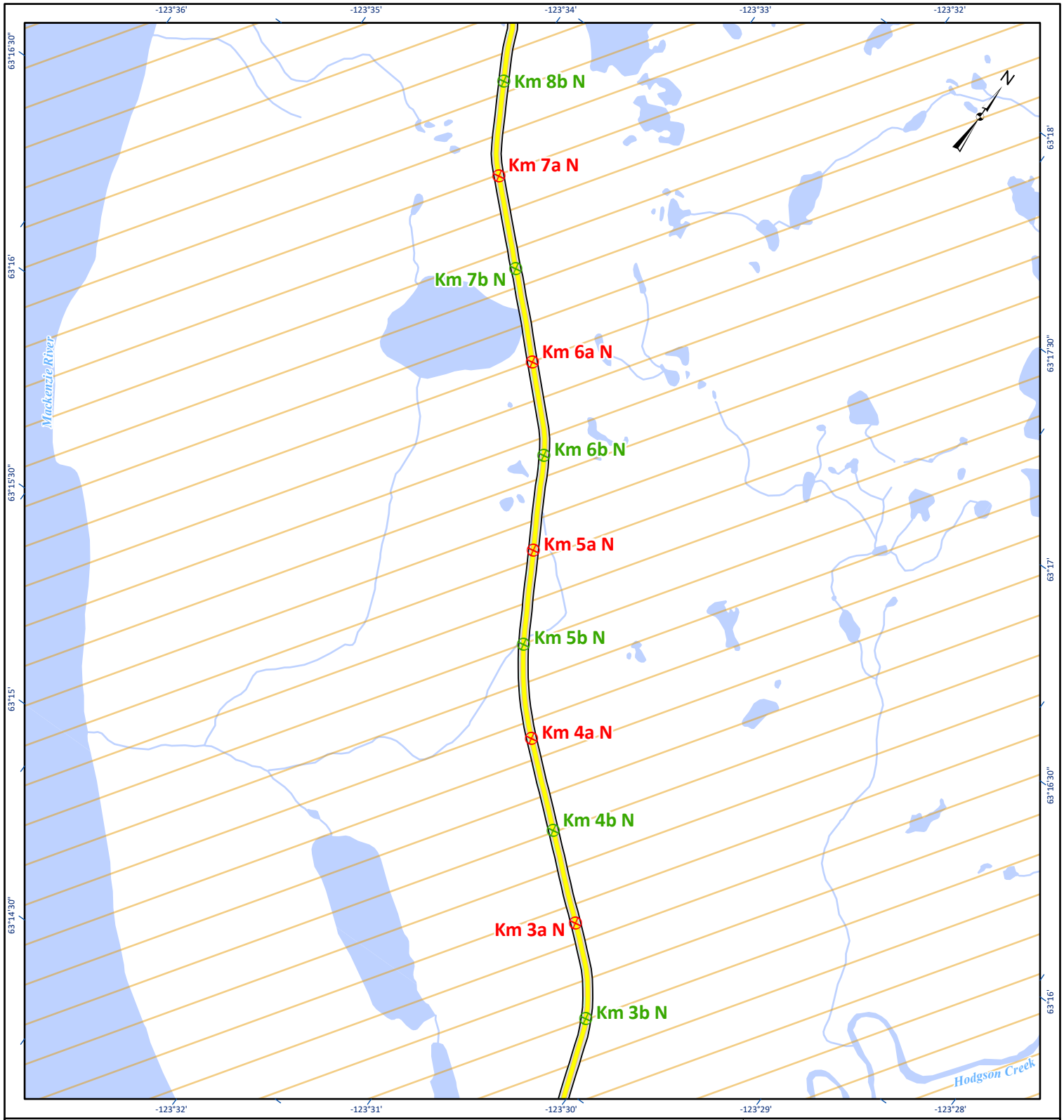
NOTES

Sources: Project Data: Government of Northwest Territories. Base Data: CanVec, Government of Canada; Government of Northwest Territories; NWT Centre of Geomatics
Spatial Reference: NAD 1983 Northwest Territories Lambert

Figure 2-1 - Access Road - MGAR Segments
Page 3 of 6

GIS	DR	2020-06-11	Doc ID: 144902910-3015 REVB
QA/QC	EV	2020-06-11	Government of the Northwest Territories

GOVERNMENT OF NORTHWEST TERRITORIES • GOUVERNEMENT DES TERRITOIRES DU NORD-OUEST •



LEGEND

- Bridge (S3)
- Kilometre Post (Scenario 1)
- Kilometre Post (Scenario 2)
- Mackenzie Valley Fibre Link
- Mackenzie Valley Winter Road
- MGAR Segment 1
- MGAR Segment 2a
- MGAR Segment 2b
- MGAR Segment 4a
- MGAR Segment 4b

Land Authority Parcel

- Territorial
- Watercourse
- Waterbody

500 250 0 500

1:28,000 Meters

NOTES

Sources: Project Data: Government of Northwest Territories. Base Data: CanVec, Government of Canada; Government of Northwest Territories; NWT Centre of Geomatics
Spatial Reference: NAD 1983 Northwest Territories Lambert

Figure 2-1- Access Road - MGAR Segments
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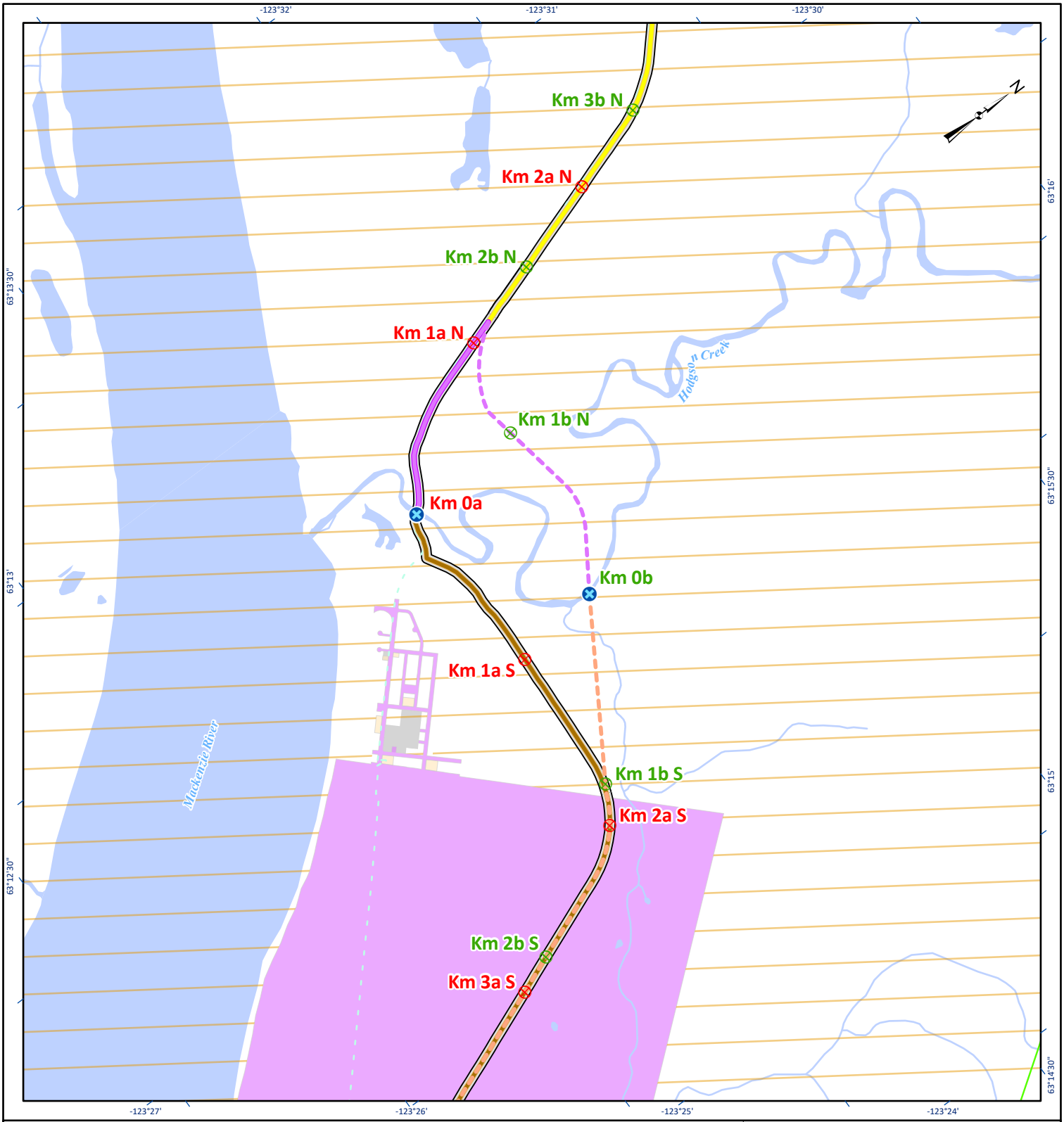
GIS	DR	2020-06-11	Doc ID: 144902910-3015 REVB
QA/QC	EV	2020-06-11	Government of the Northwest Territories

GOVERNMENT OF NORTHWEST TERRITORIES • GOUVERNEMENT DES TERRITOIRES DU NORD-OUEST •



LEGEND

- Bridge (S3)
- Kilometre Post (Scenario 1)
- Kilometre Post (Scenario 2)
- Enbridge Pipeline
- Mackenzie Valley Fibre Link
- Mackenzie Valley Winter Road
- MGAR Segment 1
- MGAR Segment 2a
- MGAR Segment 2b
- MGAR Segment 4a
- MGAR Segment 4b

Land Authority Parcel

- Commissioner's
- Private
- Territorial
- Other
- Watercourse
- Waterbody

500 250 0 500
1:28,000 Meters

NOTES

Sources: Project Data: Government of Northwest Territories. Base Data: CanVec, Government of Canada; Government of Northwest Territories; NWT Centre of Geomatics
Spatial Reference: NAD 1983 Northwest Territories Lambert

Figure 2-1-Access Road - MGAR Segments
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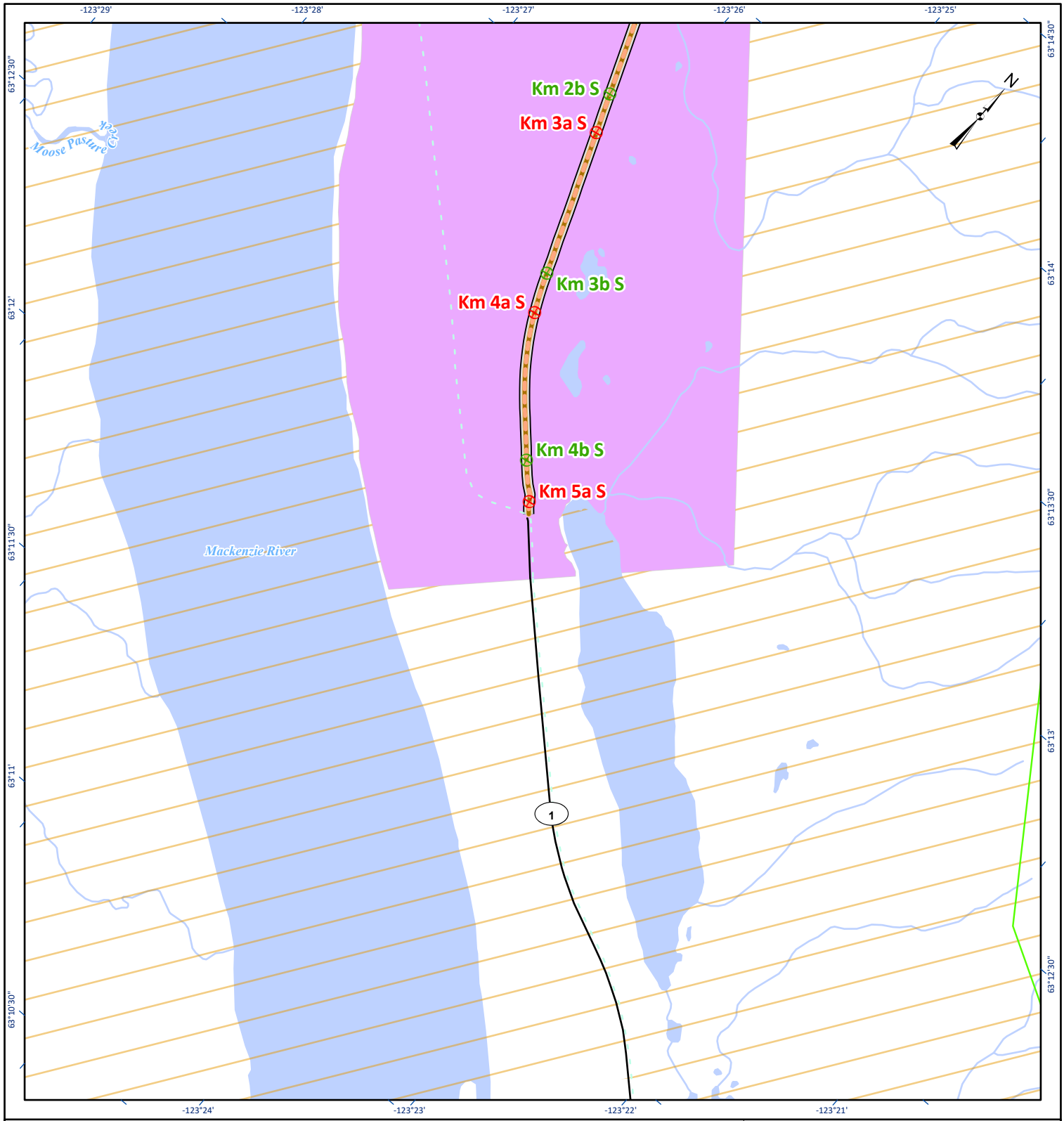
GIS	DR	2020-06-11	Doc ID: 144902910-3015 REVB
QA/QC	EV	2020-06-11	Government of the Northwest Territories

GOVERNMENT OF NORTHWEST TERRITORIES • GOUVERNEMENT DES TERRITOIRES DU NORD-OUEST •



LEGEND

- Bridge (S3)
- Kilometre Post (Scenario 1)
- Kilometre Post (Scenario 2)
- Enbridge Pipeline
- Highway 1 - Mackenzie Valley Highway
- Mackenzie Valley Fibre Link
- Mackenzie Valley Winter Road
- MGAR Segment 1
- MGAR Segment 2a
- MGAR Segment 2b
- MGAR Segment 4a
- MGAR Segment 4b

Land Authority Parcel

- Commissioner's
- Territorial
- Watercourse
- Waterbody

500 250 0 500
1:28,000 Meters

NOTES

Sources: Project Data: Government of Northwest Territories. Base Data: CanVec, Government of Canada; Government of Northwest Territories; NWT Centre of Geomatics
Spatial Reference: NAD 1983 Northwest Territories Lambert

Figure 2-1 - Access Road - MGAR Segments
Page 6 of 6

GIS	DR	2020-06-11	Doc ID: 144902910-3015 REVB
QA/QC	EV	2020-06-11	Government of the Northwest Territories

LEGEND

- Existing Bridge
- Proposed Bridge
- Highway 1 - Mackenzie Valley Highway
- Mackenzie Valley Winter Road
- MGAR Segment 1
- MGAR Segment 2a
- MGAR Segment 2b
- MGAR Segment 4a
- MGAR Segment 4b

250 125 0 250
1:15,000 Meters

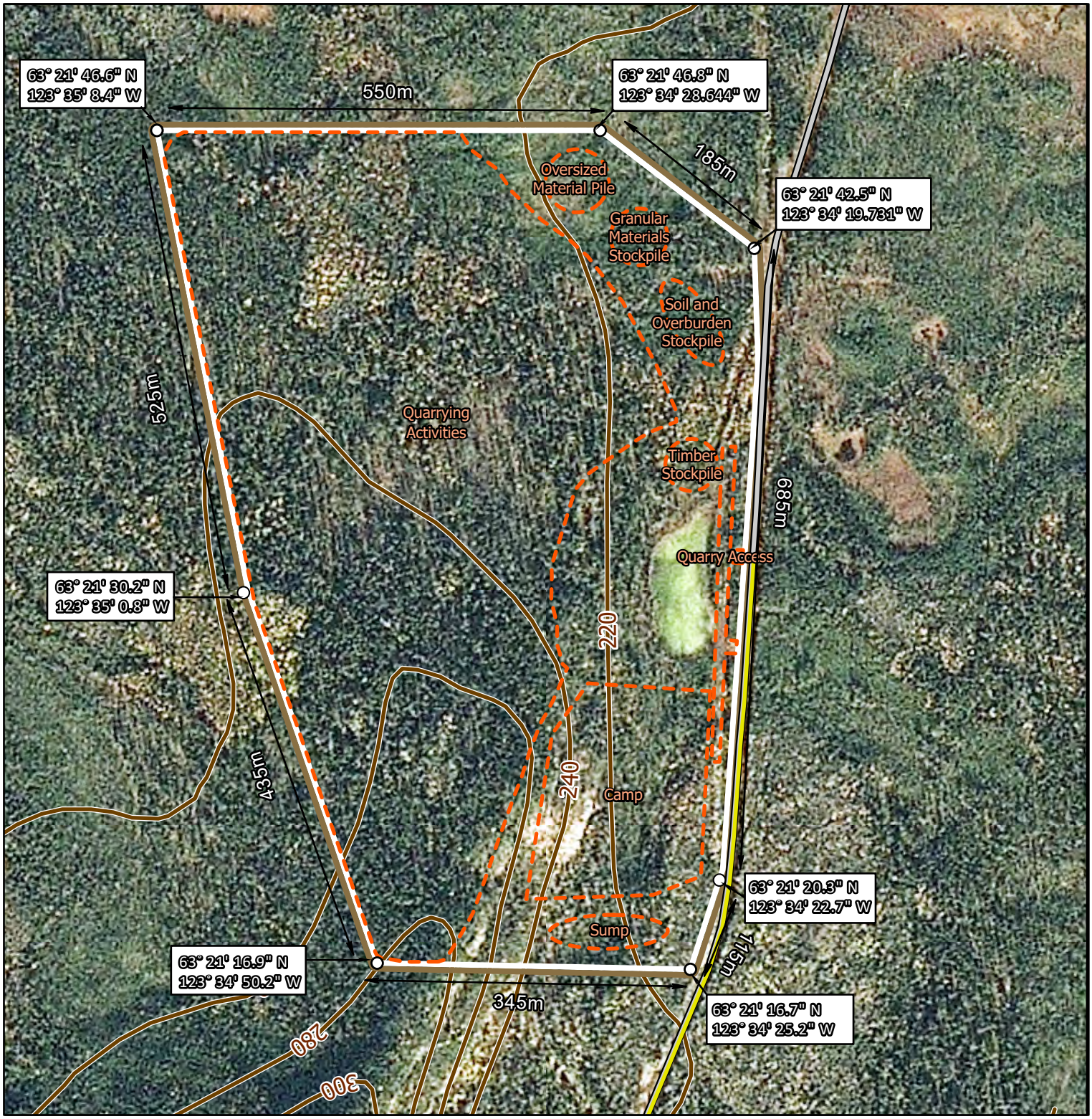
NOTES

Sources: Project Data: Government of Northwest Territories. Base Data: CanVec, Government of Canada; Government of Northwest Territories; NWT Centre of Geomatics
Image Source: Government of Northwest Territories; NWT Centre of Geomatics
Spatial Reference: NAD 1983 Northwest Territories Lambert

Figure 2-2 Bridge Relocation

GIS	DR	2020-06-03	Doc ID: 144902910-3007 REVG
QA/QC	EV	2020-06-03	Government of the Northwest Territories

GOVERNMENT OF NORTHWEST TERRITORIES • GOUVERNEMENT DES TERRITOIRES DU NORD-OUEST



LEGEND

- Quarry Coordinate
- Mackenzie Valley Winter Road
- Major Contour (20m)
- Mount Gaudet Access Road
- Quarry Boundary
- Activity Zones (Conceptual)

100 50 0 100
1:6,000 Meters

NOTES

Sources: Project Data: Government of Northwest Territories. Base Data: CanVec, Government of Canada; Government of Northwest Territories; NWT Centre of Geomatics
Image Source: Government of Northwest Territories; NWT Centre of Geomatics
Spatial Reference: NAD 1983 Northwest Territories Lambert

Figure 2-3 - Conceptual Mount Gaudet Quarry Development Map

GIS	EV	2020-06-03	Doc ID: 144902910-3006 REVE
QA/QC	JA/KB	2020-06-03	Government of the Northwest Territories

GOVERNMENT OF NORTHWEST TERRITORIES • GOUVERNEMENT DES TERRITOIRES DU NORD-OUEST •

The NTS Map Sheet Numbers are 95 O/3, 95 O/4 and 95 O/5 (Natural Resources Canada Website: NTS Map Index, Accessed January 2020). The map coordinates for the Project area are shown in Table 2-1.

Table 2-1 Project Area Coordinates

Description	Latitude	Longitude
MGAR Northern Extent	63˚ 21’ 31”	-123˚ 34’ 21”
MGAR Southern Extent	63˚ 12’ 31”	-123˚ 24’ 53”
Existing Hodgson Creek Bridge	63˚ 14’ 01”	-123˚ 28’ 58”
Potential New Hodgson Creek Bridge	63˚ 14’ 17”	-123˚ 27’ 55”
Mount Gaudet Quarry Corner 1	63°21'47"	-123°35'8"
Mount Gaudet Quarry Corner 2	63°21'47"	-123°34'29"
Mount Gaudet Quarry Corner 3	63°21'43"	-123°34'20"
Mount Gaudet Quarry Corner 4	63°21'20"	-123°34'23"
Mount Gaudet Quarry Corner 5	63°21'17"	-123°34'25"
Mount Gaudet Quarry Corner 6	63°21'17"	-123°34'50"
Mount Gaudet Quarry Corner 7	63°21'30"	-123°35'1"

3 Eligibility for a Permit

INF’s eligibility for a permit is described in Section 18 part (b) of the Mackenzie Valley Land Use Regulations (MVLUR) which states “A person is eligible for a permit who … in any other case [than exercising the right to search for, win or exploit minerals or natural resources] … has the right to occupy the land and either contracts to have the land-use operation carried out or is the person who is to carry out the operation.” INF has the right to occupy the land where the Project is to take place on the basis that this land is territorial and Commissioner’s land.

This Project is entirely on territorial and Commissioner’s land and within the PKFN asserted traditional territory of the Northwest Territories. According to the Government of the Northwest Territories (GNWT) Atlas website (accessed Dec 12, 2019), the land tenure for the MGAR is as follows:

- Segment 1 is entirely on territorial land.
- Segments 2a and 2b are entirely on territorial land.

- Segment 3a (existing Hodgson Creek Bridge) and 3b (potential new Hodgson Creek Bridge) are entirely on territorial land.
- Segment 4a follows territorial land until Km 17.61a and then follows Commissioner's land to the end of Highway #1; Segment 4b follows territorial land until Km 17.34b, and then follows Commissioner's land until the end of Highway #1.

Borrow material for this Project will come from the Mount Gaudet Quarry, which is located on territorial land (see Figures 2-1 to 2-3).

4 Regulatory Approvals

Table 4-1 outlines the regulatory approvals that are or may be required for the Project.

Table 4-1 Regulatory Approvals Required for Project

Authorization, Permit, Licence, Approval	Act and/or Regulation	Responsible Agency
Project Planning Related Approvals		
Wildlife Research Permit	• *Wildlife Act*	• GNWT Department of Environment and Natural Resources (ENR)
Northwest Territories Scientific Permit	• *Northwest Territories Scientists Act*	• Aurora Research Institute (ARI)
• Construction Related Regulatory Approvals		
Type "A" Land Use Permit	• *Mackenzie Valley Resource Management Act (MVRMA)* • MVLUR	• Mackenzie Valley Land and Water Board (MVLWB)
Type "B" Water Licence – Miscellaneous Undertaking	• *Waters Act* • *Waters Regulations*	
Land Reserve	• *Northwest Territories Lands Act* • *Northwest Territories Land Use Regulations*	• GNWT Department of lands (Lands)
Quarry Permit	• Quarrying Regulations • *Northwest Territories Lands Act* / Regulations • *Northwest Territories Land Use Regulations*	• Lands
Timber Cutting Licence	• *Forest Management Act*	• ENR
Permit to Burn	• *Forest Protection Act*	• ENR

Authorization, Permit, Licence, Approval	Act and/or Regulation	Responsible Agency
DFO Review and Authorization (if deemed required)	• *Fisheries Act*	• Fisheries and Oceans Canada (DFO)
Northwest Territories Archaeologists Permit	• *Northwest Territories Archaeological Sites Act* • *Northwest Territories Archaeological Sites Regulations*	• Prince of Wales Northern Heritage Centre (PWNHC)
Explosives Permit	• *Explosives Act* / Regulations • *Explosives Use Act* / Regulations	• Natural Resources Canada (NRCan) • Workers' Safety and Compensation Commission (WSCC)
Approval to Transport Dangerous Goods	• *Transportation of Dangerous Goods Act* / Regulations	• Transport Canada
Waste Disposal Approval	• None	• Village of Fort Simpson

4.1 Project Planning Related Approvals

4.1.1 GNWT Authorizations

4.1.1.1 Department of Environment and Natural Resources

Wildlife Research Permit

A wildlife research permit was obtained from ENR to conduct caribou collaring surveys associated with this Project.

4.1.1.2 Northwest Territories Scientific Permit

A scientific permit was obtained from the ARI to conduct most of the preliminary environmental and technical studies associated with this Project.

4.2 Construction Related Approvals

4.2.1 Mackenzie Valley Land and Water Board Approvals

4.2.1.1 Land Use Permit

As per Items 4(a)(i,ii,iii,v) and 4(b)(i,ii,iii) of the MVLUR, a Type "A" LUP is required for the Project. The 'triggers' for the LUP are due to the equipment required to construct the road, the width of the

road (greater than 1.5 m), and the operation of a work camp for a duration which will exceed 400 person-days. A LUP application is included in Appendix B of this PDR.

4.2.1.2 Water Licence

As per the Waters Regulations, the Project is classified as a "Miscellaneous Undertaking" and will require a Type "B" WL. The 'triggers' for a Type B WL are described below:

- Water crossings – The Project may include the construction of structures across water crossings greater than 5 m in width.
- Direct water use – The estimated direct water use during the Project will be between 150 cubic metres (m3) and 299 m^3 per day.

A WL application is included in Appendix B of this PDR.

4.2.2 GNWT Authorizations

4.2.2.1 Department of Lands

Land Reserve

INF will be applying to Lands for a land reserve for the entire footprint of the Project (both Scenarios) with the exception of the quarry.

Quarry Permit

The Project will require a quarry permit as per the *Northwest Territories Lands Act* and Quarrying Regulations. A quarry permit will be needed to develop and operate the Mount Gaudet Quarry (Figure 2-4). The Quarry permit application and Draft Quarry Operations Plan (QOP) are included in Appendix C of this PDR. The quarry will be operated as a single user source which could be transitioned to multi-user upon completion of the Project.

The Contractor will be responsible for submitting a final QOP to the applicable regulatory agencies for review and approval prior to the commencement of work at the quarry site.

4.2.2.2 Department of Environment and Natural Resources (ENR)

Timber Cutting Licence

As per the *Forest Management Act*, ENR holds jurisdiction over timber cutting on territorial land. A Timber Cutting Licence will be required to clear the ROW during construction.

The Contractor will be responsible for obtaining the Timber Cutting Licence from Forest Management Division of ENR prior to the commencement of site work.

Permit to Burn

In accordance with the *Forest Protection Act* and the Fire Prevention and Suppression Guidelines for Industrial Activities (ENR, 2001) a Fire Preparedness Plan will be required for Project activities (such as blasting, tree felling, trail building, land clearing, ROW clearing) completed between May 1 and September 30. A Permit to Burn is also required as per Section 21 of the Guidelines, which states that any party who lights, fuels, or makes use of a fire for the purposes of burning waste materials must first obtain a Permit to Burn.

The Contractor will be responsible for obtaining a Permit to Burn and submitting a Fire Preparedness Plan to the applicable regulatory agencies for review and approval prior to the start of the Project.

4.2.3 Fisheries and Oceans Canada

DFO administers the *Fisheries Act*, which includes provisions that potentially relate to aspects of the proposed Project. The *Fisheries Act* was amended in 2019 to enhance protections to fish and fish habitat. Proponents are required to avoid causing the death of fish, and harmful alteration, disruption or destruction of fish habitat during Project related activities. In cases where impacts to fish and/or fish habitat cannot be avoided through the application of the interim codes of practice, or where species at risk are present, the Project will require a review. As the interim codes of practice are limited to the end-of-pipe fish protections (used during water withdrawal) and two species at risk, bull trout and shortjaw cisco, are located in the Project area, the Project will require a review by DFO.

INF is completing fisheries assessments of drainage channels, Hodgson Creek, and a pond located at the proposed Mount Gaudet Quarry in the summer of 2020. Upon the completion of the assessments, INF will submit a request for review to the regional DFO Fish and Fish Habitat Protection Program office. If deemed required by DFO, INF will obtain an authorization in accordance with Section 34.4(2)(b) or 35 (2)(b) of the *Fisheries Act*.

4.2.4 Prince of Wales Northern Heritage Centre

4.2.4.1 Archaeological Research Permit

The Prince of Wales Northern Heritage Centre (PWNHC) administers the Northwest Territories Archaeological Sites Regulations under the *Archaeological Sites Act* through the issuance of archaeological permits. Each of the archaeological assessments completed to date have obtained permits prior to the commencement of field work. Reports were issued to the PWNHC for review and approval.

An archaeological permit will be required in 2020 to complete an archaeological impact assessment (AIA) of the Mount Gaudet Quarry and potential new Hodgson Creek Bridge location and alignment.

4.2.5 Natural Resources Canada / Workers Safety and Compensation Commission

NRCan and WSCC are the regulating bodies for the *Explosives Act* and the *Explosives Use Act*. Blasting activity during the Project will be limited to the Mount Gaudet Quarry. The methodology and proposed extent of blasting will be determined by the Contractor and described in the Draft QOP in Appendix C of this PDR. The QOP will be submitted to NRCan and WSCC for review and approval prior to the use of explosives.

The Contractor will be responsible for obtaining the necessary permits and licences that will allow them to transport and operate explosives where required.

4.2.6 Village of Fort Simpson

INF has received a conditional letter of approval from the Village of Fort Simpson to dispose of certain Project-related non-hazardous waste products, i.e. paper, wood, glass, plastics, metals or chemicals not deemed to be hazardous by territorial regulations (ENR 1998; GNWT 2017) in community facilities, pending confirmation of the precise waste volumes and waste streams associated with the Project. This letter is included with the Draft Waste Management Plan (WMP) in Appendix D. Final approval from Fort Simpson for the disposal of waste from the MGAR is expected to be provided to INF following selection of the Contractor for the Project, and determination of the exact types and volumes of waste that will be generated from the Project. The final approval letter will be provided to the MVLWB and included in the final WMP.

5 Project Description

5.1 Project Scope

The scope of the proposed Project includes:

- Conversion of approximately 21 km of the MVWR to all-season standard from the current end of Highway #1 near Wrigley to the proposed Mount Gaudet Quarry at the north end of Mount Gaudet. Construction would start at the Mount Gaudet Quarry and would follow the existing MVWR alignment south, ending at the terminus of Highway #1 south. Construction of the MGAR from Mount Gaudet Quarry to Hodgson Creek currently has funding and community support. Construction of the MGAR south of Hodgson Creek is awaiting future funding and consultations with PKFN.
- Potential relocation of the Hodgson Creek Bridge approximately 1 km upstream (within 1 km of the MVWR alignment to the east), or raising the bridge at its existing location to address problems of excess water and ice backup. If Hodgson Creek Bridge is moved, the final MGAR alignment will follow the Scenario 2 route, which includes a 2.77 km deviation to the east from the MVWR alignment, includes Segments 1, 2b, 3b and 4b (Figure 2-1).
- Development and operation of one borrow source - the Mount Gaudet Quarry along with 1-2 access roads to enter the quarry. Work will include but is not limited to blasting, excavation,

crushing and stockpiling of granular materials. The Mount Gaudet Quarry was previously developed by Enbridge and is currently managed by INF under LUP MV2016E0006.

- Mobilizing construction equipment to the Project sites.
- Installing and operating a 100 person camp and associated facilities at the Mount Gaudet Quarry.
- Clearing, grubbing, and stripping vegetated material in certain sections of the alignment ROW.
- Planning studies including but not limited to geotechnical drilling at the Mount Gaudet Quarry, the potential new Hodgson Creek Bridge location, and Segments 2b and 4b of Scenario 2.
- Sourcing and use of water from the Mackenzie River, at 63° 13' 30"N, 123° 28' 21" W, to provide temporary working surfaces and winter access during frozen ground conditions. A new Type B water licence will be needed for this component of the Project.
- Construction, operation, and reclamation of temporary support infrastructure areas (laydown and equipment staging areas, camp for work crew, etc.).
- Installation of culverts along the proposed MGAR alignment (approximately 3-5 20-30 m culverts every km along the alignment).

Operation and maintenance (O&M) of the MGAR is not subject to screening as part of the preliminary screening process [Section 13, Schedule 1 of the Exemption List Regulations issued under the *MVRMA*]. O&M of the MGAR following its construction is expected to be covered under INF's existing LUP MV2016E0006 for Highway #1 O&M.

5.2 Project Benefits

The construction of the MGAR will provide:

- All-season access to Hodgson Creek, the Hodgson Creek Bridge and the Mount Gaudet Quarry.
- Hands on training and employment opportunities for residents of Wrigley and other Dehcho communities.
- Access to potential quarry/borrow sites, in addition to Mount Gaudet Quarry, for potential MVH construction beyond the MGAR.
- Economic opportunities for businesses in Wrigley and the Dehcho Region associated with the road construction and quarry development and operations.
- Access to lands for recreation, tourism and business development. This includes easier access for community members to their traditional fishing and hunting areas.

5.3 Description and Design of the MGAR

The Project is currently at the preliminary design stage and the design will be finalized following the completion of additional studies. However, the current stage of design is sufficient for an evaluation of potential environmental impacts and to proceed through the regulatory process. The

specific details of road design and construction will be determined by INF and the Contractor prior to beginning construction.

The alignment of the MGAR is intended to follow the existing ROW for the MVWR wherever possible. Assuming a 30-60 m ROW is created in either scenario, along a length of 20.81 km for Scenario 1 and 20.57 km for Scenario 2, and assuming a total clearing area of 45 hectares (ha) to develop the Mount Gaudet Quarry, the overall disturbance associated with each scenario is described below:

- Scenario 1 – 86.6 ha to 149 ha
- Scenario 2 – 86.14 ha to 150.6 ha

The structural design of the road will incorporate the results of geotechnical, geophysical, and thermal surveys to be performed prior to construction.

It is expected that the MGAR will be constructed using a 'fill only' embankment approach, and that excavation will be limited to localized ditching as may be required to ensure drainage flows are maintained. In areas where erosion of the ditch materials is a concern, the use of geogrid/geotextile covered by reused organic material from ditching work and hydro-seed could be used depending on detailed design considerations and field observations during construction.

The cross section design and required thicknesses of road structures will depend on existing ground conditions in the Project footprint. The road structure will likely consist of woven geotextile placed along the ground, embankments composed of 300 mm quarried rock, a 200 mm thick sub-base course composed of 50 mm gravel and 150 mm thick base course composed of 20 mm surfacing gravel. The ground underlying the MGAR varies with location, and includes glaciofluvial, alluvial, colluvial, glaciolacustrine, moraine, and peat deposits, with surficial material ranging from fine to coarse grained (GVM, 2019). The minimum thickness of the road structure will vary with subgrade conditions.

The design of the road structure will be based on seasonal loading restrictions and design details will be determined based on the outcome of geotechnical investigations. The design approach for the MGAR will consider the operating speeds, the types of vehicles which are likely to be used on the road, overall safety considerations, road stability and accommodation over permafrost (subsurface layers which are frozen for 2 or more years continuously), and avoidance or minimization of impacts on areas considered environmentally and/or culturally sensitive.

The final MGAR design will incorporate published and accepted guidelines and best practices for developing infrastructure in the Northwest Territories. Given that the MGAR will be constructed in an area of discontinuous permafrost (that is, permafrost is present over 50-90% of the area), and considering the impacts of climate change on permafrost to date, the final design will incorporate past experience and adaptation of engineering principles and practices. In general, the design approach for the MGAR will vary depending on the presence and extent of permafrost along the proposed route. Potential methods and lessons learned from other northern road building projects (e.g. Inuvik to Tuktoyaktuk Highway, Tlicho All-Season Road) for addressing construction in

variable permafrost conditions will be addressed in the Permafrost and Erosion Plan which will be submitted to the MVLWB prior to starting construction.

The horizontal and vertical alignment of the MGAR will be designed to support an operating speed of 90 km/hr (posted speed limit) with local speed reductions where required. Because the MGAR will eventually be an extension of the existing all-season highway and follow the MVWR, the design of the MGAR will take into account requirements for public highways in the Northwest Territories. Using the Canyon Creek Access Road as a reference (as this road was of a similar length and design to the proposed MGAR, and was built to replace a portion of the MVWR), the estimated average traffic volumes for the MGAR are expected to be about 1 to 20 vehicles per day (very low) (R. Thom, INF, Personal Communication, March 4, 2020).

Table 5-1 describes the proposed design parameters for the MGAR.

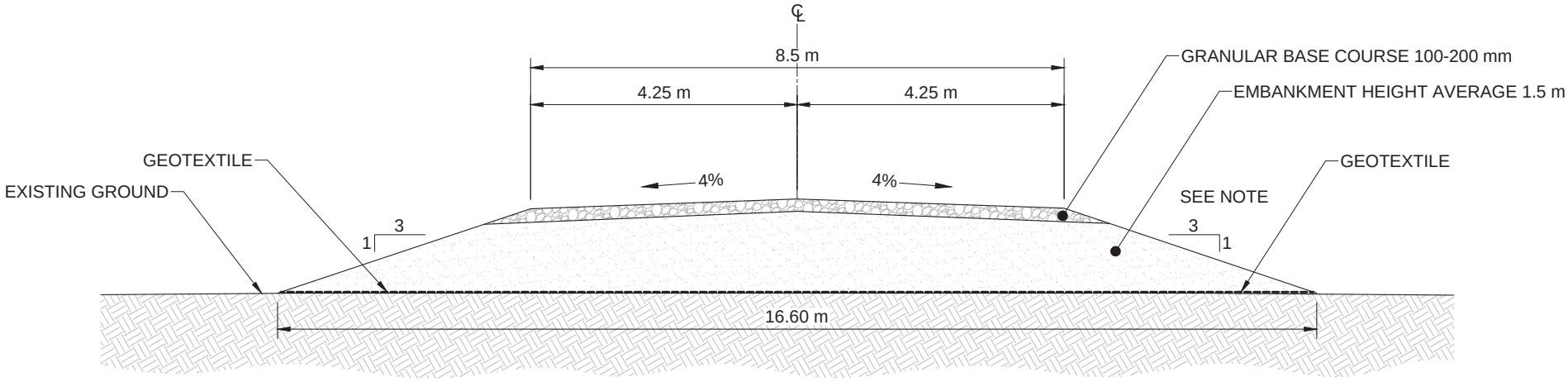
Table 5-1 Geometric Design Parameters for the Proposed MGAR

Design Parameters		
Design Designation	RAU 90	Rural Arterial Undivided (Low Volume Road)
Design Speed	90 km/h	Posted speed limit = 90 km /h
Design Guidelines and References		All design parameters must meet or exceed the National Standards established by applicable governing/regulatory bodies. Design of the road will be governed by Transportation Association of Canada (TAC) Geometric Design Guidelines and will incorporate prior experience from similar GNWT infrastructure projects.
Roadway Design		
Horizontal Curve Radius	510 m	This horizontal curve radius is applicable for the entire length of the roadway. The minimum radius is also applicable for the entire length of the roadway; however, exceptions will be permitted on a site specific basis. The minimum radius for the horizontal alignment through site specific areas shall be 90 m.
Minimum Curve Radius	340 m	
Passing Sight Distance (minimum)	610 m	There is no requirement for continuous passing opportunities for the entire length of roadway; however, the designer should endeavour to allow for passing opportunities along a minimum of 30% of the roadway length. Passing opportunities should be equally spaced along the entire length of the roadway with a desirable spacing of approximately 10 km.
Minimum Sight Distance	160 m	Horizontal sight distances are to be verified on all curves
Superelevation (e max)	0.06 m/m	

Minimum Spiral Parameter – "A" Value	Not Applicable	Refer to appropriate Superelevation Tables for minimum and desirable "A" parameters for each curve radius and design speed. Spirals not required on all curves requiring superelevation.
Vertical Alignment		
Minimum Passing Sight Distance	610 m	Where the minimum stopping sight distance is used, the sight should be verified using an object height of 0.38 m and an eye height of 1.05 m. Where the minimum decision sight distance is used, the sight should be verified using an object height of 0.15 m and an eye height of 1.05 m. Where the minimum passing sight distance is used, the sight should be verified using an object height of 1.30 m and an eye height of 1.05 m.
Minimum Stopping Sight Distance	160 m	
Minimum Decision Sight Distance	275 m	
Minimum Sag K Value	20	Desirable "K" Value = 40
Minimum Crest K Value	39	Desirable "K" Value = 50
Minimum Length of Vertical Curve	90 m	
Maximum Gradient	6 %	
Cross Section		
Finished Roadway Width	8.5 m	In guardrail installation areas, an additional 1 m in width shall be added for each side that the guardrail is installed.
Travel Lane Cross Slope	4 %	Gravel surface
Lane Width	3.50 m	
Side Slope / Fill Slope Ratio • Normal • Minimum (with Toe of Slope in water area) • On Fills Over 4 m	 3.0 to 1.0 3.0 to 1.0 2.5 to 1.0	 Use rock-fill only in the water. Final embankment heights and other recommendations/direction subject to thermal analysis.
Slope Stabilization Height	> 4 m	Slope stabilization features shall be designed for fills over 4 m in height (i.e. benched embankments, etc.). Further recommendations/direction subject to the thermal analysis (TBC).
Average Embankment Height (Above ground level)	1.5 m	Where lacustrine materials or weak soils are encountered, the minimum road structure thickness will be 1.4 m. Where glacial tills or more competent soils are encountered, the minimum road structure thickness will be 1.0 m. In areas where the existing ground is a thin layer of organic material overlaying bedrock, the cross section will include base-coarse

		and sub-base-coarse over woven geotextile placed on the existing ground.
Surface Gravel Thickness	100-200 mm	Typically, the embankment will feature 300 mm minus quarried rock, 200 mm thick sub-base coarse of 50 mm minus gravel and 150 mm thick base coarse of 20 mm minus surfacing gravel.
Culverts (in accordance with latest edition of the Canada Standards Association CANS-G401)		
Drainage / Equalization Culverts		
Detailed Specifications		Refer to: 1. SD-400-01-51 2. Standards Specifications – Division 4 Structures Section 1 – Supply and Installation of Corrugated Steel Pipe Culverts
Guardrail		
		Guardrail shall be designed for use in areas with embankment heights of 4 m of greater and/or areas where waterbodies are close enough to the highway to be considered a hazard. The British Columbia Ministry of Transportation (BC MOT) Warrant Guide (2019) and practical safety considerations will be used for determining barrier installation locations. The type of guardrail shall be selected to minimize snow accumulation or drifting on roadway.

The cross-sectional design for the MGAR is shown in Figure 5-1.



NOTES
1. SLOPE OF 3:1 EXCEPT ON FILLS OVER 4 m; THEN 2.5:1.

Designed by: INF		Title: MOUNT GAUDET ACCESS ROAD TYPICAL ROADWAY CROSS SECTION	
Drawn/Drafted by: INF			
Approved by: INF			
Scale: N.T.S.	Date: JUNE 2020	Project No.: MGAR	Drawing No. Figure 5-1

5.3.1 Existing Infrastructure along the Alignment

5.3.2 Bridges

The MGAR alignment will include only one bridge, at the Hodgson Creek crossing. The existing bridge is a 24.4 m long, 4.3 m wide clear span bridge with steel grate and timber decking and supported by binwall abutments. The bridge is located at 63˚ 14’ 01”N, 123˚ 28’ 58” W.

5.3.3 Winter Road

The Project will be completed within the 60 metre (m) wide right-of-way (ROW) for the MVWR. A 2.77 km deviation from the current MVWR ROW may be required for the potential new location of Hodgson Creek Bridge which is approximately 1 km upstream of the existing bridge location. If Scenario 2 is chosen for the Project (new bridge location), then Segment 4b will become the new alignment for the MV winter road until construction funding has been acquired to upgrade this segment to an all-season road.

5.3.4 Mackenzie Valley Fibre Line

The Mackenzie Valley Fibre Line (MVFL) is buried along the MVWR alignment. Contact with the MVFL by equipment is a potential risk during the Project due to the close vicinity to heavy vehicle movement. Site personnel will be informed of the presence and location of the MVFL, and will be advised to take appropriate precautions to avoid damage to the cable, such as adding additional layers of compacted snow and/or ice to provide a buffer between the cable and the equipment. Additionally, INF will work with the operator of the MVFL to have appropriate precautions in place to protect this infrastructure from damage during construction.

5.3.5 Enbridge Pipeline

Enbridge’s Line 21 pipeline, which extends from Norman Wells to Zama, AB, varies in its distance to Project activities, from 2.5 to 7 km depending on location. Considering the pipeline is 2.5 km away from the Project at its closest point, the pipeline is not expected to be affected by Project activities, nor will Project activities enter the pipeline ROW.

5.4 Hodgson Creek Bridge - New Location

Depending on the results of geotechnical investigations, a new bridge may be installed at Hodgson Creek to address problems of water and ice back up at the existing bridge location. The proposed location for the new bridge is at 63°14'17"N, 123°27'55"W. The new bridge would be a clear-span bridge with no in-stream work involved in the installation, though the exact design parameters for the bridge will be based on the results of hydro-technical studies at Hodgson Creek (Golder, 2019) and geotechnical studies to be completed following the issuance of a LUP from the MVLWB. The standard mitigations for the banks during bridge construction are part of the Permafrost and Erosion Plan (PEP) which will be submitted after receiving the Land Use Permit but prior to starting construction.

5.5 Material Sources

All material used for constructing the MGAR will be obtained from the Mount Gaudet Quarry.

5.5.1 Mount Gaudet Quarry

The location of the quarry is shown in Figure 2-3. There is an estimated volume of about 6,000,000 m3 of useable material. The quarry is located just off to the west of the MVWR.

Site reconnaissance of the Mount Gaudet Quarry was completed in 2019. The rock was determined to be limestone and was highly reactive to hydrochloric acid, indicating that it is carbonaceous. Laboratory analysis produced a neutralizing potential ratio (NPR) of approximately 3100, with an NPR of greater than 2 being considered to be non-potentially acid generating. Shake flask extraction analysis indicated no potential concerns with ML.

During the summer 2020 drilling programs at the quarry, additional samples will be taken at depth for ARD/ML testing. If non-limestone inter-beds are noted, a minimum of three samples per unique rock type will be collected and analyzed.

5.5.2 Material/Quarry Development

Material and quarry pits are a necessity in roadway construction. Well-planned development is therefore required, so as not to detract from the appearance of the landscape. Even if pits are hidden from the community or the motorist's view, they will remain visible to those flying overhead.

It will be feasible to design the quarry site to acquire the needed construction material, yet still blend the quarry into the landscape. The shape, size and contours of the quarry must be determined by the amount of material to be taken, location and shape of suitable deposits, local topography, and drainage. A temporary winter access trail connecting to the MVWR is anticipated to be used initially to develop the quarry.

It is expected that the quarry will remain operational following any material extraction for the development of the MGAR. However, it will be single user only at least for the duration of the Project.

Drill and blast (D&B) methods will be used to excavate the required volumes of material. D&B protocols are described in the Draft QOP and Quarry Permit Application included in Appendix C.

5.5.3 Further Investigation of Material Sources

The work done to date at the Mount Gaudet Quarry is included in Appendix C. Future work will include an AIA at the quarry, determination of the volume of material available and overburden to be stripped at the quarry during pit development, and an assessment of the size of materials available.

5.6 Conceptual Quantity Estimates for Preferred Alignment

5.6.1 Estimate of Embankment (Fill) and Surfacing Material

Conceptual quantity estimates for surface and embankment material, estimated using per km volumes from preliminary design, are provided in Table 5-2. Final volume estimates will be prepared following the detailed design stage for the Project.

Table 5-2 Material Estimates for MGAR Routing Options

Road	Surface Base Course (m^3)	Sub-base Course (m^3)	Embankment (m^3)	Total (m^3)
MGAR – Scenario 1	21,000 – 32,000	50,000 – 60,000	425,000 – 735,000	496,000 – 827,000
MGAR –Scenario 2	21,000 – 32,000	50,000 – 60,000	425,000 – 735,000	496,000 – 827,000

5.6.2 Drainage Structures

It is estimated that approximately three to five culverts will be required every 1 km along the proposed MGAR to convey flows from seasonal runoff from snow melt, and localized drainages. The specific culvert diameters and the number of culverts will be determined during detailed design (with field modifications during construction as required) to maintain the natural hydrological regime and prevent ponding of water. A nominal length of 20-30 m is estimated at this conceptual stage of the Project for the culverts. With this culvert length, the total estimated length of culverts is:

- Scenario 1 – 1,250 – 3,121 m (20-30 m/culvert x 3-5 culverts/km x 20.81 km of total road construction).
- Scenario 2 – 1,234 – 3,086 m (20-30 m/culvert x 3-5 culverts/km x 20.57 km of total road construction).

5.7 Construction Details

5.7.1 Proposed Methodology

The proposed construction methodology for the MGAR is a 'fill only' approach starting in the winter and finishing in the summer with the following general activities schedule:

- Clearing/mulching ROW for proposed roads/upgrades (winter 2021/2022).
- Clearing and removal of overburden at the proposed quarry (winter 2021/2022).
- Place woven geotextile within the road structure footprint (winter 2021 to fall 2022).
- Place and compact quarried rock sourced from the quarry (winter 2021 to fall 2022).

- Haul, place, and compact surface gravel (summer 2021/2022/2023).

The actual construction timing and methodology will be a matter for further discussion with the selected Contractor.

5.7.2 Construction Activities and Assumptions

5.7.2.1 Embankment Construction

The highway embankment construction methods will be based upon the presence of permafrost, ice rich soils, bedrock and other terrain features along the alignment. The embankment will be constructed using a 'fill approach'; a typical cross section of the embankment is provided in Figure 5-1. Embankment design will be finalized in the detailed design, incorporating the findings of the geotechnical assessment, thermal analysis, and topographic survey. The final embankment design will be selected to minimize the expansion of the active layer under the embankment and will incorporate ice-content, terrain, and permafrost characteristics.

Embankment material will be hauled to the end of the constructed embankment, starting at the Mount Gaudet Quarry, and then "end dumped" over geotextile fabric and leveled. Multiple lifts of material will be placed until the specific thickness is achieved. Once the full length of the embankment is constructed, the surfacing and grading will be completed.

Construction equipment will utilize the existing MVWR for accessing areas within the ROW as well as maneuvering within the ROW (i.e. to turn around). Multiple lifts of material will be placed and compacted until the specific thickness is achieved. Compaction will be completed using water sourced from the Mackenzie River (further discussed in Section 5.9).

Geogrid/geotextile covered by re-used organic material (from ditching work) and hydro-seed may be used on side slopes in areas where erosion is of concern. Application of this material would be dependent upon detailed design considerations and field observations.

Geotextile and culvert placement, embankment hauling, and embankment placement will primarily occur in winter but may also be completed during the summer depending on the extent of permafrost and thaw sensitive terrain. Embankment compaction, grading, surfacing, and base coarse placement will occur in summer. Other site specific activities, such as borrow material stockpiling, placement of riprap, and erosion control mitigation may occur year-round depending on site characteristics and access considerations.

The final construction timing and methodology will be established during detailed design and discussion with the selected Contractor.

5.7.2.2 Staging Locations

Construction staging locations are expected to include existing facilities in Wrigley and at the Mount Gaudet Quarry. Activities at staging locations will include:

- Wrigley:
  - lodging and maintenance buildings
  - equipment and material storage
  - fuel storage
  - staging area
- Mount Gaudet Quarry
  - lodging and maintenance buildings
  - equipment and material storage
  - fuel storage
  - staging area
- Alignment ROW
  - equipment storage
  - borrow material stockpile

It is intended that the construction of the road will occur from north to south. Construction north of Hodgson Creek will be based out of a work camp at the Mount Gaudet Quarry which is described in Section 5.8. Material will be excavated and stored at the camp. Construction of the road south of Hodgson Creek may be based out of Wrigley. Further discussions will occur with the selected Contractor.

5.7.2.3 Seasonal Timing of Construction

A fundamental concept of the proposed construction methodology is to use winter construction techniques, as much as possible, for building the road embankment or accessing areas within the ROW before the MGAR is constructed.

Winter construction offers the following advantages:

- Allows the use of temporary winter access to material sources without the need to first construct an all-season road.
- Allows placement of construction material directly onto frozen ground, helping to protect sensitive and ice rich terrain. Construction on frozen ground will reduce environmental impacts in adjacent areas.
- Minimizes potential impacts on vegetation and soils adjacent to the actual roadway that might occur if working under snow-free or wet conditions.
- Promotes initial stability of the road through the placement of frozen material directly onto frozen ground (with geotextile separation layer).

- The installation of certain culverts may be simplified because of the diminished flow in streams during the winter months; however, the timing and method for the installation of culverts will be site specific.
- Avoidance of bird nesting season (with the exception of early-nesting raptors, if suitable nesting habitat exists for them), lowering the risk of violating the federal *Migratory Birds Convention Act* or the *Wildlife Act* by destroying an active nest, egg, chick, or adult. An aerial nest survey will be completed before the start of construction.
- Use of MVWR to reach points not accessible in summer.
- Minimize environmental impacts of development of the access road into the quarry. The initial settlement and consolidation which occurs when an embankment is placed directly on unfrozen soils can be eliminated if construction works are completed in winter. The frozen ground surface can support the weight of the embankment which could not be supported in thawed conditions.

The disadvantages of the winter construction include the following:

- Work is challenging for both personnel and equipment, with extreme cold temperatures common at the beginning of the construction season in late December and early January.
- Operations are conducted in periods of minimal daylight.
- Excavation of frozen material in borrow sources will likely require the use of drill and blast methods to be able to source the required volumes of material required for construction.
- Excavation and placement of frozen material directly on top of geotextile placed on the natural ground makes it more difficult to achieve compaction of the embankment layers.
- Potential sensory and physical disturbance to over-wintering wildlife.

Embankment compaction, grading, surfacing, and base coarse placement will occur in summer. Other site specific activities, such as borrow material stockpiling, placement of riprap, and erosion control mitigation may occur year-round depending on site characteristics and access considerations.

The final construction timing and methodology will be established during detailed design and discussion with the selected Contractor.

5.7.3 Ditching

Completion of the hydrology assessment in the summer of 2020 will identify drainage areas that require culverts to convey flows across the roadway. Installation of ditches along the MGAR will be minimized to only those locations where required to allow the culverts to function properly to convey the hydrological flow and avoid ponding

5.7.4 Culverts

Culverts will be required to convey flows along the roadway (equalization culverts) and at drainage channels located along the alignment.

As part of the preliminary design, INF reviewed historical assessments completed along the ROW to evaluate culvert requirements. A hydrological study of the drainages will be completed in the summer of 2020 to supplement the historical information, in advance of the completion of the final design. The final design will outline the specifications for each culvert, including culvert type, diameter, and closed- versus-open- bottom and will be determined based on the topography and road geometry. The final design will outline the requirements for excavation, preparation of culvert bedding (including material types and requirement for geotextile), and rip-rap placement.

As discussed in Section 4.2.3, INF will submit a request for review to DFO prior to the start of construction as required by the *Fisheries Act.* If deemed required by DFO, INF will obtain an authorization in accordance with Section 34.4(2)(b) or 35 (2)(b) of the *Fisheries Act*. Culvert installation will be completed in accordance with the findings of the review and/or authorization issued by DFO.

Equalization culverts will also be required to convey flows along the roadway. A nominal diameter ranging from 800 mm to 900 mm and a nominal length of 20-30 m are the estimated dimensions for these culverts, with an installation frequency of three to five culverts per kilometre. The number, size, and location of these culverts will be confirmed in the final design. INF estimates that approximately 1,234 – 3,121 m of equalization culverts will be required during the Project (three to five 20-30 m long culverts per km for approximately 21 km total).

Culvert installation will proceed concurrently to the construction of the MGAR. Installation of all culverts is planned to occur during no flow periods, and if relevant to the specific location due to the presence of fish and/or fish habitat,, these activities will respect the sensitive timing windows for fish in the NWT (DFO; Web Access June 2020), and will include appropriate mitigations for potential impacts on fish and fish habitat (Section 12.3.6).

5.8 Camp Areas

During construction of the MGAR from Mount Gaudet to Hodgson Creek, including development and operation of the Mount Gaudet Quarry, work crews are expected to operate out of a 100 person camp located at the quarry. The camp facilities are expected to include a kitchen, washroom, accommodation trailers, repair and maintenance facilities, a medical facility, and fuel storage facilities. Power will be provided to camp facilities by on-site portable generators. Potable water for the camp will be supplied from the water sources described in Section 5.9.

Project activities south of Hodgson Creek may involve work crews being stationed at Wrigley. Otherwise, personnel working on this portion of the Project will be stationed at the camp at Mount Gaudet Quarry.

5.9 Water Use

Water use during the Project will primarily include dust control and compaction of road surfacing gravel during placement and may also include general water use at the camp. Water for the Project will be withdrawn from the Mackenzie River at 63° 13' 29.8”N, 123° 28' 20.9" W, which is currently used as a water withdrawal point by INF for ongoing Highway #1 O&M activities.

Maximum daily water use during peak times of construction is expected to be between 150 and 299 m^3/day, which exceeds the triggers for a Type B WL but is below the threshold for a Type A WL. The application for a Type B WL for the Project is included in Appendix B.

5.10 Health, Safety, and Environment

During construction, the health and safety of the Project work staff and the preservation of the environment will be key considerations. The concept of Health, Safety and Environment (HSE) includes the following components:

- Safety orientation and training;
- First aid requirements;
- Spill prevention; and
- Erosion control.

All employees working on or around the construction site will be given an employee orientation and relevant training for the equipment or tasks they have been assigned. Project personnel will include individuals trained and qualified as advanced First Aiders.

Most of the MGAR construction will take place on the currently active MVWR. Public traffic and winter road O&M activities will continue to occur while the MGAR is being constructed. The following measures will be taken during the Project to ensure that public safety is protected, and that Project activities do not interfere with MVWR O&M activities:

- INF and Contractor personnel responsible for the MGAR Project will maintain communications with INF – Regional Operations Division to coordinate Project activities with ongoing MVWR O&M.
- Safety protocols will be in place for Project personnel with respect to working on an active road.
- Flaggers and warning signs will be employed during construction activities to inform and direct public traffic in Project work areas.
- Speed limits will be reduced in active construction areas.
- Good quality traffic lanes will be maintained for public vehicle use.

5.11 Explosives

D&B operations in the quarry will be required. The Contractor, once selected, will obtain an Explosives Permit from Natural Resources Canada for the storage and use of explosives at the quarry.

5.12 Mobilization

Construction equipment will be mobilized from Wrigley wherever possible, and will otherwise be mobilized from Fort Simpson or the Dehcho region to the extent possible. Equipment will be brought to site along the MVWR.

5.13 Geotechnical Programs

Geotechnical drilling was completed in the winter of 2019/2020 for MGAR Segments 1, 2a, 3a, and 4a.

Further geotechnical investigations will be required to determine whether the Hodgson Creek Bridge will be moved approximately 1 km upstream (within 1 km of the existing MVWR alignment) or if the bridge will be raised at its existing location to address problems of excess water and ice backup. The geotechnical investigations at the alternate bridge location and the 2.77 km alignment to this crossing are not covered under LUP MV2016E0006, and will need to be carried out following the issuance of a LUP for the MGAR by the MVLWB. These geotechnical programs are included in the scope of the Project for the new LUP application. INF will inform the MVLWB of whether or not the bridge will be moved or raised once this decision has been confirmed.

Geotechnical investigations will also be carried out as required at the Mount Gaudet Quarry (Section 5.5.1) during the summer of 2020 to further characterize ARD/ML potential and develop a more refined estimate of the quarry volume which will assist in quarry design. The quarry geotechnical investigations will also include an assessment of ground ice content and permafrost characteristics. This geotechnical work will be covered under LUP MV2016E0006.

Thermistors and similar instrumentation will be installed as part of the geotechnical programs to better understand ground temperatures and to aid in the final design of the MGAR.

5.14 Additional Studies

INF plans to undertake several field studies to supplement information provided within the PDR. These studies include:

- Thermal analysis of the proposed alignment.
- Topographical survey of the proposed alignment.
- Additional Light Detection and Ranging (LiDAR) collection.
- Fish study of the potential new Hodgson Creek Bridge location.

- Fish, hydrology, and hydrotechnical studies of drainages along the proposed alignment.
- AIA of the Mount Gaudet Quarry and potential new Hodgson Creek Bridge location and alignment.
- Geotechnical assessment of the Mount Gaudet Quarry and potential new Hodgson Creek Bridge location and alignment (including additional geochemical assessment for ARD/ML potential).
- Den and nest surveys along the proposed alignment.

5.15 Management Plans

Management plans provide guidance and boundaries so that Project activities can proceed in a safe and environmentally conscious manner. The management plans describe the techniques that will be employed and the practices that will be applied to meet the commitments stated in this PDR and to meet the conditions of approvals and permits.

Upon contract award, the Contractor will finalize the draft management plans submitted with this PDR, including the Spill Contingency Plan (SCP), Waste Management Plan (WMP), and QOP. INF anticipates that the draft management plans provided with this PDR will be adopted in full or utilized in part where Contractor best management plans exceed the draft plans.

Upon receipt of regulatory approvals, INF will develop the following plans:

- Wildlife Management and Monitoring Plan (WMMP)
- PEP

Final plans will be submitted to the MVLWB for review and approval prior to the start of construction.

6 Access to Project Sites

All activities along Segments 1, 2a, 3a and 4a will be accessed from the existing MVWR ROW. The approach for accessing the potential new bridge location and the associated 2.77 km deviation along Segments 2b and 4b will be determined closer to the construction start date, although it is expected that any new clearing that is required will incorporate existing cut-lines as much as possible.

7 Waste Management and Disposal

Waste from the Project will be managed in accordance with the Guidelines for Developing a Waste Management Plan (MVLWB 2011) and the Guideline for the General Management of Hazardous Waste in the Northwest Territories (ENR 1998; GNWT 2017). The Draft WMP for this Project is included in Appendix D.

The primary waste management approaches outlined in the WMP are:

- Non-hazardous garbage will be disposed of at Fort Simpson's municipal solid waste facility.
- Hazardous materials will be stored in secure containers and brought to appropriate disposal facilities.
- Sewage will be collected and disposed of at the sewage lagoon in Fort Simpson.
- Trees and brush cleared along the alignment will be either mulched or windrowed and compacted along the side of the cleared area using heavy equipment.
- Merchantable timber will be stacked along the side of the winter road or clearing, or will be handled as otherwise specified by the conditions of the LUP.

The Contractor for the Project will be responsible for submitting a final WMP to the MVLWB prior to the commencement of the Project, which will adhere to the relevant guidelines and be approved by INF.

INF has secured a conditional agreement with local waste management facilities for the disposal of any waste generated by the Project. *'This "Agreement in Principle" will be finalized with the drafting, by the Village, and signing of "Acceptance Agreements" by the GNWT INF and the Contractors ultimately responsible for the delivery of materials.'* The conditional agreement is included with the Draft WMP in Appendix D. The draft WMP will be updated prior to the start of construction and will include a final letter of approval from local waste management facilities once this has been received.

8 Equipment

The exact types, numbers, and weights of equipment used for the Project will not be known until the Contractor(s) for the Project has been selected. Table 8-1 describes the typical equipment which would be used for a project of this scale and nature. A finalized equipment list for the Project will be provided to the MVLWB prior to starting construction.

Table 8-1 Preliminary Project Equipment List

Equipment Type	Model/Size	Number	Purpose
Tracked Dozers	Cat D6 - D8	2-4	• Clearing to open new MGAR ROW. • Clearing at quarry. • Pushing construction material on roadway and within quarry. • Compaction of cleared vegetation.

Equipment Type	Model/Size	Number	Purpose
Hydraulic Excavators (tracked and wheeled)	30 to 90 metric tons	2-4	• Clearing to open new MGAR ROW. • Excavating drainage channels. • Excavation at culvert and bridge installation sites. • Excavation of quarry material for road construction. • Loading haul vehicles, making repairs to roadway embankment, etc.
Graders	Various	2	• Grading and surfacing of road. • Snow ploughing. • Roadway maintenance and road repairs. • Borrow source maintenance.
Loaders	Various	2	• Moving material into haul trucks for transport to construction sites. • Moving granular materials at work areas. • Stockpiling granular materials. • Feeding crusher.
Compaction Equipment	Various	3	• To compact roadway surface and surfacing, compact roadway embankment, compact around culvert installations, etc.
Tree Harvesters/Mulcher/Brushers	Various	2	• Mulching of vegetation (bush/shrubs) along the alignment and at the quarry site.
Dump Trucks	Various	6	• Hauling construction material from quarry and stockpile sites.

Equipment Type	Model/Size	Number	Purpose
Tractor Trailers	Various	8	• Moving equipment to, from, and around Project sites.
Rock/Aggregate Trucks	Various	5-7	• Moving borrow material between quarry areas. • Hauling construction materials within work areas.
Fuel Truck	Up to 40,000 L	1	• Fuelling of equipment and vehicles.
Sewage Truck	Various	1	• Transport of sewage from work site to approved disposal facilities.
Water Truck	Various	2	• Transport of water from source bodies to camp and work areas.
Service Vehicles	Various – Pickup trucks, utility service trucks, flat decks, snowmobiles, quads, etc.	20	• Supporting and maintaining all equipment and vehicles required for the construction.
Crusher	36 x 48	1	• Rock crushing and borrow source development.
Crane (or similar)	Various	1	• Installation of culverts.
Tool Carriers	Cat IT38G / 938	1	• Hold tools used during construction activities.
Temporary Work Camp		1	• Provide a staging area for MGAR construction along the north section, maintenance facilities for equipment and vehicles, sewage facilities, fuel storage, and break rooms for Project personnel.

Equipment Type	Model/Size	Number	Purpose
Light Towers	Various	2	• Provide sufficient visibility during operations in low-light conditions.
Generators	Various	2-4	• Provide power to lighting units, crusher plants, small hand tools and other equipment.
Mechanics Truck	5T	1	• Mobile repairs on equipment.
Rotary Rock Drills	Various	2	• To carry out granular and geotechnical investigations, prepare for piling installations at bridge, to prepare for blasting at quarry sites, etc.

9 Fuel

9.1 Fuel Types and Volumes

The Contractor will determine fuel volumes, fuel types, and the size and number of storage tanks based on Project needs. Diesel and gasoline are expected to be the primary fuels used during the Project. Diesel will be used for mobile equipment and vehicles and heating of facilities, and gasoline may or may not be needed depending on the types of vehicles used. Both diesel and gasoline may be used for running generators at the camp. INF expects that external fuel tanks used during the Project will include stationary fuel tanks for heating and vehicle refueling and pickup-mounted fuel tanks for refueling mobile equipment. Estimated fuel requirements are provided in Table 9-1. Both mobile and stationary fuel tanks will comply with regulatory specifications.

INF will provide the MVLWB with updated information on fuel types, fuel tanks, and fuel volumes prior to the start of construction.

Table 9-1 Anticipated Fuel Types, Volumes, and Storage Specifications for the Project

Equipment Type	Design/model	Storage Type
Diesel	25,000 L	Double-walled enviro-tanks
Gasoline	5,000 L	Double-walled enviro-tanks

9.2 Fuel Transfer

The Contractor will determine fuel transfer methods used during the Project. It is expected that fuel will be transferred into vehicles, equipment, and stationary tanks using pumps and hoses attached to fuel tanks mounted on pick-up trucks and/or designated fuel trucks. All fuel transfers will be performed by experienced personnel and will adhere to the regulatory requirements specified in the LUP (for instance, fuel transfers will occur at a minimum safe set-back distance from any watercourses). INF and the Contractor may make changes to the equipment, operations and/or personnel as necessary to maintain regulatory compliance and to protect the environment.

10 Spill Contingency

INF is committed to managing spills proactively with regular inspections of equipment, proper training, and reporting of spills when they occur. A Draft SCP for the Project is provided in Appendix E. A final SCP will be provided once a Contractor has been selected and prior to the start of construction.

11 Proposed Schedule

INF plans to begin construction of the MGAR in the winter of 2021. Construction work will begin once a LUP is received from the MVLWB and a Contractor has been hired for the Project. An AIA for the Mount Gaudet Quarry and potential new Hodgson Creek Bridge location and alignment will be completed in the late summer of 2020 and geotechnical drilling of these areas will be completed following the issuance of a LUP for the Project. The construction contract is expected to be awarded in the fall/winter of 2020/21. The Project schedule is shown in Table 11-1.

Construction of the road is expected to take approximately 24-30 months (starting in the winter of 2021), although INF is requesting a LUP and Type B WL with a period of 5 years to account for any unexpected delays in the Project schedule.

Table 11-1 Proposed Project Schedule

Phase	Activity	Proposed Schedule
Pre-Construction	Environmental Approvals Received	October 2020
	Additional Studies	September to October 2020
	Detailed Design	October to December 2020
	Contract Award Process	October to December 2020
	Management Plans Approval	January 2021
Construction	Clearing of ROW; placement of geotextile within the road structure footprint; borrow source development	January 2021 and on as required

Phase	Activity	Proposed Schedule
	Borrow material processing; hauling and placement of embankment material	November to March 2021/2022/2023
	Compaction of placed embankment material; placement and compaction of surfacing material; culvert installation; borrow material processing	April to October 2021/2022/2023
Bridge Construction/Raising	All Activities	To Be Determined.

11.1.1 Pre-Construction Phase

Activities completed during the Pre-Construction Phase are to support detailed design, construction planning, acquisition of permits, and issuance of the contract.

11.1.2 Construction Phase

The construction phase will include the following activities:

- Clearing/mulching of trees and brush and grading along the alignment to increase the ROW width up to a maximum 60 m in areas where required
- Mobilization of camp, equipment and laydown/staging
- Development and Operation of the Mount Gaudet Quarry
- Operation of the camp at Mount Gaudet Quarry
- Raising of existing Hodgson Creek Bridge or installation of proposed new bridge
- Construction of the access road:
  - Placement of woven geotextile within the road structure footprint
  - Placement and compaction of quarried rock sourced from Mount Gaudet Quarry
  - Installation of culverts
  - Hauling, placement, and compaction of surface gravel

11.1.3 Operation and Maintenance

As outlined in Section 5.1, operation and maintenance of the MGAR is not subject to screening as part of the Preliminary Screening process (Section 13, Schedule 1 of the Exemption List Regulations issued under the MVRMA). Following the construction of the MGAR, O&M activities are expected to be included under INF's existing LUP MV2016E0006 for Highway #1 O&M.

12 Environment in the Project Area

12.1 Traditional Knowledge Study – Environment

Traditional Knowledge (TK) refers to social, natural and spiritual information that is accumulated and passed down through generations by oral means or through experiences and teachings. The Project takes place within the Pehdzéh Kį Ndeh traditional territory of PKFN, and information provided through TK is important for identifying components of the natural environment within and surrounding the Project footprint which are considered to be of cultural and spiritual importance to PKFN.

As part of planning for this Project, INF conducted a review of TK information for the Wrigley to Mount Gaudet area which was provided in the 2012 Dehcho Region PDR for the Mackenzie Valley Highway (MVH) (Dessau, 2012). The MVH PDR itself identified TK for the Dehcho segment of the proposed MVH based on consultations with PKFN and review of previous traditional land use studies in the area. A summary document generated from the TK review for the MGAR was sent to PKFN for verification and approval of the information. The contents of this TK summary can be found in Appendix A.

Traditional use areas, traditional activities, and traditional resources identified within the Wrigley to Mount Gaudet area include historical travel and hunting trails, traplines, fishing areas, and vegetation harvesting areas. Of particular note is a moose pasture area which is located to the north of the proposed Mount Gaudet Quarry, at approximately km 710 of the MVWR. This moose pasture is of great spiritual and cultural importance to PKFN, and INF has acknowledged that it will engage in ongoing discussions with PKFN to identify approaches to mitigate Project impacts on this traditional area. INF conducted a helicopter survey of the proposed MGAR with two members of PKFN to identify the extent of the moose pasture as understood by PKFN. The moose pasture area identified during this survey is located further north of any activity planned for MGAR, and will therefore not be considered in selecting the final route for the MGAR or in any mitigation measures incorporated into the construction process.

Additionally, PKFN has identified caribou as an important harvesting resource in the Wrigley to Mount Gaudet area which should be protected, though no seasonal caribou habitat (i.e. summering, calving, or overwintering areas) was identified in close vicinity to the Project footprint.

12.2 Environmental Overview

A description of the existing environmental conditions within the Project footprint and the surrounding area is provided in Appendix F.

12.3 Environmental Impacts and Mitigations

The following sections outline the potential impacts of construction and construction-related activities on components of the environment in and around the Project footprint. Potential

environmental and resource impacts and proposed mitigative measures have been summarized relative to the appropriate Valued Component (VC). The VCs presented in this application draw from several sources including:

- The Project Description Report for the proposed Mackenzie Valley Highway in the Dehcho Region (Dessau, 2012)
- TK Discussions with PKFN (a TK summary is included in Appendix A)
- Other projects which have occurred in the area, including the Mackenzie Gas Project (MGP) and the MVFL.
- Information provided by ENR and the Government of Canada.

12.3.1 Air Quality

The generation of dust particles of various sizes is associated with the handling of embankment and granular materials during construction. Dust will also be generated by vehicles and equipment travelling along the access road during construction. While larger particles (>44 microns diameter) usually only create nuisance issues, smaller particles (<10 microns diameter) can be a source of increased ecological problems.

Water will be applied as a dust suppressant during the construction and maintenance of the MGAR. This approach, which is recommended by ENR guidelines (ENR, 2013), should be effective in mitigating the generation of dust from crushing and surfacing activities. Water used for dust suppression will be obtained from the Mackenzie River, as described in Section 5.9.

The use of vehicles will also be associated with the emission of exhaust fumes which could negatively impact air quality. Table 12-1 summarizes the potential impacts and mitigation measures that are associated with air quality and emissions.

Table 12-1 Potential Air Quality Impacts and Mitigation

Potential Impacts	Mitigation Measures
Deposition of dust onto vegetation; eggs and nests of migratory birds; and waterbodies located within proposed Project footprint	• Water from suitable water sources, as per the GNWT Guideline for Dust Suppression (2013), will be applied during summer construction • Slow speeds (50 km/h) for haul trucks and other vehicles susceptible to creating excessive dust during summer, and to a lesser extent winter, construction will be enforced • Blast mats will be used when blasting • Additional measures associated with nesting birds are discussed under Section 12.3.8.4(Wildlife Impact Mitigation Measures)
Greenhouse gas emissions from diesel engines and incineration	• Equipment will be well maintained and in good operating condition • Unnecessary idling will be minimized

12.3.2 Noise

Noise impacts during the Project will be associated with blasting activities at the quarry and the use of heavy machinery for construction and quarry operations. Increased noise levels can present a disturbance to wildlife.

Haul trucks and heavy machinery will be moving at low speeds (<50 km/h) and will generate low levels of noise; typically within 78 decibels (dB) to 82 dB at 15 m from the truck. These noise impacts will be localized, temporary and rapidly reversible, and will be limited to the location in which operations are taking place at a particular time.

There are no local noise regulations that apply to construction; however, the Contractors will be directed to apply mitigation measures outlined in Table 12-2 to reduce the possible impacts associated with construction noise. These will include adequate maintenance of construction equipment, including mufflers.

The use of explosives will be timed to avoid periods when sensitive wildlife species are in the area (refer to the sensitive periods described in Section 12.3.8.4;

Table 12-11 and Table 12-12.) Borrow activities, including blasting, will be intermittent and temporary. Most of the noise will be associated with earth-moving equipment operation during periods of quarry activity.

Best management practices and mitigation measures will be applied to reduce the effect of noise; examples of measures to be implemented are described in Table 12-2 below.

Table 12-2 Potential Noise Impacts and Mitigation

Potential Impacts	Mitigation Measures
Noise level and unfamiliar noise associated with construction (traffic and equipment operation, blasting, and aggregate crushing) will disturb wildlife	• Construction activities will be timed to avoid sensitive periods for wildlife (• Table 12-11 and Table 12-12). • Opportunities to minimize vehicle movements will be used. • Regular maintenance of equipment. • Use of appropriate mufflers for equipment. • INF will take reasonable steps to follow wildlife setback guidelines detailed in Northern Land Use Guidelines (NLUG): Seismic Operations (Lands 2014d.) Where it is not possible to follow the setbacks, INF will work with ENR to implement additional mitigations.

Appropriate measures will be included in the quarry operations plan to minimize noise impacts from blasting.

12.3.3 Climate Change

Climate change is primarily a cumulative impact issue associated with fossil fuel use and it has already caused considerable impacts on the ground permafrost profile across the NWT. Impacts from climate change (warming temperatures, greater precipitation, and extreme/ unpredictable events) could have an impact on the stability of the MGAR from an operations, maintenance, and preservation perspective, potentially resulting in negative impacts on the surrounding environment, such as greater thawing of permafrost and altered precipitation patterns contributing to ground settlement and subsidence.

The permafrost is extensively discontinuous in the Project area and the frozen ground has variable proportions of ground ice. When thaw occurs, the excess water is squeezed out and compression produces substantial settlement. The thermal stability of the frozen ground is sensitive to minor changes in heat transfer at the ground surface. These minor changes in heat transfer alter the surface heat balance, initiating thaw and increasing active layer thickness. Such heat transfer and potential settlement due to thaw is possible in permafrost regions even without climate warming. Subtle increases in temperature and extreme weather events that result in extreme precipitation and rapid snow melt can contribute to and accelerate thaw.

The effects of climate change on permafrost are further compounded by direct impacts from the road itself. High thermal conductivity of the road structure during the summer can increase the thaw of surrounding permafrost and increase active layer thickness, although it also cools the ground during the winter by promoting heat loss. Additionally, snow will tend to accumulate along the side of the road, increasing thermal insulation of the underlying ground.

A Climate Resilience Assessment (CRA), intended to address the performance infrastructure and systems over a 75-year lifespan in the context of a changing climate, was not completed for the MGAR because funding for this Project was secured from the Government of Canada prior to the CRA being a requirement of federal funding applications. However, a CRA was completed for PCAR, a similar project in a similar geographic region (approximately 260 km northwest of the MGAR), in 2019 (Stantec, 2019). Both the PCAR and the MGAR will be constructed in the extensive permafrost zone, on the eastern side of the Mackenzie River and in the same climatic zone, and similar climate-risk and adaptation measures also apply to both projects. The PCAR CRA utilized greenhouse gas emissions scenario Representative Concentration Pathways (RCP) 8.5 to identify climate parameters that may pose a risk to the proposed access road. The CRA concluded that several climate parameters may pose a hazard including temperature (mean seasonal temperatures, high and low temperature extremes), precipitation extremes, sustained rainfall, dry spells, daily frost, and freeze-thaw days. A risk analysis was completed on each of the climate parameters and adaptation measures were identified for each component.

Table 12-3 Potential Climate Interactions Identified During PCAR Climate Resilience Assessment (Stantec 2019b)

Climate Parameter	Description of Climate Interaction
Increase in mean seasonal temperatures may adversely impact road base and subgrade material.	• Increasing air temperatures in the Project area will result in permafrost thaw and cause an increase in active layer thickness. Permafrost containing soils will be weakened, and unfrozen soils may heave. • Permafrost thaw will initiate the expulsion of water and settlement of the embankment material resulting in instability, differential settlement, and structural failure. • Additional costs due to increased frost heave and thaw settlement.
Mean seasonal temperatures impacting road embankment / cuts	• Increasing subgrade temperatures may change ground and surface water flows. • Changes in the water table during unfrozen conditions may result in settlement and shifting of the roads/ embankment and sinking and cracking of road shoulders. This results in road instability and structural failure.
Mean seasonal temperatures impacts to road	• Increasing temperatures may increase the occurrence of icings on the road. The active layer will become thicker and the subsurface water flow will increase.
High temperature extremes impacting wildfires	• Wildfires along ROW may destroy the insulating ground cover and increase ground temperatures. This may accelerate permafrost thaw and accentuate structural issues.
Low temperature extremes impacting road	• Rain on snow events may cause flooding and traffic hazards. Possibility to over-sand road way which can physically change the crown of the road, shoulders and compromise the roadways load bearing capacity.
Precipitation extremes impacting the road base and subgrade	• Intense rain events may exceed the design flow capacities for the culverts. This would result in water ponding against, overtopping, or flowing uncontrollably through the road embankment. • Saturated road embankments may lose structural strength, causing rutting and producing potholes when heavily loaded. • Increased frequency of severe winter storm events will increase the need for snow clearing, resulting in additional load to the road surface. Insufficient late winter snow pack removal can result in soft areas. High-volume snow melt may result in flooding, increased pore water pressure, and erosion, leading to permafrost impacts. • Additional maintenance of ditches and culverts may be necessary.
Precipitation extremes impacting the road embankments/ cuts	• Embankments can be susceptible to changes in spring melt, rainfall frequency, intensity and duration, as well as ground water levels resulting in internal erosion. • Internal and external erosion can impact structural integrity increasing the possibility of wash outs, loss of sediment to watercourses, etc.
Sustained rainfall impacting ditches and culverts	• Drainage structures that cross the embankment, such as culverts and rock drains, are considered at higher risk to climate change than diversion structures that do not due to the severity. • Increase in rain events may increase the potential for aquaplaning.

Climate Parameter	Description of Climate Interaction
	• Extreme storms may hinder maintenance activities.
Dry spells impacting vegetation	• Dust may form after long droughts and limit visibility of the road • Dust particles that settle onto plants can smother leaf surfaces and increase leaf surface temperature, reducing the overall photosynthetic efficiency of the plant.
Daily frost impacting culverts and ditches	• Road surface and/or culverts can be structurally affected due to deformations associated with volumetric changes when water freezes to ice and vice-versa. Increase in the number of frost-free days is likely to reduce this impact.

Key operational and design measures, intended to minimize greenhouse gas emissions and reduce the potential impacts of climate change on terrain in the Project area, are detailed in Table 12-4. Specific approaches for dealing with permafrost during the Project will be included in the Permafrost and Erosion Plan (PEP) to be submitted to the MVLWB prior to the start of the Project.

Table 12-4 Potential Climate Change Impacts and Mitigation

Potential Impacts	Mitigation Measures
Greenhouse gas emissions from Project contributing to further climate change globally and locally.	• Proper insulation and winterization of camp to minimize the use of heating fuel. • Maintaining vehicles and equipment in proper operating condition. • Discouraging unnecessary idling of vehicles. • Solar or wind generators may be used to power the camp if feasible. • Plugging in vehicles and equipment at camps to minimize the need to keep them running during cold weather. • Confining the Project footprint, to the extent where possible, to cut lines and other areas that have already been disturbed to preserve vegetation which acts as a carbon sink. • Use of fuel-efficient equipment, where possible, to lower fuel consumption.
Increase in mean seasonal temperatures initiating permafrost thaw, water expulsion from soils, and material re-settlement.	• Using a “fill” only embankment concept rather than “cut and fill” approach to minimize impacts on weak subgrade soils. • Use of woven geotextile to reinforce embankments and reduce differential settlement. • Incorporate approaches to minimize the presence of ponded water within the ROW (e.g. appropriate culvert placement and sizing). • Use of geo-fabrics, geo-synthetic materials, wattles or other erosion control products in ditches covered by organics to minimize erosion of the existing fine grained soils. • Stage the construction such that the placement of granular surfacing is delayed until any significant differential settlement has occurred. • Confine activities to the Project footprint to the extent where possible.
Increase in mean seasonal temperatures resulting in altered ground surface and water flows, increased	• Identify areas within ROW that are most vulnerable to climate change, including those areas with ice-rich permafrost. • Avoid constructing in ice-rich areas, if possible, and where not possible, deploy methods to minimize thermal disturbance.

Potential Impacts	Mitigation Measures
ponded surface water, and potential erosion and drainage issues associated with permafrost thaw.	• Avoid installing drainage ditches in sub-grade to minimize impacts to thaw sensitive soils. • Incorporate approaches to minimize the presence of ponded water within the ROW (e.g. appropriate culvert placement and sizing). • Placement of culverts directly on the ground surface rather than ditching into subgrade to prevent water management concerns.
Precipitation extremes impacting the road embankments/ cuts, contributing to internal and external erosion, impacting structural integrity, and increasing the possibility of wash outs and loss of sediment to watercourses. Sustained rainfall impacting ditches and culverts	• Using a "fill" only embankment concept rather than "cut and fill" approach to minimize impacts on weak subgrade soils. • Use of woven geotextile to reinforce embankments and reduce differential settlement. • Employing the erosion control measures outlined in the PEP. • Use of appropriately sized and placed culverts along the alignment,
Increases in high temperature extremes increase wildfire potential, which may impact insulating ground cover and increase ground temperatures.	• Minimize area disturbed during construction.
Increased frequency of dry spells, due to climate change impacts on temperature and precipitation patterns, leading to greater generation of dust particles.	• Use of water as a dust suppressant during periods of high dust generation.
Daily frost impacting culverts and ditches	• Appropriate sizing and positioning of culverts.
Warming temperatures globally decreasing the amount of permafrost in the local area of the Project. Increased ground temperatures resulting in additional	• Use of geotextile to support weak subgrade soils and reduce differential settlement. • Use of geo-fabrics, geo-synthetic materials, wattles or other erosion control products in ditches covered by organics to minimize erosion of the existing fine grained soils. • Use of high quality material (strong blast rock) from the Mount Gaudet Quarry to construct the embankment instead of low quality borrow material. • Incorporate approaches to minimize the presence of ponded water within the ROW

Potential Impacts	Mitigation Measures
microbial activity	(ex. appropriately sized and located culverts to manage surface flow). • Taking advantage of the natural topography and grades along the alignment that are gentle so side-hill cuts are eliminated. • Avoiding construction on steep slopes to prevent material slumping and gully erosion. • Staging the construction such that the placement of granular surfacing is delayed until any significant differential settlement has occurred. • Confining the Project footprint, to the extent where possible, to cut lines and other areas that have already been disturbed. • Placement of culverts directly on the ground surface rather than ditching into subgrade to prevent water management concerns. • Monitoring Project sites as required during freshet (annual spring snow melt) to identify and mitigate erosion concerns. • Following the appropriate erosion control measures and maintaining supply of erosion control materials locally to avoid delays in implementing erosion control measures. Development of a Permafrost and Erosion Plan prior to starting construction. • Monitor sections of the road where changes in permafrost could have impacts on the road structure. Use information gathered from monitoring to inform ongoing maintenance approaches.

12.3.4 Terrain and Topography

The road will be built on discontinuous permafrost terrain which is vulnerable to physical and thermal ground disturbances. A full description of terrain and topography in the Project area is included in the Environmental Overview in Appendix F. Mitigation measures during design, construction and monitoring will be employed to manage impacts on the surrounding terrain, especially permafrost.

Key aspects of the terrain and topography description for the MGAR route are provided below:

- Elevation (topographic relief) along this section is approximately 237 m above sea level (a.s.l.) at the Mount Gaudet end of the road to 103 m a.s.l. at the Wrigley end of the road (Google Earth, 2014).
- The Central Mackenzie Valley area (BC HBb) is primarily covered by glacial tills and glaciolacustrine and glaciofluvial deposits. Glaciation resulted in a generally flat to gently rolling and sloping topography. Meltwaters have been surficially reworked the till deposits and at lower elevations, these till deposits were subsequently covered with silts, clays and fine sands. Silty and clay-like glaciolacustrine deposits form a veneer over till and become thicker and flatter-surfaced towards the Mackenzie River (Aylsworth et al., 2001).
- Geohazards are generally defined as natural, existing or potential, geomorphic and geologic processes and formations that could lead to damage to engineering structures. Significant and relevant risks and vulnerabilities to the proposed road are primarily related to working in a

permafrost environment on permafrost terrain. Potential geohazards which could affect the project are described in the Environmental Overview document in Appendix F.

Mitigation efforts associated with the impacts of permafrost, sensitive terrain, massive ground ice and thermal erosion in the design and construction stage are the same as those described in Section 12.3. Additionally, potential impacts on terrain, soils and permafrost from erosion and subsequent mitigation measures are listed in Table 12-5. A PEP will be submitted as a condition of the LUP for Board review and approval prior to the start of construction.

Table 12-5 Potential Terrain, Soil and Permafrost Impacts and Mitigations from Erosion

Potential Impacts	Mitigation Measures
Erosion and drainage pattern changes as a result of construction related activities (including overburden removal and excavation)	• Potential erosion will be controlled by using an effective road design (including use of culverts and bridge). • Slopes will be stabilized, if required. • Re-vegetation with native species, where possible. • Best practices outlined in the PEP will be followed. • Runoff velocities will be kept low.
Soil damage as a result of construction related activities (including potential soil contamination due to accidental spills)	• Surface disturbance to undisturbed terrain will be minimized as much as possible. The majority of the Project work will be confined to previously disturbed areas within the Project footprint. • In cleared areas where required, woody debris will be left on-site and spread over the cleared area to protect the soil and permafrost instead of windrowed. • Construction on highly saturated soil (primarily during freshet) will be avoided where practical or suitable ground equipment will be used to prevent unnecessary soil damage through rutting, etc. • Geotextile will protect the organic layer in areas where there is concern. • Adherence to Standard Operating Procedures for fuel handling and following the SCP. • Spill pans will be placed under equipment where required and inspected daily. • Preventative maintenance will be completed on equipment to reduce the potential for leaks.
Permafrost thaw as a result of construction related activities	• During geotechnical investigations, ice-rich permafrost areas will be identified and avoided if possible. Cut and fill operations will be avoided where there is the possibility of hitting ice-rich permafrost and instead geotextile will be laid and sensitive areas will be filled. • During susceptible seasons (spring, summer, fall), suitable ground equipment will be used to prevent impact to sensitive terrain.
Erosion and drainage pattern changes as a result of permafrost thaw	• Minimizing the area of ground disturbance by following the pre-existing winter road alignment. • Providing sufficient cross drains along the roadway to facilitate water

Potential Impacts	Mitigation Measures
	movement and maintain drainage patterns. • Monitoring erosion and drainage patterns and increasing the number of cross drains and locations if warranted to provide remedial erosion protection.
Permafrost thaw as a result of natural conditions (forest fires, climate change)	• Minimizing disturbance of the active layer during construction activities. • Identification and observation of areas where permafrost thaw may be accelerated in the future, such as forest fire-prone areas. • Avoidance of steep grades where subsidence may occur as a result of permafrost thaw, where possible.

12.3.5 Hydrology and Surface Water Quality

The Project is expected to have limited impacts on hydrology and surface water quality or hydrology. Impacts to groundwater are not anticipated. Impacts that could occur as a result of the construction of the Project include:

- surface water quality impacts as a result of the deposition of deleterious substances (i.e. through spills, ARD/ML from the quarry, sediment release, erosion, permafrost melting, dust from vehicles)
- changes to flow regimes during freshet
- Potential impacts of the Hodgson Creek Bridge relocation or raising will be minimized through the clear span bridge design and construction planning process. Table 12-6 includes general hydrology impact mitigation measures which are based on DFO's guidelines for protecting fish and fish habitat (DFO, 2019).
- Several small drainages have been identified along the proposed MGAR alignments (GNWT ATLAS Web Service; Accessed May 5th, 2020). INF plans to complete hydro-technical assessments for these drainages in the late summer or fall of 2020 to appropriately size the culverts (for drainage and or fish passage) to be placed at these locations.

No damming of flow or installation of water-control structures is required for the Project. Water withdrawn from the Mackenzie River to support Project activities such as winter road construction will be low in volume (150 – 299 m3/day).

Table 12-6 outlines the potential impacts of the Project on hydrology and surface water quality with associated mitigation measures.

Table 12-6 Potential Water Quality and Quantity Impacts and Mitigation

Potential Impacts	Mitigation Measures
Surface Water quality affected by deposition of deleterious	• Adhering to the GNWT's Dust Suppression Guidelines (ENR, 2013) to manage dust levels.

Potential Impacts	Mitigation Measures
substances	• Enforcing vehicle speeds to reduce the amount of dust. • Following the guidelines outlined in the GNWT's Erosion and Sediment Control Manual (DOT, 2013) and PEP during the design and installation of culverts. • Use of appropriately sized and located culverts to prevent backwatering and washouts. • Installation of silt fencing where required to control possible sediment release during construction and post construction. • Following the Project SCP to prevent spills entering the waterways and to manage and clean up a spill should a spill occur. • Progressive reclamation of the borrow source through re-vegetation and contouring to help prevent dust and sediment from entering waterbodies. • Delaying major construction activities in the event of high rainfall events. • Removal of all sewage from the Project sites to an approved facility to prevent any discharge onto the land or into the water. • Locating sumps used for the disposal of grey water at least 100 m from any water body. • Geochemical testing of borrow materials will prevent ARD/ML impacts to waterbodies. • If work is required within 100 m of the ordinary high water mark of any waterbody, INF will obtain authorization from Lands prior to the commencement of work. • Laydown and equipment staging areas will be located at least 100 m from the ordinary high water mark of any waterbody. • Maintaining a 100 m buffer between quarry activities and nearby waterbodies. The quarry will be designed to drain naturally to allow water to flow into the natural environment with the avoidance of distinct run-off channels. • If required, performing water sampling in the event of a spill to monitor potential impacts to surface water quality.
Impacts to surface water quality due to vegetation clearing	• Minimize clearing within Project footprint, where possible. • Maintain a 30 m vegetated buffer strip between Project footprint and water bodies. • Dust will be minimized by enforcing speed and load limits to preserve the road bed, and regular road maintenance will be completed to reduce dust production. • Areas for cleaning equipment will be located a minimum of 100 m from watercourses and will not drain into or toward water bodies. • Riparian areas will be maintained whenever possible to minimize erosion and impacts to water quality, with vegetation removal limited to the width of the ROW. • Cleared vegetation will be removed from within 100 m of the water body, to prevent them from entering the watercourse. • Grading of the stream banks at approaches will not occur. • Disturbed areas along the stream banks will be stabilized if required upon completion of work to minimize erosion (as per the DOT Erosion and Sediment Control Manual and the PEP). Avoiding disturbance of the surface organic layer and damage to root structures during clearing in non-permanent footprint areas.

Potential Impacts	Mitigation Measures
Disruption of Stream Flow and Alteration of Hydrology from the Relocation or Raising of Bridge	• Avoid disturbing riparian vegetation as much as possible by using existing cut-lines during clearing and maintaining an undisturbed vegetated buffer zone between Project activities and the high water mark of the creek. • Work will not be conducted directly within the water. • Avoid building structures in areas that may result in erosion, and/or scouring of the stream bed or banks • Avoid stream locations that are inherently unstable (Ex. bends, meanders, floodplains, or braided streams)
Changes in flow	• Completion of hydrology assessments to appropriately size culverts to convey flows. Design of culverts to withstand a 1 in 100 year flood flow rate. • Equalization culverts will be installed to prevent ponding as outlined in Section 5.7.4. The locations of the culverts will be outlined in the final design. • Design for culverts will include requirements for bedding materials and geotextile to protect surrounding permafrost from thaw. Rip rap will be incorporated into culvert design to avoid erosion around inlet and outlet of each culvert. • Regular observation and maintenance along the MGAR to confirm culverts remain operational. • Thermal assessment will be completed prior to the completion of the final design to identify areas with permafrost and implement mitigations (e.g. avoidance where possible). • Geotextile will be used to minimize permafrost thawing which could impact water quantity. • Road design criteria has considered an appropriate slope ratio along the proposed MGAR to protect slopes during rain events. • NLUGs: Pits and Quarries (Lands 2015d) guidance will be followed regarding water management at the Mount Gaudet Quarry (e.g. not excavating below the water table and water management).
Groundwater Impacts	• Boreholes will be filled with drill cuttings to prevent a potential spill from entering nearby groundwater.

12.3.6 Fish and Fish Habitat

Appropriate mitigation measures will be applied during the Project to address potential impacts on fish and fish habitat. Project activities will follow DFO's protocols on the protection of fish and fish habitat (DFO, 2019).

The proposed MGAR alignment crosses Hodgson Creek at approximately .5 km northwest (Scenario 1) or 1 km north (Scenario 2) of the community of Wrigley. Several species of fish are present in Hodgson Creek. The headwaters of the creek serve as overwintering habitat for Arctic Grayling (*Thymallus arcticus*), Slimy Sculpin (*Cottus cognatus*), Lake Chub (*Couesius plumbeus*), Longnose Sucker (*Catostomus catostomus*), Burbot (*Lota lota*), and Northern Pike (*Esox lucius*), while spawning and nursery habitat for Arctic Grayling, Lake Chub, Longnose Sucker, Round Whitefish

(*Prosopiurn cylindraceurn*), and Slimy Sculpin occur throughout the creek (Stewart & Low, 2000). None of these species have conservation status under territorial or federal legislation.

A few smaller drainages have also been identified along the proposed MGAR alignment (GNWT ATLAS Web Service; Accessed May 5th, 2020), and a small waterbody approximately 7500 m^2 in area is located within the proposed boundaries of the Mount Gaudet Quarry.

The existing bridge at Hodgson Creek may be relocated as part of the final MGAR alignment, which will involve geotechnical investigations to determine the location of the alternate bridge, the construction of the new approaches, and the transport of necessary material for the bridge installment. These activities have the potential to impact fish and fish habitat in Hodgson Creek. Additionally, should fish be present in the waterbody within the quarry boundaries (investigations to confirm summer 2020), quarry activities have the potential to impact fish and fish habitat, while road construction may impact drainages along the proposed MGAR alignment.

Fish habitat assessments of Hodgson Creek, the waterbody at Mount Gaudet Quarry, and drainages along the MGAR alignment are planned for the late summer or fall of 2020.

The Project is within the ecological range of Shortjaw Cisco (*Coregonus zenithicus*) and Bull Trout (*Salvelinus confluentus*), which are both listed as threatened by the federal *Species at Risk Act* (SARA) and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Neither of these species has previously been recorded in Hodgson Creek.

Fish Impacts and Mitigation

The most likely potential impact which the Project may have on fish and fish habitat is through erosion and the generation of sediment during road construction, bridge work, and quarry operations (including blasting). Sediment released to streams and lakes, both in suspended and settled forms, presents risks to fish and fish habitat which include, but are not limited to: degradation of potential spawning areas; smothering of eggs and the benthic invertebrate food supply; reduction in feeding efficiency; avoidance of potentially suitable habitats; and, abrasion of fish tissues (Lloyd et al. 1987; Birtwell 1999). During the Project, work will not occur within 100 m of the ordinary high water mark of any waterbody unless authorization from Lands is provided. Work within 100 m of the waterbodies will be minimized, where possible. Erosion protection measures will be installed as per DOT Erosion and Sediment Control Manual and the approved PEP.

Other potential impacts from the Project include changes to runoff patterns due to culvert placement, accidental spills of fuels and hazardous wastes, and the entrainment of fish during water withdrawal (i.e. the entry of fish into water withdrawal structures).

Table 12-7 summarizes potential Project impacts on fish and fish habitat and general mitigation measures that will be employed in relation to these impacts.

Table 12-7 Potential Fish and Fish Habitat Impacts and Mitigations

Potential Impacts	Mitigation Measures
Direct loss of riparian habitat during construction activities	• Follow best management practices for riparian habitat, including a setback of 100 m from the ordinary high water mark of any waterbody. Where work within the setback is required, INF will consult with DFO prior to work within the riparian zone. • Road construction methods in vicinity of waterbodies will limit the amount of habitat lost. • Installation of erosion control measures in accordance with DOT Erosion and Sediment Control Manual and the approved PEP. • Dust suppression techniques will be utilized to minimize the amount of dust entering the water.
Direct loss of habitat during culvert installation	• Culvert installation shall be completed in accordance with DFO guidance. • In-stream work, if required, will be restricted to during no-flow or low-flow periods. Work will respect DFO fish timing windows for the NWT.
Sediment release during culvert installation	• Installation of erosion control measures in accordance with DOT Erosion and Sediment Control Manual and the approved PEP. • Keep work areas clean and free of deleterious substances.
Changes in flow patterns due to culvert installation	• Best management practices for culvert installation will be followed. • Disturbance of watercourse streambed and banks will be minimized as much as possible. • Erosion and sediment control measures will be installed and maintained where required. • Appropriate sizing, installation, numbers and locations of culverts to avoid backwatering and washouts.
Introduction of deleterious substances impacting surface water quality	• Dispose of wastes at the approved disposal facility located in the Norman Wells. • Laydown and equipment staging areas will be located at least 100 m from the ordinary high water mark of any water body. • Clean up spills in accordance with the SCP.
Operation of quarry causing erosion and sedimentation as well as noise, vibration and pressure changes from explosives which impact fish habitat	• Quarry operation will occur at least 100 m from any water body. • Installation of erosion control measures in accordance with DOT Erosion and Sediment Control Manual and the approved PEP. • Borrow source materials will be evaluated for ARD/ML potential prior and during development.
Potential fish impingement during water withdrawal	• Screens for water withdrawal will be designed and operated in accordance with the DFO Interim Code of Practice: End of Pipe Fish Screens (DFO 2020) and DFO Fish Screen Design Criteria for Flood and Water Truck Pumps (DFO 2011).

Potential Impacts	Mitigation Measures
Increased exploitation due to improved access to remote fishing areas	• Public education.

12.3.7 Vegetation

No plant species listed under federal or territorial legislation occur near the Project area. The closest recorded occurrence of a rare plant species to the Project area is the presence of red bulrush (*Blysmus rufus*) across the Mackenzie River and approximately 3.5 km from the proposed Project (B. Fournier, Personal Communication, November 18, 2019).

Vegetation Impacts and Mitigation

Vegetation in the Project area will be impacted by clearing activities to expand the existing winter road ROW to support an all-season road, as well as the removal of overburden at the quarry to carry out quarrying activities. Loss of vegetation during the Project could include the loss of merchantable timber. Additionally, overall loss of vegetation from the Project would impact the carbon sequestering potential of the landscape and would contribute to increased release of greenhouse gasses, through below-ground vegetation decay and microbial activities associated with warmer, more exposed ground (Houghton et al., 2012). Combined, these effects would further contribute to the climate change impacts discussed in Section 12.3.3.

Vegetation immediately adjacent to the Project footprints could be indirectly affected by dust generated during construction and blasting activities and from vehicles travelling along the road. Dust particles that settle directly onto plants can smother leaf surfaces and increase leaf surface temperature, reducing overall photosynthetic efficiency in the plant (Farmer 1993).

Plant communities could also be indirectly affected by the introduction of non-native or invasive plant species during construction. Disturbance associated with linear infrastructure developments can unintentionally create growing conditions that facilitate the successful establishment of invasive plants (Snyder & Anions 2008). Exposed soil resulting from the removal of plant cover is particularly susceptible to colonization. Dirty equipment transported to site from other areas can act as a dispersal mechanism for invasive plant propagules (reproductive structures) that may be lodged in tires and mud.

The spread of invasive plant species is an even greater concern when the effects of climate change are taken into consideration. Several studies have found that warmer climate conditions can increase both the rate and extent of invasive plant species propagation (Clements & Ditommaso, 2012; Smith et al., 2012). It is therefore particularly important to both prevent the establishment and spread of invasive plants within the Project area.

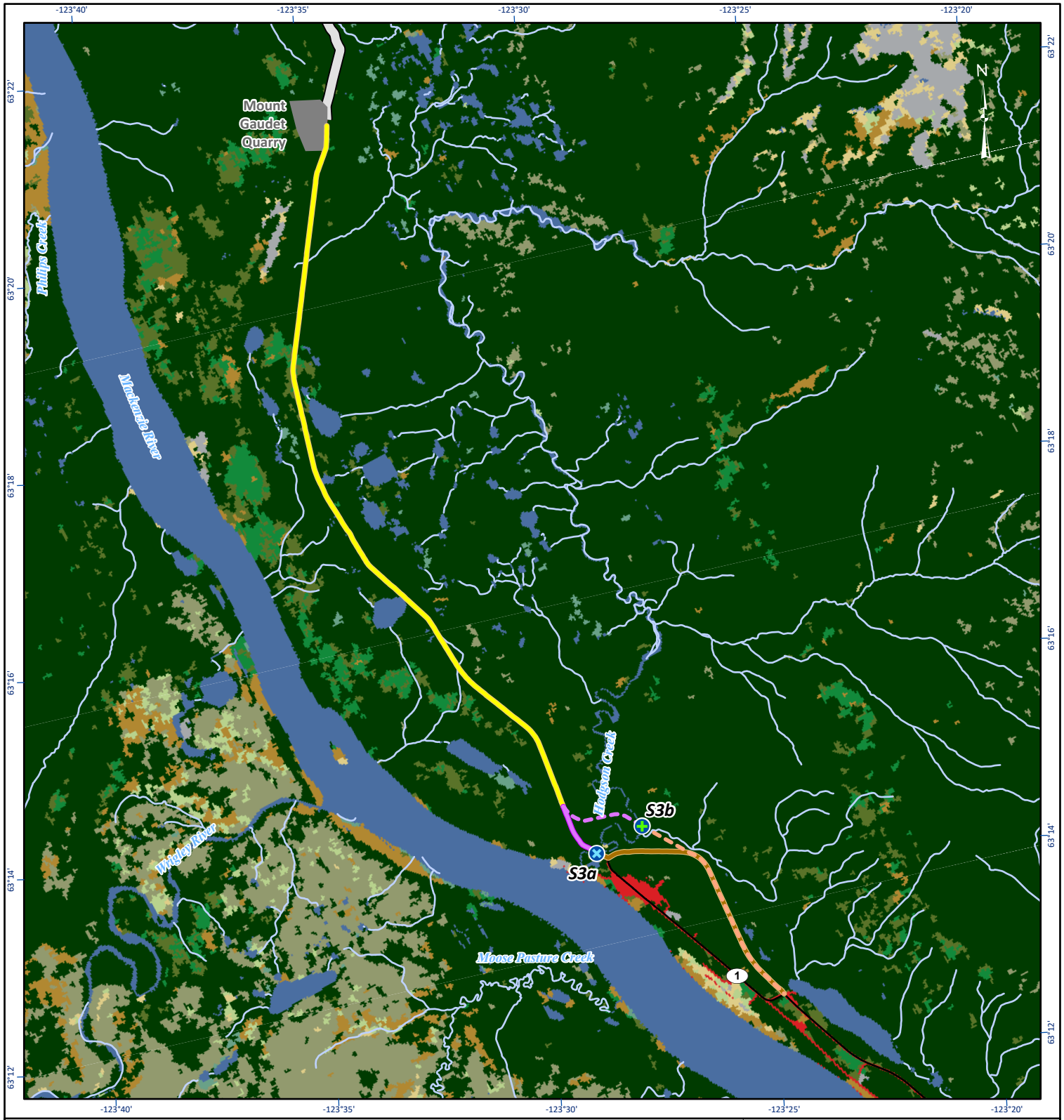
Vegetative land cover in the Project area is shown in Table 12-8.

Table 12-8 summarizes potential impacts to vegetation which could result from Project activities along with general mitigation measures that will be implemented to minimize these impacts.

Table 12-8 Potential Vegetation Impacts and Mitigation

Activity	Potential Impacts	Mitigation
Clearing along MGAR alignment and at the quarry.	Destruction of habitat-providing vegetation and culturally important plant species.	• Limiting movement of equipment and vehicles to the previously disturbed winter road alignment where possible to avoid unnecessary disturbance to vegetation. • Limiting removal of overburden at the quarry site to those parts of the quarry from which material is actively being removed. • Using natural topography to avoid the need for side-cutting during construction activities. • Stacking of merchantable timber (butt size >120mm) along the side of the road, and posting advertisements to notify community members that this timber is available for use. • Avoiding disturbance of the surface organic layer and damage to root structures during winter clearing in non-permanent footprint areas • Preparing temporary footprint areas for re-vegetation once Project activities are finished (ex. re-contouring of the ground surface
Use of vehicles and heavy machinery during all components of the Project and blasting at the quarry.	Generation of dust.	• Application of water to the road surface during periods of high dust generation (summer). • Blast mats will be used when blasting.

Activity	Potential Impacts	Mitigation
Use of machinery, vehicles, and equipment coming from outside the Project site. Potential use of plants for a variety of purposes during the Project, including to control erosion and to promote reclamation of depleted quarry areas.	Introduction of invasive plant species.	• Cleaning equipment thoroughly before bringing it to the work site to prevent the introduction of invasive plant species. • Prohibiting the use of potentially invasive plant species (ex., prohibit use of straw to minimize erosion potential) and use of native species where feasible.
Improper installation of culverts.	Disruption of drainage flows potentially resulting in erosion.	• Maintaining natural drainage patterns by using sufficient numbers of properly sized and positioned culverts.



LEGEND

- Hodgson Creek Bridge
- Alternate Hodgson Creek Bridge
- Canyon Creek All Season Access Road
- Highway 1 - Mackenzie Valley Highway
- Mackenzie Valley Winter Road
- MGAR Segment 1
- MGAR Segment 2a
- MGAR Segment 2b
- MGAR Segment 4a
- MGAR Segment 4b
- Quarry
- Watercourse

2015 Land Cover of Canada

- Temperate or sub-polar needleleaf forest
- Sub-polar taiga needleleaf forest
- Temperate or sub-polar broadleaf deciduous forest
- Mixed forest
- Temperate or sub-polar shrubland
- Temperate or sub-polar grassland
- Sub-polar or polar shrubland-lichen-moss
- Sub-polar or polar grassland-lichen-moss
- Sub-polar or polar barren-lichen-moss
- Wetland
- Cropland
- Barren land
- Urban and built-up
- Water
- Snow and ice

2 1 0 2
1:100,000 Kilometres

NOTES

Sources: Project Data: Government of Northwest Territories. Base Data: CanVec, Government of Canada; Government of Northwest Territories; NWT Centre of Geomatics
Land Cover Source: Government of Canada; Natural Resources Canada; Canada Centre for Remote Sensing
Spatial Reference: NAD 1983 Northwest Territories Lambert

Figure 12-1 - Vegetation Communities

GIS	DR	2020-06-03	Doc ID: 144902910-3003 REVD
QA/QC	EV	2020-06-03	Government of the Northwest Territories

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12.3.8 Wildlife

The Project will involve a number of activities which could have impacts on wildlife and wildlife habitat in the Project area. Activities with the most potential for impacting wildlife and their habitat include clearing, blasting, hauling, and vehicle traffic.

The Potential wildlife and habitat impacts discussed below are grouped into 3 categories:

1. Habitat fragmentation
2. Habitat loss and alteration
3. Wildlife mortality (direct and indirect)

An overview of the wildlife species which occur in the Project area is provided in the Environmental Overview in Appendix F. It includes detailed species accounts, a baseline of preferred habitats, temporal occurrence within the Project area, and sensitive life history stages.

12.3.8.1 Habitat Fragmentation

Habitat fragmentation refers to the division of a contiguous habitat into two or more separate areas, and is often the result of human developments. Habitat fragmentation can reduce genetic diversity by limiting interactions within a population to smaller populations in the now fragmented area (Holderegger & Di Giulio 2010). This reduction in genetic variation can make populations much more prone to extinction.

Fragmentation of habitat is not expected to be a major concern for the MGAR, as most, if not all, of the final MGAR alignment will be constructed along the previously disturbed winter road alignment. Some habitat fragmentation, however, may be associated with clearing at the Mount Gaudet Quarry and at the alignment to the alternate bridge location should Scenario 2 (segments 1, 2b, 3b, and 4b) be selected. Additionally, construction traffic, with its associated noise, dust, and exhaust generation may reduce the movement of wildlife through the area temporarily.

Several studies have shown that roadways can impair the movement of ungulate species between summer and winter habitat (Klein, 1971; Ward, Cupal, Goodwin, & Morris, 1976), and can limit access of woodland caribou to important food sources (Environment Canada, 2012a). Road developments have also been found to prevent access of grizzly bears to food sources (McLellan & Shackleton, 1988).

High snow banks constructed during the winter and windrowed timber placed during all times of the year can contribute to reduced habitat connectivity by making it more difficult for wildlife, such as caribou, to pass through the area.

12.3.8.2 Habitat Loss and Alteration

Road construction may cause certain species to avoid an area due to indirect effects (such as noise disturbance) associated with blasting and construction traffic and the generation of dust and vehicle exhaust. Avoidance of roads due to noise and other road-related disturbances has been

documented in grizzly bears (McLellan & Shackleton, 1988), wolves (Thruber et al., 1994), and caribou (Klein, 1979). Moose display a greater avoidance of suitable habitat which is located closer to roadways, and this avoidance behaviour increases with the size of the road and the volumes of traffic (Eldegard, Lyngved and Hjeljord, 2012).

Some loss of habitat will be associated with clearing of vegetation for the Project. Currently, the total approved ROW for the MVWR is 60 m under LUP MV2016E0006, although the alignment is currently only cleared to approximately 10-15 m. It is anticipated that the final MGAR alignment will be cleared to 30 – 60 m in width. The total Project footprint, and the portion of this footprint constituting new disturbance, will ultimately depend on the final MGAR route which is chosen (Scenario 1 or Scenario 2), which will depend on whether the Hodgson Creek Bridge is moved or raised at its existing location.

Linear developments are generally associated with the removal of habitat over the development area and can contribute to the overall degradation of habitat quality in the surrounding area. The development of roads and clearings converts nearby habitat into edge habitat, which differs in characteristics such as light, temperature, and ground moisture compared to the original habitat (Matlack, 1993; Cadenasso et al., 2003). These different characteristics of edge habitat make it suitable for different plants compared to non-edge habitat in the area (Wales, 1972; Watkins et al., 2003), and the occurrence of any given species can differ significantly between edge habitat and non-edge habitat. Ortega & Capen (2002), for instance, found that several bird species occurred with less abundance in habitats adjacent to roads. Habitat edges can also be expected to negatively affect interior forest species whose tolerance for environmental change is limited such as boreal caribou, which require large tracks of undisturbed habitat. On the other hand, moose have a tendency to spend more time at habitat edges, though this only applies to edge habitat located between abundant food and cover (Dussault et al., 2005; Courtois et al., 2002).

Both accidental spills and improperly disposed waste reduce the quality of habitat in an area. The measures described in the Project WMP and SCP will be applied during the Project to mitigate these types of impacts.

Habitat Loss and Alteration from Invasive Species

Road construction activities can also alter habitat quality through the introduction and spread of invasive plant species. Invasive species propagules may inadvertently be brought to site on vehicles and equipment being used for construction. Furthermore, ecological conditions associated with the presence of a road can promote the spread of invasive species which are already present in an area (Flory and Clay 2009; Christen & Matlack 2006).

Equipment and vehicles will be inspected and cleaned thoroughly before being brought to site to avoid the introduction of invasive plants.

Habitat Loss and Boreal Caribou

Boreal caribou are considered particularly vulnerable to anthropogenic disturbances, such as roads and seismic lines, and require large tracts of undisturbed habitat to avoid predation (Species at Risk

Committee 2012). Environment Canada (2012b) predicts a minimum threshold of 65% undisturbed habitat (or a maximum 35% disturbed habitat) at any given time across their range to be the minimum required to support a self-sustaining population (with a 60% probability).

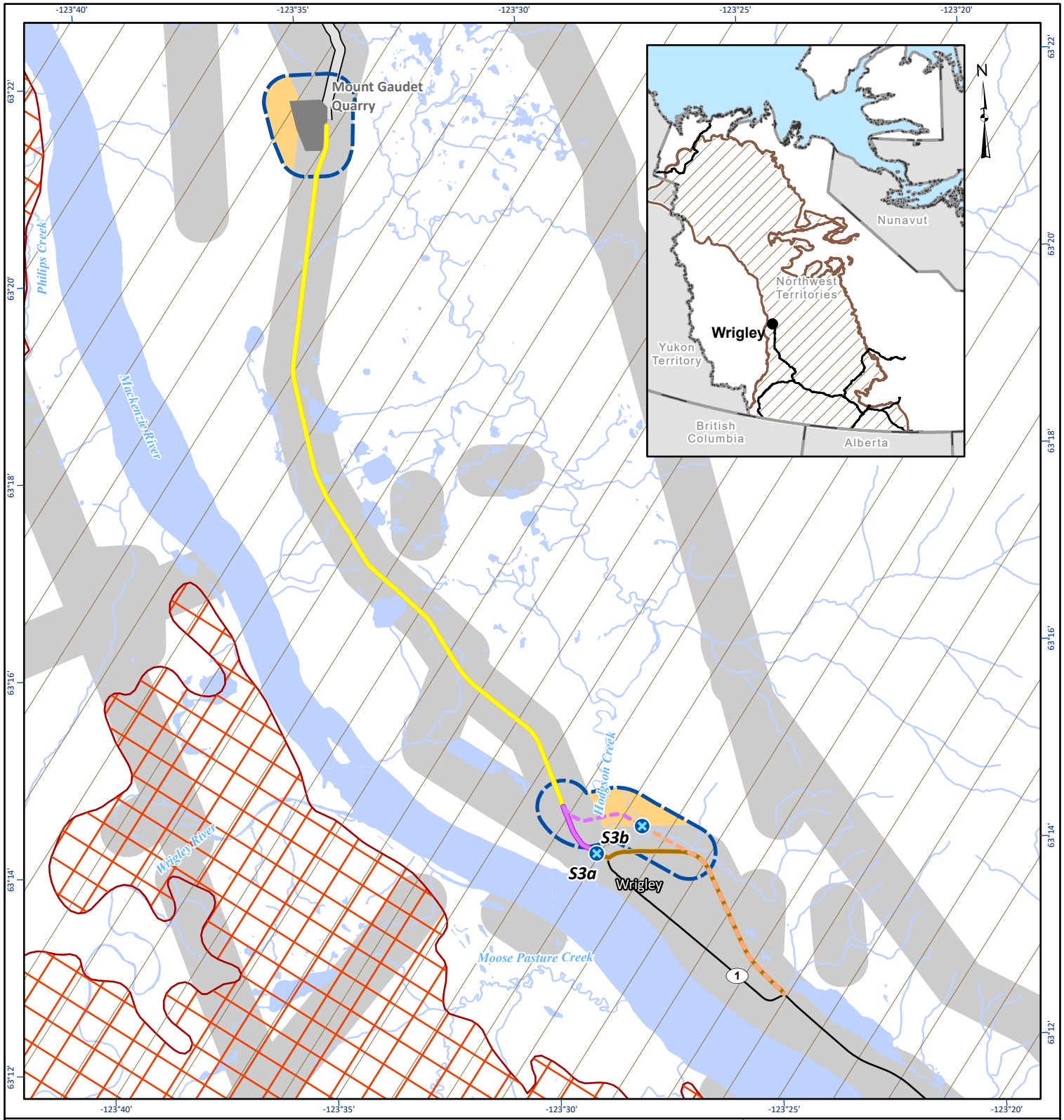
A Geographic Information System (GIS) was used to determine the amount of boreal caribou range which would be disturbed by the Project. Layers representing the existing undisturbed caribou habitat across the Northwest Territories range and the applicable Project-related footprint (a 500 m buffer around Project activities) were compared to estimate Project-related disturbance to baseline undisturbed boreal caribou habitat. Baseline undisturbed habitat (i.e., without the Project) was identified as all habitat within the Northwest Territories' boreal caribou range beyond 500 m of existing anthropogenic disturbances (e.g., roads, seismic, towns) and un-burnt within the past 40 years. This 500 m buffer, defined by Environment Canada (2012), represents habitat alteration or indirect habitat loss to boreal caribou habitat. Table 12-9 summarizes the caribou habitat disturbance calculations. GIS shapefiles of forest fires (ca. 2017) and buffered anthropogenic disturbances (ca. 2015) within boreal caribou range were available from Environment and Climate Change Canada (ECCC) and the GNWT. The range of boreal caribou within the Northwest Territories was provided by the Northwest Territories Centre for Geomatics web mapping service.

GIS data shows that approximately a third (31 %) of the Northwest Territories boreal caribou range is already considered disturbed as a result of fire and anthropogenic disturbances, with approximately 69% of caribou habitat remaining undisturbed (Table 12-9). This is slightly above Environment Canada's threshold of 65% of habitat remaining undisturbed.

Most of the buffered Project footprint (95.32% for Scenario 1 and 91.45% for Scenario 2) is proposed within existing disturbed caribou habitat (Table 12-9). Overall, the Project footprint for Scenarios 1 and 2, represented by 500m buffer zones, result in a loss or alteration of approximately 107.88 and 194.9 ha (conservatively assuming a full clearing of the 60 m ROW), respectively, of existing undisturbed boreal caribou habitat, representing 0.000002% and 0.000004% of the critical habitat available across the Northwest Territories boreal caribou range (Table 12-9; Figure 12-2 Boreal Woodland Caribou Habitat Disturbance).

Table 12-9 Approximate Boreal Caribou Habitat Disturbance Calculations

	Area (ha) (approximate)	Percent (%)
Baseline Habitat in Northwest Territories Range		
Northwest Territories Range (approximate)	44,292,048.98	100.0
Northwest Territories Range, Total Fire and Anthropogenic Disturbed Habitat	13,750,975.23	31.05
Northwest Territories Range, Total Undisturbed Habitat (i.e., critical habitat)	30,541,074.75	68.95
Baseline Habitat MGAR footprint under Two Scenarios plus Quarry and Buffer		
Scenario 1 New footprint + Quarry + Buffer	2304.01	100
Buffered Scenario 1 footprint within Disturbed Caribou Habitat	2163.81	95.3
Buffered Scenario 1 footprint within Undisturbed Caribou Habitat	107.88	4.68
Scenario 2 New footprint + Quarry + Buffer	2280.07	100
Buffered Scenario 2 footprint within Disturbed Caribou Habitat	2085.17	91.45
Buffered Scenario 2 footprint within Undisturbed Caribou Habitat	194.9	8.55
Loss/Alteration of Critical Habitat in Northwest Territories Range		
Total, Critical Habitat Disturbed by the Project (Scenario 1 footprint + Quarry + buffer)	107.88	0.000002
Total, Critical Habitat Disturbed by the Project (Scenario 2 footprint + Quarry + buffer)	194.90	0.000004



LEGEND

- Hodgson Creek Bridge
- MGAR Segment 4b
- MGAR Segment 4a
- MGAR Segment 2b
- MGAR Segment 2a
- MGAR Segment 1
- Highway 1 - Mackenzie Valley Highway
- Mackenzie Valley Winter Road
- Caribou Range
- Existing Anthropogenic Disturbance
- Historical Fire Area
- New Disturbance
- Quarry
- Study Area - 500m
- Watercourse
- Waterbody

2 1 0 2
1:100,000 Kilometres

NOTES

Sources: Project Data: Government of Northwest Territories. Base Data: CanVec, Government of Canada; Government of Northwest Territories; NWT Centre of Geomatics
Spatial Reference: NAD 1983 Northwest Territories Lambert

Figure 12-2 - Boreal Woodland Caribou Habitat Disturbance

GIS	DR	2020-06-03	Doc ID: 144902910-3002 REVE
QA/QC	EV	2020-06-03	Government of the Northwest Territories

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ENR is developing 5 regional range plans for boreal caribou in the NWT following the *Framework for Boreal Caribou Range Planning* (ENR, 2019). The range plan for the Southern NWT (Dehcho and South Slave regions combined) is expected to be completed by spring 2022. The range plans will identify different management class areas (Basic, Enhanced or Intensive) within each region, along with specific actions for managing habitat disturbance in each area. The range plan will be applied as required upon its completion.

Among the federally or territorially listed species occurring in the Project area, boreal caribou are the only species with a conservation strategy that includes habitat disturbance thresholds.

12.3.8.3 Wildlife Mortality (Direct and Indirect)

Causes of wildlife mortality during the Project could include vehicle-wildlife collisions, increased exposure to predators in cleared areas, killing of problem predators that wander into work sites, destruction of dens, nests, or eggs, and killing of birds during clearing and blasting activities. The potential for these impacts during the Project should be sufficiently mitigated through the measures described in Section 12.3.8.4.

Increased occurrence of vehicle-wildlife collisions is one of the primary environmental risks associated with road construction and operation. Reductions in population due to vehicle-wildlife collisions can increase a species' probability of extinction or extirpation if numbers of a species are already low in an area (Fowle, 1996; Maehr, Land, & Roelke, 1991). With respect to larger wildlife, vehicle-wildlife collisions are also a serious problem due to the potential for severe injury to drivers. Herbivorous wildlife (moose, caribou, bears, etc.) can be attracted to road-side areas due to higher-value edible plants growing in these areas, which increases the risk of vehicle-wildlife collisions for these animals (Gibeau & Herrero 1998; Dyer 1999).

Prey species crossing through cleared areas tend to be more exposed to predators. James and Stuart-Smith (2000) found that wolves occurred with greater frequency, and caribou mortalities associated with wolf predation were also more frequent, at locations near roads. Whittington et. al (2011) also showed that caribou were at a significantly greater risk of predation by wolves when travelling near roadways.

When compared to other all-season roads in the Northwest Territories, the MGAR is expected to have relatively low traffic volumes during periods when the MVWR is not in use due to the low overall population of Wrigley. Average traffic volumes for the Canyon Creek Access Road were around 10 vehicles per day; average volumes for the MGAR will likely be similar but slightly lower due to the lower population of Wrigley compared to Norman Wells. The standard speed limit for traffic along the MGAR will be 90 km/h and vehicle speeds during construction will be under 50 km/h. The risk of vehicle-wildlife collisions during the Project will be managed through the application of speed limits and the reporting of any wildlife occurring near Project activities.

As most of the proposed MGAR will follow the existing disturbed alignment of the MVWR, increased exposure to predators is not expected to be an issue except at the potential new alignment associated with the re-located bridge, should this scenario be selected. Overall, the extent of

clearing during the Project will be minimized to necessary areas, and re-vegetation of non-permanent footprint areas will be implemented where appropriate.

Blasting and clearing activities could lead to the accidental destruction of animal dens and bird nests, although this risk is expected to be minor for the MGAR, as most Project activities will occur while birds are not in the area. Previous den and nest surveys, conducted over a 3 km buffer around the proposed Project area, did not identify any dens or nests. Additional surveys will be conducted prior to starting Project activities. Work crews should follow the minimum setbacks from known den and nest sites, should one be found, described in the NLUG: Seismic Operations (Lands, 2014d) where practical.

Wildlife may be attracted to work areas due to the improper disposal of food waste. Predators such as bears which wander into work areas are at risk of being shot and killed to protect human safety. Project personnel will follow the measures outline in the WMP to avoid the attraction of wildlife and will follow appropriate wildlife response protocols to prevent harm to wildlife or personnel in the event of an encounter.

12.3.8.4 Wildlife Impact Mitigation Measures

The mitigation measures presented in Table 12-10 and

Table 12-11 will be applied to minimize and manage impacts of the Project on wildlife.

Table 12-10 Potential Wildlife Impacts Mitigation Measures: General

Activity	Potential Impact	Mitigation Approach
Clearing associated with the MGAR alignment and quarry.	Direct habitat loss (Habitat Fragmentation, Habitat Loss and Alteration)	• Minimizing Project footprint to the extent required. • Use of previously disturbed areas as much as possible. • Progressive reclamation of the quarry and access clearings to be carried out wherever possible. • Avoiding travel off-corridor unless absolutely required. • Limiting construction-related activities during sensitive periods/migratory bird windows to minimize impacts on wildlife. • In the event that a key wildlife feature of a Species at Risk is discovered, consulting ENR and/or ECCC and temporarily suspending activities pending consultation with these agencies. • Reclamation of the old MVWR alignment should the relocation of Hodgson Creek Bridge, and the associated MGAR re-

Activity	Potential Impact	Mitigation Approach
		alignment, be required.
Use of heavy machinery, vehicles, and equipment coming from outside the Project area	Introduction of invasive plant species (Habitat Alteration)	• Inspection and thorough cleaning of vehicles and equipment entering the Project area to prevent the introduction of invasive and non-native plant species. • Preparing an appropriate response plan in the event that non-native/invasive species are identified within the corridor and are suspected of being introduced during Project activities.
Potential use of plants for purposes such as erosion control and quarry reclamation.	Introduction of invasive plant species (Habitat Alteration)	• Carrying out any required re-vegetation using native species where possible. • Prohibiting the use of potentially invasive plant species (e.g., prohibit use of straw to minimize erosion potential) and use of native species where feasible.
Installation of culverts	Disruption of water flow (Habitat Loss and Alteration)	• Maintaining existing drainage patterns by using appropriately sized and located drainage culverts.
Road construction and bridge relocation work near water bodies.	Erosion leading to loss or alteration of riparian, stream, wetland, and lake habitat (Habitat Loss and Alteration)	• Applying INF's Erosion and Sediment Control Manual, the Project PEP, and suitable road design to manage erosion, sediment and slope stabilization issues.
Blasting, construction, and vehicle use during dust-prone periods. Road construction, vehicle and heavy equipment operation, drilling and blasting at the quarry	Generation of dust which could disturb and possibly deter wildlife (Habitat Alteration)	• Diligent management of dust following the GNWT dust suppression guidelines, including during blasting (e.g., water suppression, dust skirts). • Minimizing traffic along the alignment during construction by transporting workers to site using vans or crew cabs. • Maintaining low vehicle speeds and traffic volumes (<50 km/hr). • Maintaining vehicles and equipment in proper operating condition, and installing mufflers on all vehicles. • Discouraging unnecessary idling. • Plugging in vehicles and equipment when they are not in use to minimize the need to continuously run them during cold weather.
Road construction and quarry operations	Disruption of wildlife movement by snow banks, snow berms, and windrowed timber (Habitat	• Maintaining snow banks along the alignment at a low height (e.g. <1.6 m) and ploughing out regular sections for wildlife crossings.

Activity	Potential Impact	Mitigation Approach
	Fragmentation).	• Creating breaks in snow berms and windrowed timber (e.g., breaks 10 m wide every 300 m) to allow wildlife passage.
General Project operations	Attraction of wildlife due to improperly disposed waste or other attractants.	• Storing waste products in secure containers and transporting them to appropriate receiving facilities where arrangements have been made to receive the waste as necessary. • Storage of grease, oils, and food in bear-proof areas and/or in bear-proof containers and following the designated WMP for the Project. • Avoiding the use of salts for road maintenance to avoid potential wildlife attraction to the road. • Use of wildlife deterring mechanisms, such as fences and lights, as necessary to prevent wildlife from entering the worksite.
General Project operations	Wildlife incidents	• Employing worksite design measures to prevent wildlife interactions. • Educate all workers on wildlife mitigation measures. • Appropriately designated supervisor to provide field workers with training in wildlife awareness and wildlife response. • Workers will avoid interacting with wildlife except when crew safety is at risk. • Workers will not approach, feed, or harass wildlife. • Reporting of human/wildlife conflicts or incidents to both INF and the appropriately designated field supervisors. • Reporting and documenting any environmental features indicating the presence of wildlife (for instance, dens or tracks). • Not permitting the use of firearms on site unless they are in the secure possession of an authorized wildlife monitor. • Prohibiting workers from hunting or fishing in the Project area. Workers will directly report any suspicious activities involving wildlife. The appropriately designated supervisor will be responsible for reporting this information to INF. • Work crews will report all wildlife observations on site to INF and ENR.

Activity	Potential Impact	Mitigation Approach
Vehicle and heavy equipment operation	Wildlife mortalities	• Keeping vehicle and equipment speed and volumes low to minimize the risk of collisions with wildlife. • Giving all wildlife the ROW during construction. • Informing workers of the location of wildlife sightings. • Work crews will report any wildlife injuries or mortalities to INF, who will then inform ENR and the MVLWB. The cause of the injury or mortality will be investigated and appropriate new mitigation measures will be developed and applied going forward. • Conduct pre-blast surveys for the presence of wildlife within 500 m of the quarry site and other blasting areas prior to conducting blasting activities.
General Project operations	All impacts	• Keeping wildlife monitors on site to monitor and manage risks to wildlife.

Table 12-11 Mitigation Measures for Specific Wildlife

Species	Rationale	Mitigation and Management Strategies
Boreal Caribou	Sensitive to disturbance year-round, especially during late winter (March 16th to April 1st) and calving (May 1st to June 30th) periods Are sensitive to human disturbance and over-harvesting year-round. Listed as Threatened at the Territorial and Federal levels.	• Have a wildlife monitor present during Project activities to monitor the location of caribou. • Report the location of any caribou sighted near Project activities and employ temporary speed reductions in areas where caribou have been sighted. • • Cease Project activities if caribou are seen within 500 m of areas of activity (Lands, 2014d). • Avoid open, mature spruce habitats (near peatland complexes, lakes, and ponds) as much as possible, as these habitats harbour abundant ground and tree lichens.

Species	Rationale	Mitigation and Management Strategies
		• Concentrate blasting outside the sensitive calving period (late May to at least July). • Where possible, incorporate the avoidance, minimization, and restoration measures described in the Best Management Practices and Guidelines for Industry in Boreal Caribou Habitat for the Northwest Territories document (ENR, 2020, Draft)
Moose	Are sensitive year round, especially during late winter (March 16 to April 1) and calving (May 1 to June 30). Pasturing habitat is north of the Project area. Are considered a "Big Game" species under the *Wildlife Act.*	• Minimize disturbance to riparian shrub communities and avoiding lakes and ponds as much as possible. • Construction of the MGAR will start at Mount Gaudet Quarry and will proceed south, well away from known moose pasture areas. • Concentrate blasting outside the sensitive calving period (late May to at least July). • Report the location of any moose sighted near Project activities and employ temporary speed reductions in areas where moose have been sighted.
Furbearers, including Bears and Wolves	Sensitive year-round, especially during winter.	• Complete den surveys each fall to identify dens to allow for appropriate buffers (Lands 2014d).
Wolverines	Sensitive to habitat loss and habitat alteration. Sensitive period is year-round.	• Maintain a horizontal setback of 800 m from any identified wolverine natal dens (Lands, 2014d).
Raptors	Sensitive during nesting and fledging season (April 1st to September 30th). Some species sensitive year-round.	• Avoid clearing during raptor nesting and fledging season in all habitat types. • Avoid known nesting sites by 0.5 km from September 2nd to February 28th, and by 1.5 km from March 1st to September

Species	Rationale	Mitigation and Management Strategies
	Raptor nests are protected by territorial and federal legislation. It is prohibited to damage or destroy an unoccupied raptor nest at any time of the year under the *Migratory Birds Act*.	1st (Lands, 2014d). • Avoid disturbance of nesting raptors during breeding season. • Perform pre-construction nest surveys.

Mitigation Measures for Species at Risk

A total of fourteen species with special conservation status exist or potentially exist in the vicinity of the Project. Of these fourteen species, boreal caribou, common nighthawk, and olive-sided flycatcher have the highest level of conservation status and are listed as Threatened/At Risk. Mitigation specific to species with special conservation status are provided in Table 12-12. Insect species are not included in this PDR, as no special mitigation measures are required for the species, though they are listed in the Environmental Overview in Appendix F.

Table 12-12 Mitigation Measures for Species at Risk

Species	Potential Adverse Impacts	Proposed Mitigation	Proposed Monitoring	Existing Species Recovery, Action, or Management Plans
Horned Grebe (*Podiceps auritus)* [assessed by Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Special Concern] Sensitive period is spring, summer, and fall.	• Habitat loss or alteration, particularly from changes in water quality and quantity.	• Maintain natural drainage patterns (including quantity and quality). • Maintain at least 250 m distance between lakes and construction operations from June 1 to August 31.	• Surveys for nests in wetland and shoreline areas during activities which take place during waterfowl nesting season (June 1 to August 31).	• ECCC is currently developing a draft management plan for this species.
Peregrine Falcon (*Falco peregrinus anatum/tundrius)* (listed under the *SARA* as Special Concern) Sensitive period is	• Habitat loss or alteration. • Direct and indirect mortality.	• Avoid known nesting sites by 0.5 km from September 2 to February 28, and by 1.5 km from March 1 to September 1. Avoiding	• Conduct nest surveys encompassing 1.5 km around the Project. • Monitoring of known active nests	• Management Plan for the Peregrine Falcon (ECCC, 2017).

Species	Potential Adverse Impacts	Proposed Mitigation	Proposed Monitoring	Existing Species Recovery, Action, or Management Plans
spring, summer, and fall.		disturbance of nesting raptors during breeding season (March 1 to September 1). • Avoid clearing during raptor nesting and fledging season in all habitat types.	present within 1.5 km during construction may be required to confirm Project activities are not causing adverse negative impacts.	
Red-necked Phalarope (*Phalaropus lobatus*) (assessed by COSEWIC as Special Concern) Sensitive period is spring, summer, and fall.	• Habitat loss or alteration. • Direct and indirect mortality. • Habitat Fragmentation	• Maintain natural drainage patterns (including quantity and quality). • Maintain at least 250 m distance between lakes and construction activities from June 1 to August 31.	• Surveys for nests in wetland and shoreline areas during activities which take place during waterfowl nesting season (June 1 – August 31).	• ECCC is currently developing a draft management plan for this species.
Short-eared Owl (*Asio flammeus*) (listed by *SARA* as Special Concern) Sensitive period is spring, summer, and fall.	• Habitat loss or alteration • Habitat Fragmentation • Direct and indirect mortality.	• Avoid clearing and construction during nesting and fledging season (May 1 to August 1). • Maintain a 200m setback distance from short-eared owl nests (Environment Canada, 2009)	• Raptor nest surveys to be conducted prior to and during Project activities. • Surveys for nests during activities that take place between May 1 and August 1.	• Management Plan for the Short-eared Owl in Canada (Environment Canada, 2016a).

Species	Potential Adverse Impacts	Proposed Mitigation	Proposed Monitoring	Existing Species Recovery, Action, or Management Plans
Common Nighthawk (*Chordeiles minor*) (listed by *SARA* as Threatened) Sensitive period is summer and fall.	• Habitat loss or alteration. • Direct and indirect mortality. • Habitat Fragmentation	• Avoid clearing during nesting and fledging season (May 1 to August 15) and avoid known nesting sites by 200 m.	• Survey suitable habitat for the presence of nests between May 1 and August 15.	• Recovery Strategy for the Common Nighthawk in Canada (Environment Canada, 2016b).
Olive-sided Flycatcher (*Contopus cooperi*) (listed by *SARA* as Threatened) Sensitive period is spring, summer, and fall.	• Habitat loss or alteration. • Direct and indirect mortality. • Habitat Fragmentation	• Avoid clearing during nesting and fledging season (May 1 to August 15) and avoid known nesting sites by 300 m.	• Survey known habitat for the presence of nests between May 1 and August 15.	• Recovery Strategy for the Olive-sided Flycatcher in Canada (Environment Canada, 2016c).
Bank and Barn Swallows (*Riparia riparia*; *Hirundo rustica*) (assessed by COSEWIC as Threatened) Sensitive period is summer and fall.	• Habitat loss or alteration. • Habitat Fragmentation • Direct and indirect mortality during bridge maintenance and quarry excavation (ECCC Guidelines for Bank Swallow in Sandpits and Quarries; Accessed May 2020)	• Avoid clearing during nesting and fledging season (May 1 to August 15). • Avoid disturbing (May 1 to August 15) or destroying nests during bridge maintenance work and quarry excavation. • Maintain a 1.5 km setback from nesting and staging areas when birds are present. • Manage exposed soil and sand banks within the quarry (i.e. contouring to a slope of 70° or less) to avoid attracting bank swallows to areas of activity (ECCC Guidelines;	• Survey known habitat for the presence of nests between May 1 and August 15.	• No recovery strategy or management plan currently exists for bank or barn swallows in the NWT.

Species	Potential Adverse Impacts	Proposed Mitigation	Proposed Monitoring	Existing Species Recovery, Action, or Management Plans
		Accessed May 2020)		
Rusty Blackbird (*Euphagus carolinus*) (listed by *SARA* as Special Concern) Sensitive period is spring, summer, and fall.	• Habitat loss or alteration. • Habitat Fragmentation • Direct and indirect mortality.	• Maintain at least 250 m distance between lakes and construction activities. • Avoid clearing and construction during nesting and fledging season (May 1 to August 15) and avoid known nesting sites by 300 m.	• Survey known habitat for the presence of nests between May 1 and August 15.	• Management Plan for the Rusty Blackbird in Canada (Environment Canada, 2015).
Harris's Sparrow (*Zonotrichia querula*) (Assessed as Special Concern by COSEWIC and is Under Consideration by *SARA*)	• Habitat loss or alteration. • Habitat Fragmentation • Direct and indirect mortality.	• Avoid clearing and construction during nesting and fledging season (May 1 to August 15) and avoid known nesting sites by 300 m.	• Survey known habitat for the presence of nests between May 1 and August 15.	• No management plan or recovery strategy currently exists for Harris's Sparrow.
Grizzly Bear (*Ursus Arctos*) (assessed by COSEWIC as Special Concern) Sensitive period is year round, especially during denning (October to May).	• Habitat loss or alteration. • Direct (vehicle-wildlife collision) and indirect (increased hunting, poaching, problem wildlife kills) mortality.	• Cease clearing and construction activities within 800 m of all known den sites during carnivore denning season (October 15 to May 15).	• Conduct an active den survey in the late fall prior to disturbing these areas to locate active den sites. Monitor known active dens during clearing and construction activities, and report any disturbance of denning bears.	• Region-specific management plans which do not include grizzly bear populations in the NWT.

Species	Potential Adverse Impacts	Proposed Mitigation	Proposed Monitoring	Existing Species Recovery, Action, or Management Plans
			• Cease clearing and construction if disturbance to denning bears is noticed.	
Wolverine (*Gulo gulo*) (assessed by COSEWIC as Special Concern) Sensitive period is year round.	• Habitat loss or alteration. • Direct (vehicle-wildlife collision) and indirect (increased hunting, poaching, problem wildlife kills) mortality.	• Maintain a horizontal setback of 800 m from all known Wolverine natal dens.	• Den surveys.	• No management plan or recovery strategy currently exists for wolverine.
Woodland Caribou (Boreal) (*Rangifer tarandus caribou*) (listed by *SARA* (Northwest Territories) and *SARA* as Threatened) Sensitive period is year round.	• Habitat loss or alteration (including increased risk of fire frequency). • Habitat fragmentation. • Direct (vehicle-wildlife collision) and indirect (increased hunting, predator access) mortality.	• Cease clearing and construction activities if caribou are observed within 500 m. • Report the location of wildlife sightings along the road to other Project personnel via radio and temporarily reduce speed limits in areas where wildlife is sighted.	• Wildlife monitor(s) to monitor the location of caribou.	• Recovery Strategy for the Woodland Caribou Boreal population, in Canada (Environment Canada, 2012b). • Recovery Strategy for the Boreal Caribou in the Northwest Territories (Conference of Management Authorities, 2017). • Action Plan for the Woodland

Species	Potential Adverse Impacts	Proposed Mitigation	Proposed Monitoring	Existing Species Recovery, Action, or Management Plans
				Caribou, Boreal Population, in Canada (ECCC, 2018).
Shortjaw Cisco (*Coregonus zenithicus*) (Listed by *SARA* as Threatened and assessed as Threatened by COSEWIC)	• Habitat loss or alteration. • Direct and indirect mortality.	• Follow all measures for the protection of fish and fish habitat described in Table 12-7. • No in-stream work is planned as part of this Project.	• Fish habitat surveys performed prior to construction to identify if critical habitat for this species is present in nearby water bodies. •	• No management plan or recovery strategy currently exists for shortjaw cisco in the NWT.
Bull Trout (*Coregonus zenithicus*) (Listed by *SARA* as Threatened and assessed as Threatened by COSEWIC)	• Habitat loss or alteration. • Direct and indirect mortality.	• Follow all measures for the protection of fish and fish habitat described in Table 12-7. • No in-stream work is planned as part of this Project.	• Fish habitat surveys performed prior to construction to identify if critical habitat for this species is present in nearby water bodies.	• No management plan or recovery strategy currently exists for bull trout in the NWT.

Wildlife Setback Distances

Table 12-13 shows the sensitive periods, minimum setback distances, and minimum flying altitude for wildlife in the Project Area, as described in the NLUG for Seismic Operations (Lands, 2014d). Recommended setbacks for Project activities from boreal caribou are also provided by ENR's Best Management Practices and Guidelines for Industry in Boreal Caribou Habitat for the Northwest Territories (ENR, 2020, Draft). Setback distances for *SARA* listed species is provided in Table 12-13.

Table 12-13 Wildlife Setbacks, Minimum Altitude, and Sensitive Period

Species	Guidance Source	Habitat Type / Conditions	Sensitive Period	Horizontal Setback	Minimum Flying Altitude
Woodland Caribou	NLUG	Water crossings near blasting activities	May 15 to October 15	10 km	610 m
	NLUG	Shut-down (of operations) distance if Caribou are in the area	Year Round	500 m	610 m
	NLUG	Snowmobile distance if Caribou are in the area	Snow Period	250 m	610 m
	ENR 2020	All Habitat	Late Winter (March 22 to April 5)	Complete avoidance	
			Calving / post-calving (May 1 to July 12)	Complete avoidance	
Grizzly Bear and Black Bear	NLUG	Dens	September 30 to March 30 (Ground-based Activities) October 15 to May 15[t] (Aircraft Flights)	General Activities – 800 m Activities Involving Blasting – 1.5 km	300 m
Wolverine	NLUG	Dens	October 15 to July 15	2 km	300 m
Wolves	NLUG	Dens	May 1 to September 15	800 m	300 m
Birds (general)	NLUG	Staging and nesting areas, when birds are present	Year Round	1.5 km	650 m
Olive-sided flycatcher	NLUG	Nest Sites	Year Round	300 m	650 m
Rusty Blackbird	NLUG	Nest Sites	Year Round	300 m	650 m
Common Nighthawk	NLUG	Nest Sites	Year Round	200 m	650 m
Raptors (general)	NLUG	Nest Sites	March 1st to September 1st	1.5 km	650 m
	NLUG		September 2nd to February 28th	500 m	650 m

Species	Guidance Source	Habitat Type / Conditions	Sensitive Period	Horizontal Setback	Minimum Flying Altitude
Bald Eagle	NLUG	Nest Sites	April 15th to August 31st	500 m	650 m
Golden Eagle	NLUG	Nest Sites	April 15th to August 31st	800 m	650 m
Northern Goshawk and Sharp-shinned Hawk	NLUG	Nest Sites	April 1st to August 31st	500 m	650 m
Red-tailed Hawk	NLUG	Nest Sites	April 15th to August 31st	800 m	650 m
Osprey	NLUG	Nest Sites	April 1st to August 31st	1 km	650 m
Waterfowl	NLUG	Nest Sites	June 1st to August 31st	250 m	650 m
	NLUG	Staging Areas	May 1st to September 30th	250 m	650 m
	NLUG	Concentrations	Year Round	250 m	650 m

13 Socio-Economic Impacts and Mitigations

The MGAR will be carried out on traditional lands of PKFN and close to PKFN's home community of Wrigley. The MGAR presents a risk of negative socio-economic impacts for the community of Wrigley and PKFN, but is also expected to produce socio-economic benefits, including local business, training, and employment opportunities. The objective of the MGAR is to maximize the previously mentioned economic benefits to the community of Wrigley and PKFN, and to provide access to a new gravel source both for use in and around Wrigley and to support potential future construction of the MVH.

Beneficial socio-economic impacts from the MGAR include short-term employment opportunities for Wrigley community members. Project positions will include drillers, blasters, surveyors, equipment operators, camp staff, engineering staff, general labourers, and wildlife monitors. The Project will also offer technical training and education opportunities to residents who will be involved in the work.

There is potential for both the construction and the presence of the road to bring a greater number of people into the community of Wrigley in both the short and the long term. For instance, some Contractors for the Project are likely to be brought in from outside of the community. The presence of more people will likely increase economic activity and business revenue within the community.

The introduction of individuals from outside the community during construction could also contribute to drug and alcohol availability and could cause general social disruption including altered family and community dynamics. Short-term and long-term changes in community dynamics could lead to negative impacts on the language and cultural identity of community members.

Continued consultation and engagement with PKFN should help to address any negative socio-economic impacts which the Project may have on the community. INF will find ways to work with PKFN during the planning and construction phases of the MGAR to identify appropriate mitigation measures so that community relationships, health and wellness, and cultural identity are maintained both during and after the Project.

In the interest of developing the socio-economic benefits associated with the MGAR, INF has developed a Wrigley Training Committee (WTC) consisting of representatives from INF, the GNWT departments of Industry Tourism and Investment (ITI) and Education Culture and Employment (ECE), Aurora College, and PKFN. The purpose of this committee is to identify training opportunities associated with the MGAR, facilitate the development and delivery of training programs for the residents of Wrigley in relation to the Project (with a particular emphasis on training opportunities for youth), and to facilitate access to funding arrangements for these programs. Going forward, the WTC may add members from additional departments and organizations as required to achieve its objectives.

TK has been an important consideration in the planning of this Project, and will continue to be considered as Project work proceeds. TK information provided by PKFN has informed INF on the natural, cultural, and spiritual resources considered important by PKFN, and will aid in development of appropriate measures to mitigate impacts of the Project on these resources. INF conducted a review of TK information for the Wrigley to Mount Gaudet area as described in the 2012 Dehcho Region PDR for the MVH (Dessau, 2012). This TK review was sent to PKFN for verification and approval. The contents of this TK summary can be found in Appendix A

An Archaeological Overview Assessment (AOA) was conducted for the MGAR in November of 2019. Several areas with high archaeological potential were identified along the MGAR alignment and near the proposed Mount Gaudet Quarry during this study. An AIA for the Mount Gaudet Quarry and potential new Hodgson Creek Bridge location and alignment will be completed in the late summer / fall of 2020.

INF will continue to engage in discussions with PKFN through the course of the Project to identify appropriate measures to mitigate Project impacts on traditional resources.

Potential mitigation (and optimization) measures for potential negative and positive impacts of the Project on socio-economic components in Wrigley are described in Table 13-1.

Table 13-1 Potential Impacts (Positive and Negative) of the MGAR on the Community of Wrigley with Mitigation and Optimization Measures

Potential Community Impact	Mitigation or Optimization
Increased availability of drugs and alcohol	• Enforce strict no alcohol and drug policy at construction camps. • Consider wage payment options that reduce availability of 'cash-in-hand' (for instance, using direct deposit rather than cash advances).
Reduced availability of wildlife resources, such as caribou, moose, bears, migratory birds, vegetation, fish and small game	• No non-traditional hunting and fishing activities for Project staff. • Minimize Project footprint and avoid sensitive areas used for traditional and cultural activities. • Follow appropriate measures, identified in the management plans, to protect wildlife and vegetation species.
Negative impacts on language, culture, and traditional lifestyle	• Support the training and development of residents (i.e. construction and engineering), so trained residents are in place and capable to meet the needs of the required labour force. Local work force leaders should act as mentors and develop opportunities in the community. • Avoidance of cultural sites and important land use areas (such as the moose pasture) as part of Project design. • Community input will be considered in developing measures to mitigate impacts of the Project on culturally important sites.
Increased training opportunities	• Provide training opportunities relevant to the needs of the Project to allow for increased employment. • Identify and develop Project-related training opportunities through the WTC.
New business opportunities that are directly and indirectly associated with the construction of the MGAR	• Promote and support business opportunities associated with the Project. • Promote training and accreditations that will provide longer term employment benefits.
Spills and vehicle accidents during Project activities	• Prepare a traffic management plan for the construction of the MGAR. • Have trained staff available to deal with accidents and spills. • Installation of clear signage along the alignment (i.e. speed, presence of wildlife corridor). • Follow measures laid out in the SCP.
Impacts on community infrastructure, including increased demand and accidental damage	• Development of a health and safety management plan. • Proper planning and effort to recognize and not disturb existing community infrastructure and/or utilities and during construction. • Construction of temporary bypass roads or alternate transportation means to avoid disturbing traffic. • To the extent possible, camps will be equipped will all the infrastructure needed to reduce reliance of construction crew on community infrastructure.

Potential Community Impact	Mitigation or Optimization
Disturbance of cultural heritage resources during Project activities	• Conduct an AIA prior to starting the Project on previously undisturbed land. • Community input will be considered in developing measures to mitigate impacts of the Project on culturally important sites. • Incorporate avoidance of known archaeological sites into the final road design. • Monitor nearby heritage sites on an ongoing basis during Project activities. • Cease Project activities in the area and contact the Territorial Archaeologist of the GNWT in the event of an unanticipated cultural find during any Project-related activity.

14 Fees

The GNWT is exempt from application fees.

15 Land Use Planning

15.1 Conformity Requirements, Draft Dehcho Land Use Plan

The proposed Mount Gaudet Access Road is within the Pehdzéh Kį Ndeh conservation zone in the DDLUP. From the end of Highway #1, the MGAR would travel along the MVWR in the region of Wrigley as defined DDLUP.

The Conservation Zones outlined in the DDLUP (2006) are areas that have significant ecological and cultural values with only tourism permitted.

A DDLUP was developed by the Dehcho Land Use Planning Committee in 2006 and was subsequently submitted to the GNWT and Aboriginal Affairs and Northern Development Canada (AANDC) (DLUPC 2006). The 2006 DDLUP was not approved and is not in effect. The Dehcho First Nations (DFN), GNWT and Canada are developing a revised DLUP, however the 2006 draft is the only publicly available version of the DDLUP and therefore is being considered in this PDR. The plan includes specific guidelines for preserving natural and cultural resources and identifies five types of zones (DLUPC 2006). Following the MVWR alignment, the proposed MGAR passes through approximately 6.8 km of the Pehdzéh Kį Ndeh conservation zone and 14 km through the Wrigley town limits as defined by the DLUP (2006). The existing MVWR ROW is outside of the special infrastructure corridor zone outlined for the Mackenzie Gas Pipeline in the DDLUP (2006).

Conformity requirements (CR) and recommendations have been drafted and for the purposes of this Project, have been addressed in the following ways:

CR #1 – Land Use Zoning – The proposed operation does not relate to oil and gas operations, mining, forestry, tourism or agriculture.

CR #2 –MGAR construction is not related to the Mackenzie Valley Pipeline.

CR #3 – A summary of TK and Land Use reported in the Dehcho PDR (Dessau 2012) has been reviewed by PKFN and is attached in Appendix A. Areas identified as sensitive by PKFN have been avoided in the MGAR design.

CR #4- An AOA has been completed for the Project, and an AIA will be conducted in areas identified as having high archaeological potential in the AOA, and construction work will only begin following AIA approval by PWNHC. A record of engagement with affected communities and Indigenous Governments has been included with the MGAR LUP and WL application. Community input will be considered in developing measures to mitigate impacts of the Project on culturally important sites.

CR #5 – The MGAR will primarily be constructed along the existing corridor of the MVWR. Access to culturally important plant species is not anticipated to be impacted.

CR #6 – PKFN has been involved in a meaningful way in the planning of the Project and have been active participants in consultations, community engagements, preliminary field work and the ongoing Wrigley Training Committee. A summary of community engagement and consultation to date is included with the MGAR LUP and WL application, and the GNWT will continue to engage with PKFN through the life of the Project.

CR #7 – This Project does not include non – exclusive geophysical surveys.

CR #8 –Previous studies have demonstrated the need for the interconnectivity of Mackenzie Valley communities to lower the cost of living associated with economic activities. Potential users of the MGAR have been considered in the selection of the appropriate design and location (Dessau, 2012). Through targeting the previously disturbed existing MVWR for the MGAR, environmental, social, economic and cultural values have been considered. Appropriate mitigation measures will be in place to buffer ecological and culturally sensitive areas from impacts.

CR #9 – The proposed Mount Gaudet quarry has been previously developed, is essential for the construction of the MGAR, and has received the consent of PKFN. PKFN's letter of support for the Project is included in Appendix G.

CR #10 – Various transportation planning and routing studies have been completed for the MVH, and are available at https://www.inf.gov.nt.ca/en/MVH

CR #11 – The MGAR is not related to feeder pipelines.

CR #12 – The MGAR will not be within the Netla-Arrowhead Special Infrastructure Corridor.

CR #13 – The construction of the MGAR is not related to commercial fishing.

CR #14 – Project activities occurring in-water will adhere DFO guidelines as well as the erosion control guidelines outlined in the MGAR PEP.

CR #15 – Water use during MGAR construction will follow existing guidance. Appropriate measures will be implemented during Project activities to mitigate the loss of wetlands and shorelines.

CR #16 – A hydroelectric development is not proposed for this Project.

CR #17 – The construction of the MGAR is not related to mining.

CR #18 –Progressive reclamation, including re-vegetation, may be carried out at the Mount Gaudet Quarry. Native vegetation will be used for re-vegetation where possible; where use of native plants is not possible, non-invasive non-native species will be used.

CR #19 – There is a potential for a 2.77 km alignment to an alternate bridge location upstream of Hodgson Creek. Existing cut-lines will be used for access where possible and the width of the cutline will be minimized. If trees wider than 12 cm are cut, they will be stacked in a designated area for the public to use, and PKFN will be notified.

CR #20 – MGAR construction will not involve the issuance of a big game outfitter licence.

CR #21 – A tourism establishment will not be a component of the MGAR.

CR #22 – Agricultural activities will not be a component of the MGAR.

CR #23 – Digital files (shapefiles) of the Project footprint, including the potential road alignments, the quarry boundaries, and the new and old bridge locations will be provided to the MVLWB as part of INF's LUP and WL application, as outlined in the MVLWB's Guideline for Geographic Information Systems (GIS) Submission Standard. Both pre-build and as-built shapefiles will be submitted for Project infrastructure and associated boundaries.

CR #24 – Cumulative effects from this Project are considered to be minimal as the majority of work will be on the existing MVWR ROW, within 2 km of Wrigley (2.77 km new alignment which would require some additional vegetation clearing), or at the previously permitted Mount Gaudet Quarry (vegetation clearing). Shapefiles submitted to the MVLWB as part of the LUP application will provide a means for estimating the cumulative impacts of the Project relative to existing disturbance.

CR #25 – ENR has completed a den and nest survey in the area of the proposed Project, and will be performing further den and nest surveys prior to and during construction. If any dens or nests are identified in the area, Project operations will comply with the minimum setback distances. A Golden Eagle nest is known to be within 500m of the proposed MGAR (B. Fournier, Personal Communication, November 18, 2019). Any Project activities which take place during nesting season will adhere to the minimum setback distances outlined in the NLUG for Seismic Operations (Lands, 2014d).

Where applicable, the Project Contractor will follow the list of Recommendations set out in the DDLUP (2006).

16 Closure and Reclamation

The completed MGAR will be maintained and operated on a permanent basis, so there is no planned reclamation of the road. The Mount Gaudet Quarry will be maintained and be operated for the entirety of MGAR construction. It is expected that quarry operations will continue until the material is depleted. Progressive reclamation of depleted quarry areas will be carried out as described in the quarry operations plan in Appendix C. Funding for Segments 1, 2, and 3 and community approval for MGAR construction has been secured, so abandonment of road construction is not anticipated. Additional funding will be required for construction of Segment 4, though construction of this section will not proceed until funding has been obtained, and abandonment of this segment is not anticipated once construction has been initiated.

Should the final alignment of MGAR include the potential new Hodgson Creek Bridge, the unused section of the MVWR alignment (2.5 km) will be reclaimed as per the existing LUP for Highway #1 or other arrangements may be made following further consultations with PKFN.

Reclamation measures could include (but not be limited to):

- Rollback of slash and stockpiles soil/organic matter,
- Removal of creek crossings, bridges and culverts,
- Re-contouring to surrounding topography,
- De-compacting of soil,
- Restoring vegetation to the pre-development state and species mix by replanting trees and restoring terrestrial lichen resources if appropriate or allowing natural regeneration to occur, and/or creating barriers at junctions with the existing and new road alignment.

17 Completed and Planned Studies

Table 17-1 describes the studies which have been conducted to date for the Project and the studies which have yet to be completed prior to starting construction.

Table 17-1 MGAR Preliminary Studies List

Study	Completion Date
Completed Studies	
Terrain Analysis	December 2019
Planning Stage Den and Nest Surveys	November 2019
Geotechnical Assessment – Segments 1, 2a,	March 2020

3a and 4a	
Archaeological Overview Assessment	January 2020
Traditional Knowledge Review (Desktop)	February 2020
Topographic Survey	July 2020
LiDAR Surveys	July 2020
Studies to be Completed	
Caribou Collaring Surveys	Some collars deployed. Work and analysis will continue.
Thermal Analysis	June to September 2020
Archaeological Impact Assessment	September 2020
Hydrological/Hydrotechnical Studies	September 2020
Fish Habitat Assessment	September 2020
Bird Surveys	Prior to Project activities occurring during bird nesting periods as described by Environment Canada (EC Website, Accessed April 2020; https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods/overview.html)
Geotechnical Assessment- Segments 2b, 3b, 4b (where does not overlap with 4a) and Mount Gaudet Quarry	Summer/Fall/Winter 2020/2021

18 Supporting Material

18.1 Consultation and Engagement Documents

A consultation and engagement plan, along with an engagement record containing an engagement log and engagement summary, is included in Appendix H of this document.

18.2 Letters of Support

A letter of support for the Project from PKFN is included in Appendix G of this PDR.

19 References

Aylsworth, J.M, Burgess, M.M., Desrochers D.T., Duk-Rodkin, A., Robertson, T. and Traynor, J.A., 2000. Surficial geology, substrate materials and thaw sensitivity of sediments; *in* The Physical Environment of the Mackenzie Valley: a Baseline for the Assessment of Environment Change, (ed.) L.D. Dyke and G.R. Brooks; Geological Survey of Canada, Bulletin 547.

Birtwell, I.K., 1999. The Effects of Sediment on Fish and Their Habitat. Cdn. Stock Assessment Secretariat Research Document 99/139, Fisheries and Oceans Canada.

British Columbia Ministry of Transportation, 2019. BC Supplement to TAC Geometric Design Guide. Vancouver, BC.

Cadenasso ML, Traynor MM, Pickett STA, 1997. Functional location of forest edges: gradients of multiple physical factors. Can. J. For. Res. 27:774–82

Canadian Council of Ministers of the Environment, 2003. Canadian water quality guidelines for the protection of aquatic life: Guidance on the Site-Specific Application of Water Quality Guidelines in Canada: Procedures for Deriving Numerical Water Quality Objectives. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Christen, D., & Matlack, G, 2006. The role of roadsides in plant invasions: a demographic approach. *Conservation Biology*, *20*(2), 385-391.

Circumpolar Active Layer Monitoring (CALM). CALM North Summary Data Table. Accessed May 2020. https://www2.gwu.edu/~calm/data/north.htm

Clements, D.R., DiTommaso, A, 2012. Predicting weed invasion in Canada under climate change: Evaluating evolutionary potential. *Canadian Journal of Plant Science*, 2012, 92(6): 1013-1020. https://doi.org/10.4141/cjps2011-280

Conference of Management Authorities, 2017. Recovery Strategy for the Boreal Caribou (Rangifer tarandus caribou) in the Northwest Territories. Species at Risk (NWT) Act Management Plan and Recovery Strategy Series. Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT. 57 + x pp.

Courtois, R., Dussault, C., Potvin, F., & Daigle, G., 2002. Habitat selection by moose (Alces alces) in clear-cut landscapes. Alces, 38, 177-192.

Dessau, 2012. Mackenzie Valley Highway Extension / Pedzeh Ki Ndeh - Dehcho Region Project Description Report (PDR).

DFO, 1995. Freshwater Intake End-of-Pipe Fish Screen Guidelines. Communications Directorate, Department of Fisheries and Oceans. Ottawa, Ontario.

DFO, 2013. Northwest Territories Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat. Accessed June 2020 from: https://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/nwt-eng.html.

DFO, 2019. Measures to protect fish and fish habitat. Obtained from: https://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures-eng.html.

DFO, 2010. Protocol for winter water withdrawal from Ice-covered waterbodies in the Northwest Territories and Nunavut. Obtained from: http://registry.mvlwb.ca/Documents/W2010C0005/W2010C0005%20-%20Land%20Use%20Permit%20Application%20-%20DFO%20Water%20Withdrawal%20Protocol%20-%20Aug%2025_10.pdf

DLUPC (Dehcho Land Use Planning Committee), 2003. Dehcho Atlas. http://www.dehcholands.org/atlas/atlas_files/Pdfs/Deh%20Cho%20Atlas%20Version%202b.pdf. (Site accessed September 2011).

DOT, 2013. Erosion and Sediment Control Manual. GNWT. Yellowknife, NT. Retrieved April 2020 from: http://registry.mvlwb.ca/Documents/W2016E0004/W2016E0004%20-%20TASR%20-%20PDR%20Appendix%20W%20-%20DOT%20Erosion%20and%20Sediment%20Control%20Manual%20-%20Mar%2031_16.pdf.

Duchesne, C., Chartrand, J., and Smith, S.L., 2020. Report on 2018 field activities and collection of ground-thermal and active-layer data in the Mackenzie corridor, Northwest Territories; Geological Survey of Canada, Open File 8707, 84 p. https://doi.org/10.4095/321921

Dussault, C., Ouellet, J. P., Courtois, R., Huot, J., Breton, L., & Jolicoeur, H., 2005. Linking moose habitat selection to limiting factors. *Ecography*, *28*(5), 619-628.

Dyer, S.M., 1999. Movement and distribution of woodland caribou (*Rangifer tarandus caribou*) in response to industrial development in northeastern Alberta. Masters of Science in Environmental Biology and Ecology. University of Alberta.

EC, 2012b. Management Plan for the Northern Mountain Population of Woodland Caribou (Rangifer tarandus caribou) in Canada. Species at Risk Act Management Plan Series. Environment Canada, Ottawa. vii + 79 pp.

EC, 2015. Management Plan for the Rusty Blackbird (Euphagus carolinus) in Canada. Species at Risk Act Management Plan Series. Environment Canada, Ottawa. iv + 26 pp.

EC, 2016a. Management Plan for the Short-eared Owl (*Asio flammeus*) in Canada [Proposed]. Species at Risk Act Management Plan Series. Environment Canada, Ottawa. v + 35 pp.

EC, 2018. Overview of nesting periods. Web Access: April 2020. https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods/overview.html

EC, 2016b. Recovery Strategy for the Common Nighthawk (*Chordeiles minor*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. vii + 49 pp.

EC, 2016c. Recovery Strategy for the Olive-sided Flycatcher (*Contopus cooperi*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. vii + 52 pp.

EC, 2012b. Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. xi + 138pp.Environment and Natural Resources (ENR), Government of Northwest Territories 2018. A Framework for Boreal Caribou Range Planning, Discussion Document. Government of the Northwest Territories, Yellowknife, NT, Canada.

ECCC, 2018. Action Plan for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada – Federal Actions. Species at Risk Act Action Plan Series. Environment and Climate Change Canada, Ottawa. vii + 28 pp.

ECCC, 2017. Bank Swallow (*Riparia riparia*) in Sandpits and Quarries. Web Access, May 2020. https://www.canada.ca/en/environment-climate-change/services/migratory-bird-conservation/publications/bank-swallow-riparia-sandpits-quarries.html

ECCC, 2017. Management Plan for the Peregrine Falcon anatum/tundrius (Falco peregrinus anatum/tundrius) in Canada. Species at Risk Act Management Plan Series. Environment and Climate Change Canada, Ottawa. iv + 28 pp.

Eldegard, K., Lyngved, J.T. & Hjeljord, O., 2012. Coping in a human-dominated landscape: trade-off between foraging and keeping away from roads by moose (*Alces alces*). *Eur J Wildl Res* **58,** 969–979 https://doi.org/10.1007/s10344-012-0640-4

ENR, 2006. 2005/2006 Annual report of the Western Northwest Territories Biophysical Study. GNWT. Yellowknife, NT.

ENR, 2020. Best Management Practices and Guidelines for Industry in Boreal Caribou Habitat for the Northwest Territories. Unpublished Draft Document. GNWT. Yellowknife, NT.

ENR, 2001. Forest Fire Prevention and Suppression Guidelines for Industrial Activities. Accessed from:https://www.enr.gov.nt.ca/sites/enr/files/industrial_guidelines_forest_fire_prevention_suppression.pdf (accessed April 2020).

ENR, 2019. A Framework for Boreal Caribou Range Planning. Yellowknife, NT. 87 pp. https://www.enr.gov.nt.ca/en/framework-boreal-caribou-range-planning-cadre-de-planification-de-laire-de-repartition-du-caribou

ENR, 2013. Guidelines for Dust Suppression. GNWT. Yellowknife, NT. Accessed April 1st, 2020 https://www.enr.gov.nt.ca/sites/enr/files/guidelines/dustsupression.pdfFarmer, A.M., 1993. The effects of dust on vegetation—a review. *Environmental pollution*, *79*(1), 63-75.

Flory, S.L., & Clay, K., 2009. Effects of roads and forest successional age on experimental plant invasions. *Biological Conservation*, *142*(11), 2531-2537.

Fowle, S.C. 1996. Effects of roadkill mortality on the western painted turtle (*Chrysemys picta bellii*). 14 pp. *In* G.L. Evink, P. Garrett, D. Zeigler and J. Berry (eds.) Trends in Addressing Transportation Related Wildlife Mortality, proceedings of the transportation related wildlife mortality seminar. State of Florida Department of Transportation, Tallahassee, FL. FL-ER-58-96.

Gibeau, M. and Herrero, S., 1998. Roads, Rails and Grizzly Bears in the Bow River Valley, Alberta. Proceedings International Conference on Ecology and Transportation, Florida Department of Transportation, Talahassee.Web access: http://www.canadianrockies.net/Grizzly/roads.pdf. (November 2010).

GNWT, 2017. Guideline for the Hazardous Waste Management. Web access: https://www.enr.gov.nt.ca/sites/enr/files/resources/128-hazardous_waste-interactive_web_0.pdf . Last retrieved December 2019.

Golder Associates, 2019. Hydrotechnical Study for Hodgson Creek Bridge, Mackenzie Valley Highway. Yellowknife, NT.

Google Earth Pro V 7.3.2.5776 (64-bit) (September 30, 2006). Wrigley, Northwest Territories, Canada.
63° 14' 0.59"N, 123°28'55.96”W, Eye alt 11049 feet.
Maxar Technologies, 2020. https://www.google.com/earth/ [April 29, 2020].

GVM Geological Consultants, 2019. Mackenzie Highway Terrain Analysis – Wrigley to Mt. Gaudet. Prepared by G.V.M. Geological Consultants Ltd. For Government of the NWT, Department of Infrastructure, Strategic Planning, Policy & Communications. Yellowknife, NT.

Holderegger, R., & Di Giulio, M., 2010. The genetic effects of roads: a review of empirical evidence. *Basic and Applied Ecology*, *11*(6), 522-531.

Houghton, R.A., House, J.I., Pongratz, J., van der Werf, G.R., DeFries, R.S., Hansen, M.C., Le Quere, C., Ramankutty, N., 2012. Carbon emissions from land use and land-cover change. *Biogeosciences*, 9, 5125–5142.

James, A. & Stuart-Smith, A., (2000). Distribution of Caribou and Wolves in Relation to Linear Corridors. The Journal of Wildlife Management, 64(1), 154-159. doi:10.2307/3802985

Klein, D.R., 1971. Reaction of reindeer to obstructions and disturbances. Science 174:393-398.

Klein, D.R., 1979. The Alaska Oil Pipeline in Retrospect. Trans North American Wildlife and Natural Resource Conference 44:235-246.

Lands, *ATLAS* [Online] Accessed 12 December, 2019 and 5 May, 2020 https://www.maps.geomatics.gov.nt.ca/HTML5Viewer_Prod/index.html?viewer=ATLASLands, 2014b. Northern Land Use Guidelines: Access Roads and Trails . GNWT. Yellowknife, NT. Retrieved March 2020 from: https://www.lands.gov.nt.ca/sites/lands/files/resources/nlug_roadstrails_2015_english_16_sept_2015.pdf

Lands, 2014a. Northern Land Use Guidelines: Camp and Support Facilities. GNWT. Yellowknife, NT. Retrieved March 2020 from: https://www.lands.gov.nt.ca/sites/lands/files/resources/nlug_camps_2015_english_16_sept_2015.pdf

Lands, 2014c. Northern Land Use Guidelines: Pits and Quarries. GNWT. Yellowknife, NT. Retrieved March 2020 from: https://wlwb.ca/sites/default/files/images/Guidelines/EA1415-01_Northern_Land_Use_Guideline_pits_and_quarries.PDF

Lands, 2014d. Northern Land Use Guidelines: Seismic Operations . GNWT. Yellowknife, NT. Retrieved March 2020 from: https://www.lands.gov.nt.ca/sites/lands/files/resources/nlug_seismic_2015_english_-_16_sept_2015.pdf

Laurian, C., Dussault, C., Ouellet, J.P., Courtois, R., Poulin, M. and Breton, L., 2008, Behavior of Moose Relative to a Road Network. The Journal of Wildlife Management, 72: 1550-1557. doi:10.2193/2008-063

Lloyd, D.S., Koenings, J.P. and LaPerriere, J.D., 1987. Effects of Turbidity in FreshWater of Alaska. N. Am Journal of Fish. Mgmt. 7.

Maehr, D.S., Land, E.D. and Roelke, M.E, 1991. Mortality patterns of panthers in southwest Florida. Proc. Annu. Conf. of Southeast. Assoc. Fish and Wildl. Agencies 45:201-207.

Matlack, G. R., 1993. Microenvironment variation within and among forest edge sites in the eastern United States. *Biological conservation*, *66*(3), 185-194.

McLellan, B., & Shackleton, D., 1988. Grizzly Bears and Resource-Extraction Industries: Effects of Roads on Behaviour, Habitat Use and Demography. *Journal of Applied Ecology, 25*(2), 451-460. doi:10.2307/2403836

Natural Resources Canada. National Topographic System Index Maps. Accessed January 2020 https://open.canada.ca/data/en/dataset/055919c2-101e-4329-bfd7-1d0c333c0e62

Ortega, Y.K., Capen, D.E. Roads as Edges: Effects on Birds in Forested Landscapes, *Forest Science*, Volume 48, Issue 2, May 2002, Pages 381–390, https://doi.org/10.1093/forestscience/48.2.381

Smith, A. L., Hewitt, N., Klenk, N., Bazely, D. R., Yan, N., Wood, S., ... & Lipsig-Mummé, C. (2012). Effects of climate change on the distribution of invasive alien species in Canada: a knowledge synthesis of range change projections in a warming world. Environmental Reviews, 20(1), 1-16.

Snyder, E. and Anions, M. 2008. Pathways Analysis of Invasive Plants and Insects in the Northwest Territories. Report for the Department of Environment and Natural Resources, Wildlife Division, Government of the Northwest Territories. Project No: PM 005529 28 pages, 5 Appendices.

Stantec, 2019. Prohibition Creek Access Road Project, Climate Lens Part II: Climate Change Resilience Assessment.

Stewart, D.B., Low, G., 2000. A review of Information on Fish Stocks and Harvests in the Dehcho Area, Northwest Territories. Canadian Manuscript Report of Fisheries and Aquatic Sciences 2549. Department of Fisheries and Oceans, Central and Arctic Region and Arctic Biological Consultants, Winnipeg, Manitoba.

Thruber, J.M., Peterson, R.O., Drummer, T.D. and Thomasma, S.A., 1994. Gray wolf response to refuge boundaries and roads in Alaska. Wildl. Soc. Bull. 22:61-67.

Wales BA., 1972. Vegetation analysis of north and south edges in a mature oak-hickory forest. Ecol. Monogr. 42:451–71

Ward, A.L., Cupal, J.J. Goodwin, G.A. and. Morris, H.D. 1976. Effects of highway construction and use on big game populations. U.S. Department of Transportation, Federal Highway Administration. Springfield, VA. 98 pp.

Watkins RZ, Chen J, Pickens J, Brosofske K.D., 2003. Effects of forest roads on understory plants in a managed hardwood landscape. Conserv. Biol. 17:411–19

Whittington, J., Hebblewhite, M., DeCesare, N. J., Neufeld, L., Bradley, M., Wilmshurst, J., & Musiani, M., 2011. Caribou encounters with wolves increase near roads and trails: a time-to-event approach. *Journal of applied ecology*, *48*(6), 1535-1542.