PROJECT DESCRIPTION

MISERY UNDERGROUND PROJECT

Prepared for: Dominion Diamond Ekati Corporation

Prepared by: Golder Associates Ltd.

August 2017

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Acronyms and Abbreviations

Acronym	Definition
AANDC	Aboriginal Affairs and Northern Development Canada
AEMP	Aquatic Effects Monitoring Program
AQEMMP	Air Quality Emissions Monitoring and Management Program
AQMP	Air Quality Monitoring Program
ASTt	Arctic Small Tool tradition
BHP	Broken Hill Proprietary Company
BHP Billiton	BHP Billiton Canada Incorporated
BP	before present time
CCME	Canadian Council of Ministers of the Environment
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPK	coarse processed kimberlite
CRMP	Caribou Road Mitigation Plan
CWQG	Canadian Water Quality Guidelines
DAR	Developer's Assessment Report
DDEC	Dominion Diamond Ekati Corporation
DDMI	Diavik Diamond Mines (2012) Inc.
De Beers	De Beers Canada Inc.
DFO	Fisheries and Oceans Canada
DIAND	Department of Indian Affairs and Northern Development
Diavik Mine	Diavik Diamond Mine
DNA	deoxyribonucleic acid
EA	environmental assessment
EAP or the Panel	Environmental Assessment Panel
EIS	Environmental Impact Statement
Ekati mine	Ekati Diamond Mine
EQC	effluent quality criteria
ERT	Emergency Response Team
FAR	fresh air raise
FFA	far-field area
FPK	fine processed kimberlite
GNWT	Government of the Northwest Territories
IBA	Impact Benefit Agreement
ICRP	Interim Closure and Reclamation Plan
IEMA	Independent Environmental Monitoring Agency
INAC	Indigenous and Northern Affairs Canada
ISO	International Organization for Standardization
KIA	Kitikmeot Inuit Association
LKDFN	Łutsel K'e Dene First Nation
LLCF	Long Lake Containment Facility
LUP	land use permit

Acronym	Definition
MUG	Misery Underground
MVEIRB	Mackenzie Valley Environmental Impact Review Board
MVLWB	Mackenzie Valley Land and Water Board
NOx	oxides of nitrogen
NWT	Northwest Territories
PK	processed kimberlite
$PM_{2.5}$	particulate matter with a mean aerodynamic diameter of 2.5 microns (µm) or smaller
Project	Misery Underground Project
QA	quality assurance
QC	quality control
REA	Jay Project Report of Environmental Assessment and Reasons for Decision
RMR	ross mass rating
SE	southeast
SEA	Socio-Economic Agreement
SLR	sub-level retreat
SNP	Surveillance Network Program
SO_2	sulphur dioxide
SOx	oxides of sulphur
spp	multiple species
SW	southwest
TCWR	Tibbitt to Contwoyto Winter Road
TDS	total dissolved solids
TK	Traditional Knowledge
TSP	total suspended particulates
TSS	total suspended solids
VC	valued component
WEMP	Wildlife Effects Monitoring Program
WL	water licence
WLWB	Wek'èezhìı Land and Water Board
WPKMP	Wastewater and Processed Kimberlite Management Plan
WROMP	Waste Rock and Ore Storage Management Plan
WRSA	waste rock storage area
YKDFN	Yellowknives Dene First Nation
ZOI	zone of influence

Units of Measure

Unit	Definition
%	percent
>	greater than
°C	degrees Celsius
ha	hectare
km	kilometre
km^2	square kilometre
kV	kilovolt
L	litre
L/s	litres per second
m	metre
m^2	square metre
m^3	cubic metre
m^3/hr	cubic metres per hour
m^3/s	cubic metres per second
masl	metres above sea level
mg dw	milligrams dry weight
mL	millilitre
ML	million litres
mm	millimetre
MPa	mega pascals
V	volt

1.0 INTRODUCTION

1.1 Purpose

The purpose of this Project Description is to provide information to support the Dominion Diamond Ekati Corporation (DDEC) application to the Wek'èezhìı Land and Water Board (WLWB) requesting a new land use permit (LUP) for certain activities and the necessary amendments to the Type A Water Licence for the Ekati Diamond Mine (Ekati mine) to include underground mining at the Misery kimberlite pipe.

The Misery Underground (MUG) Project is a small, but important development that extends the mine life of the existing Ekati mine. The Project will be an extension of the mining operations at the Misery Pit area involving the use of existing infrastructure, along with the development of limited new infrastructure to support underground mining operations at Misery allowing for the recovery of high value kimberlite from the Misery main kimberlite pipe. Development of the MUG Project would require approximately one year of initial underground development activities, followed by underground ore extraction over about 3.5 years, producing the equivalent of about six months of full time feed to the Ekati mine processing facilities. The Project is a small but critical economic “bridge” for the Ekati mine and will ensure a steady supply of ore between the end of the Misery open pit and Sable Pit operations and the start of production from the Jay Project.

The Misery underground operations and support infrastructure, minewater and waste management including the Misery waste rock storage area (WRSA) are collectively termed the MUG Project. Underground mining at the Misery kimberlite pipe represents an extension of the existing Misery operations and will make use of existing surface infrastructure at the Misery site. There will be no new land disturbance as a result of the Project.

This document provides an overview of the MUG Project, the existing Ekati mine operations including those elements directly associated with mining of the Misery kimberlite pipe, and existing regulatory permits and approvals.

1.2 Corporate Overview

Dominion Diamond Corporation is a wholly Canadian-owned mining company that mines, processes, and markets Canadian diamonds. The Ekati mine was acquired from BHP Billiton Canada Incorporated in April 2013. Dominion Diamond Corporation is focused on the mining and marketing of rough diamonds to the global market. The Company supplies rough diamonds to the global market from its operation of the Ekati mine (in which it owns a controlling interest) and its 40% ownership interest in the Diavik Diamond Mine (Diavik Mine).

Dominion Diamond Corporation controls the Ekati mine as well as the associated diamond sorting and sales facilities in: Toronto, Canada; Mumbai, India; and Antwerp, Belgium. The Ekati mine consists of the Core Zone, which has been and is currently the focus of mining operations, as well as the Buffer Zone, which is the focus of new development and exploration potential. DDEC, an indirect wholly-owned subsidiary of the Dominion Diamond Corporation, is the operator of the Ekati mine. DDEC is actively pursuing options to expand its operations and economic benefits in the Northwest Territories (NWT).

The Core Zone Joint Venture is currently held by the Dominion Diamond Corporation (88.9%), Nor-west Rotors Ltd. (10%), and 1012986 B.C. Ltd. (1.1%). The Core Zone encompasses 175 mining leases,

totaling 172,992 ha, and hosts the Koala, Fox, Misery Main, Misery South, Misery SW Extension, Pigeon, and Sable kimberlites. Legal title to the mining leases are held by DDEC in its capacity as operator of the Core Zone. Dominion Diamond Corporation's ownership interest in the Buffer Zone is 100.0%. The Buffer Zone contains 106 mining leases covering 89,184 ha, and hosts the Jay and Lynx kimberlite pipes.

DDEC is fully committed to maintaining and advancing the principles and practices of sustainable development, while making best use of the resources mined. This commitment includes respect for the natural and social environments, sharing economic benefits, and diligently reducing adverse effects or outcomes resulting from its work. DDEC maintains a high standard of environmental stewardship throughout all phases of its operations. The Ekati mine meets its environmental protection commitments through its Sustainable Development Policy and its comprehensive environmental management system, which is International Organization for Standardization (ISO) accredited (ISO14001:2004 certified).

DDEC continues to make investments to extend the operating life of the Ekati mine, and in doing so, creates value for the Canadian North through benefits such as employment and contracts. This Project aligns with DDEC's vision of building a long-term diamond business that continues to deliver benefits well in to the future by retaining skilled workforce, and providing job opportunities and contracts. The Project is a small but critical economic "bridge" for the Ekati mine and will ensure a steady supply of ore between the end of the Misery open pit and Sable Pit operations and the start of production from the Jay Project. The Project is aligned with the Northwest Territories Mineral Development Strategy (GNWT 2013), whose overall goal is to realize, responsibly and sustainably, the full potential of the NWT's rich mineral resources to ensure lasting prosperity for residents and communities.

1.3 Background Information

1.3.1 The Ekati Mine

The Ekati mine and its surrounding claim block are located approximately 200 km south of the Arctic Circle and 300 km northeast of Yellowknife, NWT. The mine is situated within the Exeter Lake, Koala, Lac de Gras, and Lac du Sauvage watersheds at the headwaters of the Coppermine River drainage basin, which flows north to the Arctic Ocean (Map 1.3-1).

Minerals that indicate the presence of kimberlite were first discovered in the Lac de Gras area in 1989. The first diamonds in this area were discovered in the fall of 1991. Data to provide information about the baseline environment were first collected between 1993 and 1996. These data were used to prepare the original Environmental Impact Statement (EIS), which outlined the predicted environmental effects from the Ekati mine. The EIS was submitted to an Environmental Assessment Review Panel (the Panel) in 1996. The Panel was convened under the provisions of Environmental Assessment and Review Process Guidelines Order SOR/84-467, which was promulgated under the *Canadian Environmental Assessment Act* (S.C. 1992, c.37). The purpose of the Panel was to provide a recommendation to the Minister of the Department of Indian Affairs and Northern Development (DIAND) on whether the Ekati mine should proceed. After public hearings were held by the Panel, approval for the Ekati mine was granted in November 1996. Effects monitoring began during construction of the Ekati mine in 1997.

LEGEND

- MISERY UNDERGROUND PROJECT
- EXISTING MINE OR PROJECT
- TERRITORIAL CAPITAL
- POPULATED PLACE
- HIGHWAY
- ALL-SEASON ROAD
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- TERRITORIAL/PROVINCIAL BOUNDARY
- TREELINE
- WATERCOURSE
- WATERBODY

150 0 150

SCALE 1:6,000,000 KILOMETRES

REFERENCE

WATER OBTAINED FROM ATLAS OF CANADA
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
PROJECTION: CANADA LAMBERT CONFORMAL CONIC

PROJECT

DOMINION DIAMOND

MISERY UNDERGROUND PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

LOCATION OF MISERY UNDERGROUND PROJECT

Golder Associates

PROJECT	1779181.2000		FILE No.	
DESIGN	EFR	02/06/17	SCALE AS SHOWN	REV. 0
GIS	AK/LS	10/08/17		
CHECK	KM	10/08/17		
REVIEW	JCC	10/08/17		

MAP 1.3-1

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\1779181_MiseryUnderground\2000_TechComponents\20_StorageEval\Map1_3-1_1779181_Location_of_MUG_Project.mxd

Production at the Ekati mine began in August 1998 after the conclusion of the licencing and permitting process. Since the start of production, the Ekati mine has included operations at nine separate open pits and one underground development. Underground mining was initiated at the Ekati mine in 2003, at the Panda Pit. The Ekati mine property map is shown in Map 1.3-2.

The Misery Pit open pit operation began in 2002 and was initially terminated in 2006. Production from the Misery stockpiles continued until 2007. Pre-stripping at Misery for a pushback pit commenced in 2011. The Misery operation is still active and has included production from the Misery Main Pipe and from the Misery Southwest Extension, Misery South, and Misery Northeast satellite pipes. Current production is primarily from the Misery Main and Misery Southwest Extension pipes.

The existing Ekati mine Water Licence (W2012L2-0001) has recently been amended to incorporate the proposed Jay Project.

1.3.2 Misery Underground Project

The Misery Pit is located in the southeastern portion of the Ekati mine property about 30 km from the main facilities in the Lac de Gras watershed (Map 1.3-3). Underground mining of the Misery kimberlite pipe will be an extension of the existing Misery open pit operation and involve the use of a number of existing and previously permitted components of the Ekati mine and Misery site infrastructure. The Project includes approximately 3.5 years of mining, with development proposed to begin in April 2018 following the completion of Misery open pit mining.

The following existing components of the Ekati mine will be used for the MUG Project:

- roads and transportation infrastructure (e.g., Ekati airstrip, Misery Road);
- Misery Camp and facilities (e.g., laydowns, maintenance buildings);
- existing water management infrastructure (e.g., King Pond Settling Facility, pipelines from the Misery site to the King Pond Settling Facility);
- processing plant; and,
- fine and coarse processed kimberlite management facilities (i.e., Long Lake Containment Facility [LLCF], coarse kimberlite storage area, mined-out Panda and Koala open pits).

The following activities will be undertaken to enable underground mining at Misery:

- mining of the Misery main kimberlite pipe using the Sublevel Retreat mining method;
- placement of underground waste rock at the existing and permitted Misery WRSA;
- operational management of minewater during underground mining; and,
- reclamation of the constructed facilities.

LEGEND

- EKATI MINE FOOTPRINT
- DIAVIK MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- EKATI CLAIM BLOCK
- SABLE ALL-SEASON ROAD
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ELEVATION CONTOUR (10 m INTERVAL)
- ESKER
- WATERCOURSE
- WATERBODY

REFERENCE

CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

4 0 4
SCALE 1:175,000 KILOMETRES

PROJECT
DOMINION DIAMOND™

MISERY UNDERGROUND PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

EKATI PROPERTY MAP

Golder Associates

PROJECT	1779181.2000		FILE No.	
DESIGN	EFR	02/06/17	SCALE AS SHOWN	REV 0
GIS	AK/LS	10/08/17	MAP 1.3-2	
CHECK	KM	10/08/17		
REVIEW	JCC	10/08/17		

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\1779181_MiseryUnderground\2000_ TechComponents\20_StorageEval\Map1_3-2_1779181_EkatiPropertyMap.mxd

536000 538000 540000 542000

7162000

7160000

7158000

N

Lake B1 (Christine Lake)

B15

B16

B3

Misery Road

Proposed Jay Road

Lake Ac36

Lake Ac35

Esker Cut Stockpile

Lake B4 (Cujo Lake)

Crusher and Stockpile Area

Jay to Misery Pipeline

Lynx Waste Rock Stockpile Area

King Pond Settling Facility

Misery Waste Rock Storage Area

Misery Camp

Waste Rock Dam Pond

Desperation Pond

Misery Pit and Main Pipe

Misery Underground Project

Lynx Road

Winter Road

Lynx Pit

Lac de Gras

LEGEND

- MISERY UNDERGROUND PROJECT
- PROPOSED JAY FOOTPRINT

REFERENCES

1. ORTHOPHOTO RECEIVED FROM DDEC, DATED: 18 MAY 2017.
FILE NAME: 2016 EKATI MOSAIC.TIF. PHOTO ACQUIRED BETWEEN JULY 28 AND AUGUST 2, 2016.
DATUM: NAD83 PROJECTION: UTM ZONE 12N

500 0 500

SCALE 1:25,000 METRES

PROJECT

DOMINION DIAMOND

MISERY UNDERGROUND PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

LOCATION OF MISERY PIT

Golder Associates

PROJECT	1779181.2000		FILE No.	
DESIGN	EFR	02/06/17	SCALE AS SHOWN	REV 0
GIS	AK/LS	11/08/17		
CHECK	KM	11/08/17	MAP 1.3-3	
REVIEW	JCC	11/08/17		

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With the change in mining methods from open pit to underground, new infrastructure required at the Misery site will be:

- 80 person addition to the existing Misery camp;
- portals for underground access – two in pit locations and possibly a surface portal;
- expansion to the existing surface Sprung structures;
- additional dewatering lines;
- development and construction of an underground mine fresh air raise (FAR) and supply of compressed air to deliver fresh air to the underground work area;
- addition of an Emergency Response Team (ERT) building (to be a fold-away structure); and,
- connection to the Misery Powerline to the underground.

In addition to the above noted new infrastructure components for the MUG Project, there will be:

- minor modifications to the Saddle Dam at the King Pond Settling Facility;
- possible upgrades to the existing shotcrete plant;
- rehabilitation of the existing ERT hall to become the underground dry building; and,
- a temporary ore stockpile to be located within the footprint of the Misery Pit area.

Licences and approvals required to undertake the proposed Project include a new LUP to accommodate additional facilities for underground mining, an amendment to the existing Type A Water Licence for the Ekati mine to include the MUG Project, and a surface lease amendment to include within the use clause a provision for underground mining at Misery.

1.4 Project Requirements

1.4.1 Regional Context

Regionally, diamond mining has been a major contributor to the NWT economy since the 1990s. Mining overall is the largest private sector employer in the NWT and accounts for 29% of the gross domestic product (GNWT 2013). The mining industry creates significant opportunities and revenue for northern businesses, and in particular, Aboriginal businesses. Currently there are three operating diamond mines in the NWT. The Ekati and Diavik mines provide the majority of the employment and economic benefits because of the open pit operations and larger scale.

1.4.2 The Future of the Ekati Mine

The mine plan for the Ekati mine schedules the development and mining sequence of the different kimberlite pipes in a manner that provides a sustainable and stable operation. The rates at which a pipe can be mined and the order in which each pipe can be developed depend on factors unique to each pipe, such as pipe size and geometry, physical properties and processing characteristics of the kimberlite, diamond grade and grade distribution within the kimberlite pipe, carat values, and location relative to the processing plant. These pipe factors combined with operational factors result in an intricate mine planning process. Typical operational factors include haul truck cycle times, equipment fleet size and composition, processing plant capacity, and workforce stability.

Since taking ownership of the Ekati mine in 2013, DDEC has maintained a focus on projects to extend the life of the Ekati mine. The extension of the Ekati mine has been achieved through the development of the Lynx and Sable pits, and the ongoing development of the Jay Project. The MUG Project is another key venture to extend the life of the mine, by bridging production from the Sable Pit to the start of ore becoming available from the Jay pit.

1.5 References

GNWT (Government of the Northwest Territories). 2013. Pathways to Mineral Development: Report of the Stakeholders Engagement Panel for the NWT Mineral Development Strategy. April 2013.

2.0 REGULATORY APPROVALS AND AUTHORIZATIONS

2.1 Regulatory Guidelines and Policies Applicable to the Misery Underground Project

This project description and the associated documentation for the Misery Underground (MUG) Project is to fulfill the requirements for permitting by the Wek'èezhìı Land and Water Board (WLWB). The following guidance documents from the Mackenzie Valley Land and Water Board (MVLWB) were referenced in the preparation of this application:

- The Mackenzie Valley Land and Water Board Document Submission Standards (MVLWB 2012a);
- Standards for Geographical Information Systems Submissions (MVLWB 2012b);
- Guide to Completing Land Use Permit Applications (MVLWB 2013a);
- Guide to Completing Water Licence Applications (MVLWB 2003);
- Engagement and Consultation Policy (MVLWB 2013b);
- Engagement Guidelines for Applicants and Holders of Water Licences and Land Use Permits (MVLWB 2013c);
- Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories (MVLWB and AANDC 2013);
- Water and Effluent Quality Management Policy (MVLWB 2011a);
- Guidelines for Developing a Waste Management Plan (MVLWB 2011b); and
- Draft Guidelines for Adaptive Management (WLWB 2010).

Other supporting documentation used to inform this application includes:

- Aboriginal Affairs and Northern Development Canada (AANDC) Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the NWT (Government of Canada 2009);
- Draft Guidelines for Adaptive Management - a Response Framework for Aquatic Effects Monitoring (WLWB 2010);
- Guidelines for Spill Contingency Planning (Government of Canada 2007);
- Environmental Impact Assessment Guidelines (MVEIRB 2004);
- Socio-economic Impact Assessment Guidelines (MVEIRB 2007);
- Guidelines for Incorporating Traditional Knowledge in Environmental Impact Assessment (MVEIRB 2005)*;*
- Fisheries and Oceans Canada (DFO) Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 1995);

- DFO Measures to Avoid Causing Harm to Fish and Fish Habitat Including Aquatic Species at Risk (DFO 2016);
- Fish Screen Design Criteria for Flood and Water Truck Pumps (Government of Canada 2011); and,
- Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guidelines (CWQG) for the Protection of Aquatic Life–Site Specific Guidance (Government of Canada 2003).

2.2 Previous Environmental Assessments

Initial applications for what would become the Ekati Diamond Mine (the NWT Diamonds Project) were reviewed by the Environmental Assessment Panel (EAP) between 1994 and 1996 (Table 2.2-1). The Report of Environmental Assessment Panel (EAP 1996) recommended that the Government of Canada approve the NWT Diamonds Project.

In 1999, BHP Diamonds Inc. applied to the Northwest Territories Water Board for an expansion to the existing Ekati Diamond Mine (Ekati mine). This application was for the inclusion of the Sable, Pigeon, and Beartooth kimberlite pipes to the north of the existing facilities. The environmental assessment (EA) for this project was undertaken by the Mackenzie Valley Environmental Impact Review Board (MVEIRB) who, in 2001, recommended that the Minister of Department of Indian Affairs and Northern Development (DIAND, now known as Indigenous and Northern Affairs Canada [INAC]) approve the proposed development. The proposed development was approved in July 2001 with conditions.

In 2013, Dominion Diamond Ekati Corporation (DDEC) proposed open pit mining of the Lynx kimberlite pipe, as an extension of mining activities at the Misery site. The Lynx pit was approved by the WLWB; a Water Licence amendment and Land Use Permit (LUP) were issued by the WLWB in 2014.

In 2013, DDEC submitted an application to the WLWB requesting a Land Use Permit and Water Licence amendment to enable development of the Jay kimberlite pipe. The Jay Project was referred to the MVEIRB for EA. In February 2016, the MVEIRB released the Jay Project Report of Environmental Assessment and Reasons for Decision (REA; MVEIRB 2016) and recommended to the Government of the Northwest Territories (GNWT) Minister of Lands that the Jay Project be approved subject to the measures described in the REA. In May 2016, the Minister agreed to adopt the recommendation of the MVEIRB, that the Jay Project be approved subject to the measures and developer's commitments contained within the REA. An LUP for the Jay Project was issued in May 2017 and an amended Type A Water Licence for the Jay Project was issued by the WLWB on July 6, 2017.

Table 2.2-1 Existing Environmental Assessments for the Ekati Mine Relevant to the Misery Underground Project

Project	Environmental Assessment	Subsequent or Associated Licensing and Permitting	Aspect Relevant to the MUG Project
NWT Diamonds Project	• NWT Diamonds Project Environmental Impact Statement (1995) • Panel recommendation to approve the NWT Diamonds Project (1996) • Government of Canada Approval (1996)	• Type A Water Licence • Surface Land Leases • Mining Leases • *Fisheries Act* Authorizations • *Navigable Waters Protection Act* Authorizations	• Initial approval for the overall Ekati Operation, which included open pit and underground development of the Panda, Koala, Fox, Leslie, and Misery kimberlite pipes, processing plant, waste rock and water management, camp, airstrip, and on-site roads, deposition of fine processed kimberlite into Cells A-D of the LLCF
Sable, Pigeon, and Beartooth Expansion	• Environmental Assessment Report for Sable, Pigeon, and Beartooth Kimberlite Pipes (April 2000) • MVEIRB Report of Environmental Assessment on the Proposed Development of Sable, Pigeon, and Beartooth Kimberlite Pipes (February 2001)	• Type A Water Licence • Type A Land Use Permits • Surface Land Leases • Mining Leases • *Fisheries Act* Authorizations • *Navigable Waters Protection Act* Authorizations	• Open pit development of Sable, Pigeon, and Beartooth pipes, waste rock and water management, Sable road construction, Ursula granular quarry, fine processed kimberlite deposition into Cells A-D of the LLCF and Beartooth open pit
Lynx Project	• Preliminary Screening by the WLWB (2013)	• Amendment to the existing Ekati Type A Water Licence • Type A Land Use Permit • Mining Leases • *Fisheries Act* Authorization • Exemption under the *Navigability Protection Act*	• Expansion of the Misery WRSA • Dewatering and open pit mining of Lynx Lake
Jay Project	• DAR for the Jay Project (November 2014) • MVEIRB Report of Environmental Assessment on the Jay Project (February 2016)	• Amendment to the existing Ekati Type A Water Licence • Type A Land Use Permits • Surface Lease (note: not yet issued) • *Fisheries Act* Authorization • Exemption under the *Navigability Protection Act*	• Jay road construction, dike construction and Dewatering, open pit development of Jay pipe, waste rock and water management, use of Misery Pit for minewater management, fine processed kimberlite deposition into Panda and Koala open pits

NWT = Northwest Territories; DAR = Developer's Assessment Report; LLCF = Long Lake Containment Facility; MVEIRB = Mackenzie Valley Environmental Impact Review Board; WLWB = Wek'èezhìı Land and Water Board; WRSA = waste rock storage area.

2.2.1 NWT Diamonds Project (i.e., Ekati Mine)

BHP Diamonds Inc. NWT Diamonds Project underwent an extensive environmental assessment and regulatory process under the *Canadian Environmental Assessment Act* in 1996, prior to the establishment of the *Mackenzie Valley Resource Management Act*. In July 1994, the DIAND Minister referred the project to the Minister of Environment for public review under the Environmental Assessment and Review

Process Guidelines Order, a process that was mandated by an Order-in-Council from the federal Cabinet. In December 1994, a Panel was appointed to assess the potential for adverse impacts from a segment of the mining industry that was new to Canada, the mining of diamonds from kimberlite.

The Panel reviewed the short and long-term environmental and socio-economic effects of the NWT Diamonds Project, as well as its proposed development plan. In May 1995, the Panel issued guidelines for the preparation of an Environmental Impact Statement (EIS). The EIS was then prepared and submitted by BHP Diamonds Inc. in July 1995. The EIS assessed the combined open pit and underground development of five diamond-bearing kimberlite pipes near Lac de Gras; four located within a few kilometres of each other in the Koala watershed (Panda, Koala, Fox, and Leslie [the Leslie kimberlite pipe has not been developed]) and a fifth, to the southeast, adjacent to Lac de Gras (Misery). The 1995 EIS also anticipated the future development of additional kimberlite pipes.

In January and February of 1996, extensive public hearings were held in potentially impacted communities identified by the Panel in the western NWT (and present day Nunavut). In June 1996, the Panel concluded that the environmental effects of the proposed Ekati mine were largely predictable and could be mitigated. The Panel concluded that monitoring would detect any effects not predicted or those not accurately predicted, allowing them to be addressed through various environmental management plans and an adaptive management strategy.

Concerning future development possibilities at the Ekati mine, the conclusion of the Panel was:

> "*The cumulative environmental effects of additional development by BHP on the Lac de Gras claim block are unlikely to be significant. It has reached this conclusion for several reasons. First, mining of additional pipes would extend the life of the mine and would not result in development of additional processing capacity. Secondly, tailings would be deposited in mined-out pits and no expansion of the Long lake tailings impoundment or creation of a new impoundment would be required. Thirdly, if additional pits were developed, the Proponent and government would have some years of experience in managing the effects of the Project. Nevertheless, continued monitoring and adaptive management would be required, especially if new pits were located in previously undeveloped watersheds. Finally, the Panel agrees with the Proponent's conclusion that the cumulative socio-economic effects entailed by extending the life of the mine are likely to be positive since extension of the life of the mine would provide economic stability*." (excerpt from page 67 of the EARP June 1996 Report)

The Panel report was accepted without any changes by the Government of Canada, indicating its acceptance of the conclusion.

2.2.2 Sable, Pigeon, and Beartooth Expansion

In 1999, Broken Hill Proprietary Company (BHP) applied for an expansion to the Ekati mine to include three new kimberlite pipes that were not included in the original application: the Sable, Pigeon and Beartooth pipes. BHP noted in their 1999 application that expansion was discussed in the original 1995 EA process for the Ekati mine, no new processes or methods would be required, and no new waste streams would be generated. The preliminary screening by the Northwest Territories Water Board recommended that the proposed development undergo an EA under the *Mackenzie Valley Resource Management Act*, based on the potential for significant adverse impacts on the environment primarily

related to the lack of water-related baseline information in the vicinity of the newly proposed developments and the need for a thorough cumulative effects assessment with respect to the existing Ekati mine and the anticipated Diavik Diamond Mine at the time. However, the new application was considered an expansion of the existing mine (rather than a new project), and the Terms of Reference for the EA report was issued by MVEIRB in December 1999 and reflected these conditions. In June 2000, BHP submitted its EA report to the MVEIRB. Extensive public hearings were held in N'Dilo in September 2000 and in February 2001. The MVEIRB concluded that the proposed development should not result in significant adverse effects.

The MVEIRB recommendation to approve this Expansion Project was accepted by the Minister of the DIAND (now INAC) in July 2001.

2.2.3 Lynx Project Extension

In 2013, DDEC proposed open pit mining of the Lynx kimberlite pipe as an extension of mining activities at the Misery site. The Lynx Project required the dewatering of a small lake and the development of an open pit mine with an access road; this type of development at the Ekati mine had been previously assessed within the NWT Diamond Project (1998) and the Sable, Pigeon, and Beartooth Expansion (2002). The proposed activities had also been successfully carried out during approximately 15 years of mining operations at the Ekati mine and the environmental management and monitoring plans already in place at Ekati mine would be expanded to include all aspects of the Lynx Project. A Type A Water Licence (WL) amendment and LUP for the Lynx Project were issued by the WLWB in 2014.

2.2.4 Jay Project Extension

In October 2013, DDEC submitted an application to the WLWB requesting a LUP and Type A WL to enable the development of the Jay kimberlite pipe as an extension project of the Ekati mine.

In November 2013, the Jay Project was referred to the MVEIRB for an EA by AANDC (now INAC). DDEC submitted the Developer's Assessment Report (DAR) for the Jay Project to MVEIRB in November 2014 (DDEC 2014). A key component of the DAR was the consideration of cumulative effects of the Jay Project in combination with the Ekati and Diavik mines. In February 2016, the MVEIRB released the Jay Project REA (MVEIRB 2016) and recommended to the GNWT Minister of Lands that the Jay Project be approved subject to the measures described in the REA. In May 2016, the Minister agreed to adopt the recommendation of the MVEIRB, that the Jay Project be approved subject to the measures and developer's commitments contained within the REA. An LUP for the Jay Project was issued in May 2017 and an amended Type A Water Licence for the Jay Project was issued by the WLWB on July 6, 2017.

2.2.5 Misery Underground Project Regulatory Process

With the exception of the Inuvialuit Settlement Region, the regulatory process in the NWT is set out in the *Mackenzie Valley Resource Management Act*. This *Act* delivers on commitments made during land claim agreements through the establishment of a co-management system. This system is designed to ensure that Aboriginal people, including those in the unsettled regions, have a greater role in the EA and decision-making process for resource development in their region.

The Land and Water Boards of the Mackenzie Valley are responsible for performing the initial review and preliminary screenings of proposed projects and regulating the use of the land and water, as well as the deposit of waste within their respective regions. The Ekati mine is located within the Wek'èezhìı

settlement area where all development applications are processed by the WLWB. The WLWB's objective is to provide for the conservation, development and use of land and water resources for the optimum benefit to the residents in their settlement areas and the Mackenzie Valley and to all Canadians.

The facilities and activities related to open pit mining at the Misery site have been subject to an EA. The proposed underground mining at Misery lies within the footprint of the existing Misery open pit. The MUG Project will make use of the existing surface infrastructure at the Misery site.

The MUG Project does require development of underground mining infrastructure at the Misery site and changes to associated water management planning. All instruments of environmental management and monitoring currently in use at the Ekati mine will be expanded to include all aspects of the Project.

2.3 Misery Underground Project Regulatory Instruments

The licences, permits and authorizations that will be required to enable underground mining of the Misery kimberlite pipe are indicated in Table 2.3-1 and described in the subsequent text. DDEC holds the necessary mineral leases that provide the fundamental mineral and mining rights for the MUG Project.

2.3.1 Surface Leases

Ten surface leases are currently in place for the existing operations at the Ekati mine (Map 2.3-1, Table 2.3-1). The area of the MUG Project is covered by existing surface leases, including 76D/9-3-2 for Misery open pit mining and 76D/9-4-2 for Misery area facilities. An amendment to surface lease 76D/9-3-2 to include the use of "underground mining" will be required for the Project.

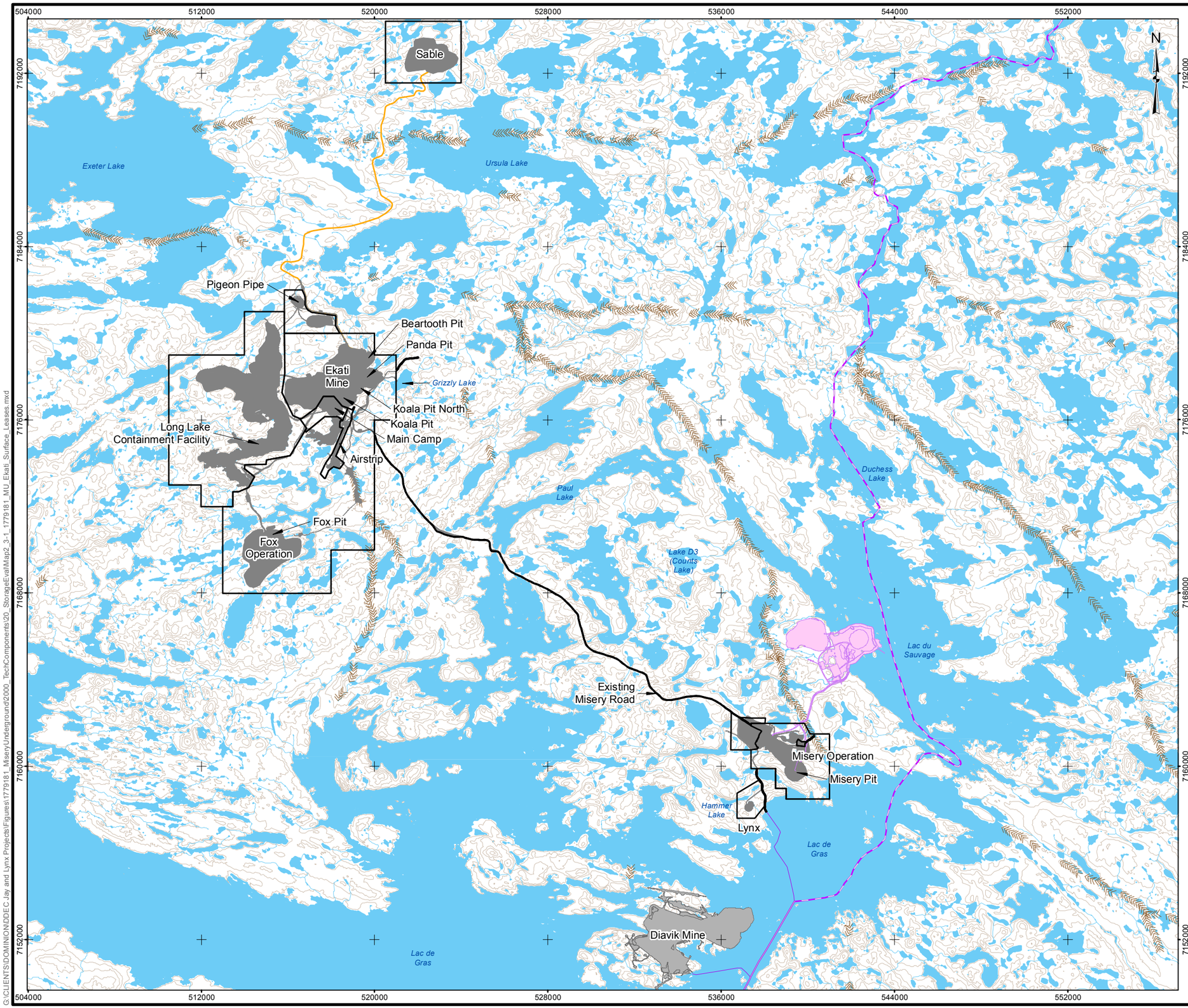
2.3.2 Type A Land Use Permits

The Ekati mine currently operates under ten Type A Land Use Permits (Table 2.3-1) issued by the WLWB. These LUPs cover mining and related activities associated with exploration and the Sable, Pigeon, Lynx, and Jay pits. A new Type A Land Use Permit will be required to cover the underground mining development activities associated with the Project.

2.3.3 Type A Water Licence

The Ekati mine operates under one Type A Water Licence W2012L2-0001 (WLWB 2017). This licence was issued to enable water use and deposition of waste, contingent on compliance with the environmental commitments set out in the WL. As part of the requirements of the WL and its relation to the proposed activities with the MUG Project, Discharge criteria for water to be released into the Receiving Environment must be met and rock seepage must be monitored.

This report is in support of DDEC's application for an amendment to the WL enabling the development, operation, and reclamation of the Project.



LEGEND

- EKATI MINE FOOTPRINT
- DIAVIK MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- SABLE ALL-SEASON ROAD
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ELEVATION CONTOUR (10 m INTERVAL)
- ESKER
- WATERCOURSE
- WATERBODY
- SURFACE LEASE BOUNDARY

REFERENCE

CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

4 0 4
SCALE 1:175,000 KILOMETRES

PROJECT
DOMINION DIAMOND™
MISERY UNDERGROUND PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE
EKATI PROPERTY MAP
SURFACE BOUNDARIES JULY 2017

Golder Associates

PROJECT		1773267	FILE No.	
DESIGN	MJ	03/08/17	SCALE AS SHOWN	REV 0
GIS	AK/MP	10/08/17	MAP 2.3-1	
CHECK	KM	10/08/17		
REVIEW	JCC	10/08/17		

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\1779181_MiseryUnderground\2000_TechComponents\20_StorageEvalMap\2_3-1_1779181_MU_Ekati_Surface_Leases.mxd

Table 2.3-1 Permits, Authorizations, Licences, or Leases Required for the Ekati Mine

Permit, Authorization, Licence, or Lease	Administration	Current Permit, Licence, or Lease	Project Components / Activities Included	Relevance to MUG Project
Surface Lease (Crown Land)	Government of the Northwest Territories	• 76D/10-2-2 (Koala, Panda, and Fox mining, and facilities) (6,023 ha) • 76D/10-3-2 (Long Lake Containment Facility) (3.701 ha) • 76D/10-4-2 (airstrip and facilities) (110 ha) • 76D/10-5-2 (Koala area facilities) (155 ha) • 76D/9-3-2 (Misery open pit mining, facilities, and road) (1,144.04 ha) • 76D/9-4-2 (Misery area facilities) (12 ha) • 76D/10-7-2 (Pigeon open pit mining, facilities, and road) (324.6 ha) • 76D/15-4-2 (Sable open pit mining and facilities) (998 ha) • 76D/9-11-1 (Lynx open pit mining) • 76D/9-10-1 (Lynx waste rock storage area) • Surface lease for Jay (in progress)	• Occupy and use lands required for open pits and underground mines, processing plant, camp, airstrip, and site roads	• No new surfaces leases are required for the Misery Underground Project; however, an amendment to surface lease 76D/9-3-2 to include the use of “underground mining” will be required.
Type A Land Use Permit	Wek'èezhìı Land and Water Board (WLWB)	• W2016F0006 (Pigeon and Sable Haul Road) • W2016D0003 (Mining and associated activities on Sable Lease) • W2016D0005 (Mining and associated activities on Pigeon Lease) • W2015D0005 (Lynx WRSA) • W2013D0006 (Mining and associated activities for Lynx) • W2013D0007 (Mining and associated activities for Jay Project) • W2014I0001 (Misery power line) • W2013C0005 (Exploration activities) • W2016F0007 (Jay Project Early Works) • W2017J0003 (Culture Camp)	• Mining development activities	• A new Type A Land Use permit is required for certain components of the Misery Underground Project

Table 2.3-1 Permits, Authorizations, Licences, or Leases Required for the Ekati Mine

Permit, Authorization, Licence, or Lease	Administration	Current Permit, Licence, or Lease	Project Components / Activities Included	Relevance to MUG Project
Type A Water Licence	Wek'èezhìı Land and Water Board (WLWB)	• N7L2-1616 – Ekati Mine – Issued: January 1, 1997 by the NWT Water Board – Renewed as MV2003L2-0013: October 4, 2005 by the MVLWB • MV2001L2-0008 - Sable, Pigeon and Beartooth Expansion Project – Issued: August 15, 2002 by the MVLWB – Renewed as W2009L2-0001: August 14, 2009 by the WLWB • MV2003L2-0013 – Ekati Mine (This licence is a renewal of N7L2-1616) – Issued: October 4, 2005 by the MVLWB – Re-issued as W2009L2-0001: August 14, 2009 by the WLWB • W2009L2-0001 – Ekati Mine (This licence is the amalgamation of the renewal of MV2001L2-0008 into MV2003L2-0013) – Issued: August 15, 2009 by the WLWB – Renewed as W2012L2-0001: August 18, 2013 • W2012L2-0001 – Ekati Mine (This licence is a renewal of W2009L2-0001) – Issued: Aug 18, 2013 by the WLWB – Assigned to DDEC: April 2013 – Amended to incorporate Lynx Project July 2013 – Amended to incorporate Jay Project July 2017 – Expiry: Aug 18, 2021	• Operation of the Ekati mine • Mining activities at all established areas • Various identified water diversions and water uses • Deposition of processed kimberlite into the Beartooth Pit • Disposal of waste from diamond mining and processing associated with development, operation, and reclamation activities within the Koala, Pigeon, Sable, and Lac du Sauvage watersheds.	• Amendment to existing Type A Water Licence to include water use and management activities and management/disposal of waste associated with the Misery Underground Project

Table 2.3-1 Permits, Authorizations, Licences, or Leases Required for the Ekati Mine

Permit, Authorization, Licence, or Lease	Administration	Current Permit, Licence, or Lease	Project Components / Activities Included	Relevance to MUG Project
Fisheries Act Authorization	Fisheries and Oceans Canada (DFO)	• Fisheries Authorization SCA96021 – Ekati • Fisheries Authorization SC00028 – King Pond – Cujo Stream • Fisheries Authorization SC01111 – Desperation Pond – Carrie Stream • Fisheries Authorization SC99037– Sable, Pigeon and Beartooth • Fisheries Authorization – Lynx Project – 15-HCAA-0026 • Fisheries Authorization for the Jay Project (in progress)	• Loss of lake and stream habitat caused by construction and operation of the Koala, Panda, Misery, Fox, and Leslie mine pits • Loss of fish habitat caused by the use of King Pond as a settling facility for the Misery Pit operations • Loss of fish habitat associated with the construction of a dike across Desperation-Carrier Stream and for the use of Desperation Pond for waste rock storage and water management • Loss of fish habitat caused by the development of the Beartooth, Sable, and Pigeon Pits • Serious harm to fish from the permanent alteration of habitat in Lynx Lake and fish-out	• A *Fisheries Act* Authorization will not be required for the Misery Underground Project, as all relevant facilities have been included in previous authorizations
Navigable Waters Protection Act authorization / *Navigation Protection Act* approvals	Transport Canada	• 8200-T-12313.1 Original Ekati water works • 8200-97-6112 Sable, Pigeon, Beartooth water works • Exemption under the *Navigation Protection Act* for dewatering Lynx Lake • Exemption under the *Navigation Protection Act* for dike construction and dewatering in Lac du Sauvage	• Construction of water intakes, water diversion, dewatering of lakes, processed kimberlite disposal, discharge/outfalls, dams/dikes, spillway discharge channel, water crossings and compensation structures associated with construction and operation of the mine and its infrastructure	• No permitting associated with the *Navigation Protection Act* is required for the Misery Underground Project (covered under existing Ekati works)

DFO = Fisheries and Oceans Canada; MVLWB = Mackenzie Valley Land and Water Board; NWT = Northwest Territories; WLWB = Wek'èezhìı Land and Water Board; WRSA = waste rock storage area.

2.3.4 *Fisheries Act* Authorizations

The Ekati mine currently operates under five *Fisheries Act* Authorizations issued by DFO. Four of the Authorizations for the Ekati mine were received under the previously in force *Fisheries Act* (pre-2012), which allowed, with a *Fisheries Act* Authorization, for the harmful alteration, disruption or destruction of fish habitat and required fish habitat compensation for any harmful alteration, disruption or destruction.

The *Fisheries Act* was revised in 2012, with the fisheries protection provisions of the *Fisheries Act* coming into force on November 25, 2013. Under Section 35 of the new Act, serious harm to fish is prohibited, unless authorized. As a condition of an Authorization, offsetting measures must be implemented to counterbalance losses. The *Fisheries Protection Policy* (DFO 2013a), and *Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting* (DFO 2013b), describe DFO's policy with respect to the new *Fisheries Act* and offsetting requirements. A *Fisheries Act* Authorization was subsequently received for the dewatering of Lynx Lake. DDEC is continuing to engage with DFO on the *Fisheries Act* Authorization for dewatering and fish-out within the diked area of Lac du Savage for the Jay Project.

The MUG Project will not result in serious harm to fish. The dewatering of Misery Lake was covered and occurred under the Fisheries Authorization SCA96021 for the Ekati mine and King Pond and Cujo Stream were covered under the Fisheries Authorization SC00028. As such, an Authorization under the *Fisheries Act* is not being sought for the Project.

2.3.5 *Navigation Protection Act* Approvals

The Ekati mine operates under two *Navigable Waters Protection Act* approvals: one for the original water works, and one for Sable, Pigeon, and Beartooth. The *Navigable Waters Protection Act* authorizations were granted to allow for the construction of the mine and its infrastructure (i.e., water intakes, water diversion, dewatering of lakes, processed kimberlite disposal, discharge/outfalls, dams/dikes, spillway discharge channel, water crossings and compensation structures) in the Lac de Gras area.

The *Navigable Waters Protection Act* was amended in 2012, with the *Navigation Protection Act* coming into force on April 1, 2014. An exemption under Section 24 of the *Navigable Waters Protection Act* was received to allow for the dewatering of Lynx Lake, and similarly for the dewatering within the isolated portion of Lac du Sauvage for the Jay Project.

No additional *Navigation Protection Act* permitting or approvals are required for the MUG Project.

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3.0 HUMAN AND BIOPHYSICAL ENVIRONMENT

3.1 Overview

The Ekati Diamond Mine (Ekati mine) area and its surrounding claim block are located approximately 200 km south of the Arctic Circle and 300 km northeast of Yellowknife in the Northwest Territories (NWT), Canada (Map 1.3-1). The mine is located within the headwaters of the Coppermine River drainage basin, which flows north to the Arctic Ocean. The Ekati mine is located in the Canadian sub-Arctic, and cold winter conditions predominate with approximately five months of spring/summer/fall weather each year when daytime temperatures are above freezing. Winters are long and extremely cold with daily temperatures that often fall below -30°C. Annual precipitation is low.

The Ekati mine and its surrounding claim block cover 2,607 km^2. Mine development only has occurred in 1.4% of the claim block (3,525 ha or 35.3 km^2). The topography is flat with local surface relief rising up to 20 m. The local terrain is characterized by boulder fields, tundra, and wetlands. There are more than 8,000 lakes with interconnecting streams in the area. It is an area of continuous permafrost overlain by an active layer (i.e., thawing during the summer and refreezing during the winter).

The lakes and streams of the area are characterized by clear, soft, low-nutrient waters typical of northern aquatic environments. Most nutrients in the soil in permafrost areas are not accessible to flowing water. Low temperatures in the active layer result in extremely low rates of organic matter decomposition and nutrient release. Hence, surface waters are very low in nutrients and in aquatic plant production. The biological productivity and biomass of plants and animals in the streams and lakes are low compared to streams and lakes in southern Canada; these waterbodies are cold, nutrient poor, and covered with up to 2 m of ice for nine months of the year (Pienitz et al. 1997).

The terrestrial vegetation is composed of species adapted to freezing temperatures, low nutrients, and localized areas of drought and standing water. The area is predominately wildlife habitat, with limited human use, mainly for hunting.

The Ekati claim block is within the Traditional lands of five groups of Aboriginal peoples: the Tłı̨chǫ, the Yellowknives, the Chipewyan, the Inuit, and the Métis (EAP 1996). Small family groups followed the caribou migration pattern throughout the winter, and fished in lakes during the summer. Archaeological studies have shown that human use of the Lac de Gras area dates back to 3,000 years before present time (BP).

3.2 Traditional Aboriginal Land Use

3.2.1 Traditional Land Use

People have lived and travelled across the North since the end of the last ice age, at least 10,000 years BP. The earliest inhabitants of the central District of the Mackenzie (Paleo-Indians or the Northern Plano tradition) are known to have lived in the region approximately 7,000 years BP. The tool assemblage associated with this population resembles that of early Aboriginal hunters of the northern plains, such as the Chipewyan (Wright 1981). Until about 3,500 years ago, the climate was warmer and animal populations were large and well established. Paleo-Indian hunters from the northern plains might have moved north following the caribou migration beyond the treeline and through the tundra of the barrenlands. Paleo-Indian sites in the NWT have been found in association with major caribou crossings

that also provide fishing (Wright 1981). These Paleo-Indian sites have been found mainly to the east of Great Slave and Great Bear Lakes (Noble 1981).The nearest known Paleo-Indian sites to the Ekati mine area are found more than 160 km northeast at Rawalpindi Lake (Rescan 2006).

The earliest cultural remains identified in the Ekati mine area are from the Paleo-Eskimo or Arctic Small Tool tradition (ASTt). The ASTt people likely migrated from Siberia at approximately 4,000 BP. Most ASTt people sites in the barrenlands date from between 3,500 to 2,600 BP (Gordon 1996). This coincides with a cooling trend noted by the retreat of the treeline and a southern shift in populations around 4,000 to 3,000 BP (Maxwell 1980). The ASTt is characterized by spears, harpoons, stone burins, and microblades, often inset into bone or antler. Arctic Small Tool tradition sites have been identified on the Lac du Sauvage esker, at the Lac du Sauvage–Lac de Gras Narrows (the Narrows), and at the outlet of Lac de Gras. The ASTt people probably fished and hunted caribou that were crossing the narrows and stayed close to sources of water (Rescan 2006).

The Taltheilei tool tradition is found throughout the Athabasca, Great Slave Lake, and north to the Lac de Gras regions. This assemblage is representative of early use and occupation of the land by the ancestral Athabaskan or Subarctic Dené (Noble 1981). It is less distinct than the ASTt and contains large shale and quartzite lanceolates, bifacial knives, sandstone whetstones, and circular scrapers. The continuity of this assemblage for over 2,000 years that, in some respects continues today supporting the Dené assertions that they have been living in the region “since time immemorial” (Rescan 2006). A small number of Taltheilei sites have been identified on inland eskers within the Ekati Mine area. It is highly probable that sites without diagnostic artifacts also can be attributed to the Taltheilei ancestors of the Chipewyan, Yellowknives, and Tłı̨chǫ (Rescan 2006).

Evidence of more recent, traditional use of the Lac de Gras region has been identified through physical remains, oral traditions, and the accounts of early European travellers. Prior to European contact, the Lac de Gras area was utilized by Dené groups such as the Tłı̨chǫ, Yellowknives, and Chipewyan. Their traditional land use patterns focused on the seasonal movements of harvestable wildlife (Helm 1981).

The Copper Inuit from the north also hunted, trapped, and travelled as far south as the Lac de Gras area. The big game animals harvested included barren ground (*Rangifer tarandus groenlandicus*) and woodland caribou (*Rangifer tarandus caribou*), moose (*Alces alces*), and, less commonly, musk ox (*Ovibos moschatus*) and wood bison (*Bison bison athabascae*). The Dené followed the migrating caribou into the tundra in the summer and fall, and then continued hunting and trapping in the barrens throughout the winter. Bow and arrow, spears, deadfall, snares, clubs, and, more recently, rifles, have been used to hunt big and small game (Smith and Rogers 1981). Small fur-bearing animals were taken regularly, with hare being an important winter food resource; grouse and ptarmigan were taken when big game was scarce. Dried meat and fish were the main sources of food in the winter.

Aboriginal people used nets, spears, or hook and line to harvest fish. Fish were an important food resource that was seasonally abundant during spawning runs. Waterfowl and their eggs provided a substantial component of the diet on a seasonal basis. Waterfowl were taken using bow and arrows tipped with blunt points or by being driven into nets (Smith and Rogers 1981). With the exception of the seasonal collection of berries, the diet of the Subarctic Dené did not include many vegetal foods. However, plants were used for medicine, dwellings, canoes, snowshoes, sleds, weaponry, and domestic items (Rescan 2006).

European iron has been available since 1750 and direct trading was occurring throughout most of the NWT by 1800. Changes in technology vary depending on location. Helm (1981) suggested that technology remained characteristically aboriginal until the twentieth century. However, Noble (1981) noted that early historical period (from 1770 to 1840) was marked by a reduction in aboriginal tools, at least from northern Great Slave Lake to the lower Coppermine River.

In 1890, Warburton Pike travelled with a Chipewyan Métis, King Beaulieu, to MacKay Lake and Lac de Gras to hunt musk ox. Pike's descriptions of traditional hunting methods mirror the accounts given by modern Dené through traditional knowledge (TK). At one time, Pike and Beaulieu were storm-bound on a promontory in Lac de Gras. This point has since been referred to as Pointe de Misère and it is the location and the source of the name of Ekati mine's Misery Pit (Rescan 2006). In his journal, Pike (1892) reports that Lac du Sauvage was named by Beauleau for the Inuit that he had met there in the past.

Dené groups shared a similar loose social organization and were highly mobile, reflecting the seasonal distribution of the region's resources. Shelters were easily transportable conical, skin-covered, tipi-like structures or temporary rectangular pole and brush-covered structures. The Dené travelled along rivers and lakes with canoes during the warmer months and used snowshoes, dogsleds, and toboggans during the winter months (Smith and Rogers 1981).

The western interior of the barrenlands was inhabited periodically by the Copper Inuit. The pre-contact origins of the Copper Inuit originate in the Thule Tradition, which spread across the central and eastern arctic approximately 750 BP (McGhee 2009). Traditionally the Thule are known for their bone, antler, and ground stone slate technologies; they are not known for chipped or flaked stone working, although the use of quartzite and chipping or flaking technology is more common on the barrenlands (Linnamae and Clark 1976). Cooler temperatures during the Little Ice Age (from around 1350 to 1850 Anno Domini) and the access to European trade could have motivated the Thule to move from the traditional costal hunting grounds to the barrenlands where they could fish and hunt caribou. Tent rings, caches, hunting blinds, and Inuksuk are common features that remain after their occupation. Inuit had a hunting technology that included kakavik (three-pronged fishing tool), kayak, bow and arrow, fishing weirs, spears, and harpoons (Maxwell 1985).

With the arrival of fur trade posts in the region in the late 1700s, conflict developed between the Tłı̨chǫ and the Yellowknives (who had better access to trade goods) (Gillespie 1981). Resolution of this conflict was achieved in the latter part of the nineteenth century. The establishment of the fur trade posts slowly changed the migratory patterns of the Dené so that they could provide caribou, and later furs, to the posts located around Great Slave Lake. Following the destruction of the plains buffalo and a decline in the number of caribou around the 1880s, the Inuit, Dené, and Métis shifted focus to the trade of musk ox, which were hunted to the northeast of Great Slave Lake. The trade of musk ox ended in the early 1900s and fur trapping became a main part of the economy for the Dené, Métis, and Inuit (Helm 1981). Until the 1950s, the Inuit at an outpost at Pellatt Lake fished and hunted caribou, providing food and clothing to coastal populations. Use of the area has declined since the closing of fur trade posts; however, such use continues near Lac de Gras and MacKay Lake (Rescan 2006).

In 1900, the Geological Survey of Canada began recording mineral observations in the NWT. Modern mining began to develop throughout the North beginning with the Eldorado Mine at Port Radium in the early 1930s. Commodities such as uranium, radium, silver, and copper were mined around Great Bear

Lake. Gold was discovered in the Yellowknife area around the same time and drill programs began in the 1940s. After the 1940s, mining operations expanded to include other mines such as Colomac, Pine Point, Tundra, Lupin, and Prairie Creek. Mining became a mainstay of the growing Northern population (GNWT Industry, Tourism and Investment 2008).

In the 1970s, diamond-bearing kimberlite was discovered in the high Arctic but was not considered economically viable. In 1991, diamonds were recovered from drill cores from the Point Lake kimberlite pipe near Lac de Gras resulting in the largest staking rush in Canadian history. Today, the Diavik Diamond Mines (2012) Inc. (DDMI) Diavik Diamond Mine and the DDEC Ekati mine operate in the Lac de Gras region. The exploration and development associated with these operations, including winter roads, are the main land use activities currently occurring in the area. The other operating diamond mine in the NWT is the De Beers Canada Inc. (De Beers) Gahcho Kué Mine, with the De Beers Snap Lake Mine in care and maintenance.

The Inuit, Dené, and Métis maintain connections with the region and continue to carry out traditional land use activities near Lac de Gras (Rescan 2006).

3.2.2 Archaeology

The main archaeological site types anticipated to be located in the general Ekati mine area are prehistoric camp/hunting sites (e.g., tent rings and hunting blinds), station and hunting sites (e.g., caches, hearths, and marker sites), lithic scatters, and isolated artifact find locations. Burials potentially are present in the mine area and some have been identified by the Tłı̨chǫ at Exeter Lake (Chocolate and Legat 2000).

Areas of moderate- to high-archaeological potential are well-drained, elevated landforms suitable for habitation. These include areas adjacent to important lakes, rivers, and drainages, and topographic features such as rock outcrops and eskers. In contrast, low, poorly drained areas are generally considered to have low archaeological potential. Low-lying areas were used as winter travel corridors in some regions, but little to no archaeological evidence is present to confirm this past use.

Topographic features, which may influence the location of campsites and hunting sites, include sources of fresh water, suitable ground surfaces campsites, and suitable building material. Most are close to food resources. Campsites and hunting sites often are found along the shorelines of lakes and creeks, which were important water sources, and modes of travel for the pre-contact and contemporary groups. Non-habitation sites associated with land use activities such as resource or subsistence activities, while less restricted tend to follow a pattern.

Landforms with the highest archaeological potential are:

- shore lines of culturally valuable fish-bearing lakes;
- river banks and lakeshores, river or lake confluences, or paleo terraces;
- hill crests;
- uplands hills and ridges, eskers, and moraines;
- nearby non-food resources such as lithic raw material sources;
- topographic features that channel animal migration, specifically caribou; and,

- seasonal travel routes (eskers or valleys).

The proposed Misery Underground (MUG) Project is located at the site of the existing Misery open pit. Previous archaeological work in the Ekati claim block has been conducted over several years by Bussey (1994, 1995, 1997, 2007, 2008) and Golder (Ross 2014; Murphy and Ross 2014; Hill 2016). Fedirchuk (1996, 2000) and Unfreed (1997) have carried out related work for the development of the neighboring Diavik Mine. Investigations at the Narrows have confirmed the importance of the area for fishing and hunting caribou. Many large archaeological sites have been recorded on both sides of the Narrows (Bussey (2000, 2001, 2002, 2003, 2004, 2005, 2007, 2008). The results of the investigations in the vicinity of the Ekati and Diavik mines are presented in several archaeological reports and summaries on file with the Prince of Wales Northern Heritage Centre. In total, there are 190 archaeological sites recorded within the Ekati mine claim block (DDEC 2014a). However, there are no recorded archaeological sites within 1 km of the Misery Pit (GNWT no date).

No further archaeological surveys are necessary for the Project and no recovery, preservation or protection of known artifacts or heritage resources is required. The *Archaeological Sites Regulations* outlines the importance for the identification, protection, and conservation of archaeology sites. The Ekati mine implements a standard for the protection of archaeological and heritage resources that may be identified during field operations and this standard will apply to the Project.

3.2.3 Traditional Knowledge

Major wildlife trails are located around and through Lac de Gras and Lac du Sauvage. People camped in areas where caribou, fish, and water were available such as at the Narrows, on small bays along the shore, and on islands with channels where swift currents kept the water open in winter. Travellers would walk along eskers, which were often used for gravesites. Elders discouraged the use of eskers for camping and recommended places behind high points that provided protection from the wind. The type of shelters used at campsites depended on the purpose and duration of the stay. Because the Dené took their supplies with them, rings of tipi stones often are the only remaining evidence of the campsite (Weledeh Yellowknives Dené 1997). Yellowknives Dené Elders have observed a historic lowering of the water levels in the Ekati mine area and have demonstrated how this changes the location of the campsites in relation to the existing shorelines. A recommendation from the 1997 Ekati Traditional Knowledge study (Weledeh Yellowknives Dené 1997) was that archaeologists check for ancestral evidence of former campsites inland from existing shorelines.

Traditional Tłı̨chǫ trails to the Ekati mine from Tłı̨chǫ territory have been mapped. The traditional names provide important information about the environment and resources along traditional routes. The Tłı̨chǫ identify open, sparse areas with a variety of vegetation as the preferred habitat for campsites. Different forms of vegetation could be used for different purposes such as starting fires and protecting meat. The Tłı̨chǫ identify the preferred habitat for hunting caribou and obtaining other resources such as berries, medicine, and mending fibres. Some traditional use sites have been destroyed by mining activities and the Tłı̨chǫ worry that changes because of development will continue to affect the value of their resources and their cultural connection with the region (Chocolate and Legat 2000).

Copper Inuit, who lived near Lac de Gras, harvested caribou, seal, grizzly bear (*Ursus arctos* ssp.), fish, waterfowl, wolves (*Canis lupus*), wolverine (*Gulo gulo*), musk ox, and moose from around the

Coppermine River and Contwoyto Lake in the spring and summer (Sadownik and Harris 1995). There were many Inuit campsites at Lac de Gras. The Dené and Inuit camped at the narrows of large lakes where the Inuit would capture and spear fish. Inuit elders recall men carving in higher areas, away from where they camped around the Ekati mine area. They suggest that the remains from those activities in the area are similar to those found within the Ekati mine area. The Inuit have helped to distinguish between the remains of Dené and Inuit campsites by describing the Dené camps as circular and Inuit camps as rectangular. As children, inland Inuit remember meeting Dené while hunting and trapping at large winter camps, such as at Tahikyoak (Contwoyto Lake), Kaomaogaktok (Rockinghorse Lake), and Lac de Gras. The Inuit and Dené crossed trails, especially in the winter, when the Dené were traveling to the north and Inuit were trapping to the south. These visits were occasions for celebrations and for trading. Major items exchanged were dogs, harnesses, food, furs, and tools such as snow knives (Banci and Hanks 2006). During a TK study of the area, Inuit participants expressed concern about the effect of mine development on the changing migration path, the health of the caribou, and on the quality of water in the Coppermine River. They also expressed their opinions that archaeological sites should be left undisturbed if possible (EAP 1996).

Métis voyageurs arrived in the Mackenzie Valley with the first wave of European fur traders in the late eighteenth century. The Métis often set up trading posts and accompanied explorers and scientists into the barrenlands. The Métis became important participants in the geologic exploration of the North while living and teaching a traditional lifestyle (Bohnet 1995). Metis involved in TK studies for the Ekati mine area have indicated that all archaeological sites and traditional use values should be protected even though the area has not been used regularly for quite some time (EAP 1996).

DDEC respects the importance of TK to Aboriginal people, and actively seeks out ways to incorporate TK at the Ekati mine. For example, TK is used to inform existing mitigation and monitoring at the Ekati mine. The Ekati mine has a strong history of supporting community-based TK projects that extends back the mid-1990s. Since taking ownership in 2013, DDEC has continued the Ekati mine's strong record of supporting TK projects and collecting TK though its engagement programs. The importance of TK is recognized and preserved in the Ekati mine's Engagement Plan, Environmental Agreement, four Impact Benefit Agreements (IBAs), and in the regulatory approvals.

Examples of Ekati based TK and community engagement programs for the Ekati mine include:

- archaeological inspections of the Jay Project area by Yellowknives Dene First Nation (YKDFN);
- inspection of the proposed Jay Road route through the esker by IBA and potentially affected communities, including Elders;
- support for the Tłı̨chǫ Government's "What'aa-Esker Research Project" that identified community-based concepts that may be useful for the planning, construction, and reclamation of mine waste rock piles;
- support for the YKDFN "Lands that are Wide Open" TK Report that provided recommendations for the Jay Project and to assist the YKDFN to share their oral and recorded TK with their members;
- support to the Kitikmeot Inuit Association (KIA) to create a web-based, user-friendly interface that will provide public access to a selection of TK from the Naonaiyaotit Traditional Knowledge Project;

- support to the Łutsel K'e Dene First Nation (LKDFN) to create a web-based, user-friendly TK archiving system that will organize TK, include detailed maps, and be publicly accessible to Project Beneficiaries;
- support for preservation and digitization of older, analogue TK records, and for development of a community-based database interface (Goyatiko Language Society -YKDFN and Tłı̨chǫ Government);
- support of the North Slave Métis Alliance for heritage research and database compilation;
- youth and Elder participation in fish sampling and assessment programs for the Aquatic Effects Monitoring Program (AEMP);
- youth, Elder, and community participation for caribou monitoring, wolverine and grizzly bear DNA field programs as part of the Wildlife Effects Monitoring Program;
- participation of members of all IBA groups in the design and carrying out of the Lynx and Sable fish-outs;
- group workshops to demonstrate and discuss air quality, dust monitoring, vegetation for closure planning, or other specific topics of interest;
- support of the West Kitikmeot Slave Study; and,
- TK studies in support of the 1995 EIS for the Ekati mine.

Since the Jay Project Report of Environmental Assessment (REA) was released in February 2016 (MVEIRB 2016), DDEC has been working to fulfill all commitments made during the EA process, many of which require TK integration and support throughout the life of the Jay Project.

3.3 Local Communities

The Ekati mine operates under four IBAs:

- Akaitcho Treaty 8 (LKDFN and YKDFN);
- Tłı̨chǫ Government;
- North Slave Métis Alliance; and,
- Hamlet of Kugluktuk and KIA.

While not holding an IBA with DDEC, Fort Resolution has been identified as a community potentially impacted by the Ekati mine and the Jay Project. As such, DDEC works to find areas where benefits to the community can be maximized.

The Tłı̨chǫ reside primarily in the communities of Behchokǫ̀ (formerly Rae-Edzo), Gamètì (formerly Rae Lakes), Whatì (formerly Lac La Martre), and Wekweètì (formerly Snare Lake), while many Yellowknives and Chipewyan Dené reside in the communities of Detah, N'Dilo, and Łutsel K'e. Copper Inuit reside primarily in the Hamlet of Kugluktuk. Wekweètì, with a population of 148 (GNWTBS 2016), is the closest community to the Ekati mine at approximately 150 km west of the mine site (Map 1.3-1).

The contemporary economies of northern communities are characterized by both traditional (e.g., hunting, trapping, and fishing) and wage-based components (e.g., employment in resource extraction, government services, and other service industries). The land, water, and the resources therein, are of spiritual and cultural importance to Aboriginal peoples in the region.

The Ekati mine also operates under a Socio-Economic Agreement (SEA) with the GNWT. In addition to Yellowknife, the Agreement identifies "fly-point" communities for employment opportunities: Cambridge Bay, Inuvik, Fort Resolution, Fort Smith, Deline, Norman Wells, Fort Simpson, and Hay River.

3.4 Socio-Economic Setting

3.4.1 Population, Labour Force and Economy

The population of the NWT is over 44,000, and is split nearly evenly between Indigenous (49.5%) and non-Indigenous (50.5%). Much of this population is concentrated in the City of Yellowknife (over 20,000). The remaining population is spread over the vast geographic area of the NWT in smaller communities with populations ranging from under a hundred to over 3,700. Most of the NWT's communities are on the lower end of this scale, with populations of several hundred. The combined population of the communities[1] near the Ekati mine is 24,636. Twenty-four percent (5,017) of the Yellowknife population is Indigenous, while in the smaller communities near the Ekati mine, the Aboriginal population represents the majority (82% to 97%, depending on community). There is some in-migration to NWT but the territory also experiences out-migration, primarily due to the high cost of living. Detailed demographic information by community is presented in Table 3.4-1.

The employment and participation rates for the NWT's labour force (i.e., 66% and 73%, respectively) have been high in recent years relative to the rest of Canada (61% and 66%, respectively [Statistics Canada 2016]). This is in part due to the labour demand created by the mining industry, and the requirement of the territory's mines to prioritize and set employment targets for Northern and Aboriginal labour as outlined in their SEAs with the GNWT. Of the NWT population aged 15 and over (34,087), 73.4% participated in the labour force in 2014 (Table 3.4-1), and the territorial unemployment rate was 10.6%. The participation rate in Yellowknife was higher than the territory at 79.4%, while the unemployment rate was lower (4.7%). Generally, in the smaller communities near the Ekati mine, two-thirds of the population aged 15 years and over participated in the labour force. Roughly one-quarter to one-third of those who were in the labour force were unemployed. Labour force participation in these communities was lowest in Gamètì (56.6%) and highest in Dettah (69.6%). Unemployment was highest in Dettah and Whatì, where over a third of the working age population (36.3% and 35.2%, respectively) were unemployed (Table 3.4-1).

In the NWT, many residents (31%) over the age of 15 have no certificate, diploma, or degree. Those with a high school diploma represent a smaller portion of the population over 15 (21%). Those possessing post-secondary education represent nearly half of the population over the age of 15 (48%). Educational attainment is stronger in the urban centre of Yellowknife, where the portion of the population aged 15 and over without a high school diploma (18%) is lower, relative to the portion with a high school diploma (24%) or some form of post-secondary education (58%). The same trend does not hold true in the smaller communities near Ekati, where the portion of the population aged 15 and over without a high school diploma

[1] Yellowknife, Behchokǫ̀, Detah, Gamètì, Łutsel K'e, N'Dilo, Wekweètì, and Whatì.

is high (57% to 68%), relative to the portion with a high school diploma (8% to 14%) or some level of post-secondary education (19% to 28%), depending on the community (Table 3.4-1).

The mining and oil and gas extractive sectors are the largest economic drivers in the NWT, accounting for approximately one third of the total territorial Gross Domestic Product in recent years. Government services (e.g., health care, education, administration, and policing and emergency response) also play a large role in the territorial economy.

Table 3.4-1 Select Demographic Characteristics of Communities near the Ekati Mine

Socio-Economic Parameter		NWT	Yellowknife	Behchokǫ̀	Detah	Gamètì	Łutsel K'e	Wekweètì	Whatì
Population (2016)	Total	44,469	20,960	2,154	248	271	306	148	549
	Indigenous (%)	*22,013 (50)*	*5,017 (24)*	*1,969 (91)*	*239 (96)*	*263 (97)*	*269 (82)*	*139 (94)*	*500 (91)*
	Average Annual Growth (% 2001-2016)	0.6	1.2	1.4	1.1	-0.5	-0.6	0.5	0.8
Labour Force (2014)	Population 15 and Over	34,087	15,921	1,427	194	228	242	97	376
	Labour Force	25,014	12,635	813	135	129	168	67	230
	Employed	22,353	12,045	541	87	95	128	54	149
	Unemployed	2,661	590	272	49	34	40	13	81
	Participation Rate (%)	73.4	79.4	57	69.6	56.6	69.4	69.1	61.2
	Unemployment Rate (%)	10.6	4.7	33.5	36.3	26.4	23.8	19.4	35.2
	Employment Rate (%)	65.6	75.7	37.9	44.8	41.7	52.9	55.7	39.6
Education (2011)	Less Than High School (%)	31.1	18.0	57.3	54.8	67.6	58.1	57.9	62.3
	High School (%)	20.6	23.9	13.7	12.9	8.1	9.3	10.5	11.6
	Post-Secondary Education (%)	48.4	58.2	21.2	22.6	18.9	28	26.3	24.6

Source: Statistics Canada 2013; GNWTBS 2015; GNWTBS 2016

Note: The sum of percentages in columns may not total 100% due to Statistics Canada rounding conventions. This is particularly true in reference to smaller communities where cumulative rounding to the nearest 5 or 10 in a number of categories can result in a percentage total lower than 100%.

% = percent.

3.4.2 Infrastructure, Services, and Tourism

Transportation in the NWT consists of a network of regional and local airports, all-weather roads, winter roads, and ferry crossings. The Deh Cho Bridge connects Yellowknife and the North Slave Region with the rest of the country by road, while the Yellowknife airport acts as a major hub for air transportation in the region. Five all-weather access roads service the North and South Slave region. A proposed all-weather road between Highway 3 and Whatì is currently undergoing a regulatory review process. Some of the smaller communities are only accessible by winter road, or by air.

NorthwesTel provides telephone and television services to the NWT, and Bell Mobility and Ice Wireless provide cellular services. The Northwest Territories Power Corporation provides electricity in the NWT, while the individual communities provide water, sewage and waste services. Diesel generators are also used as a source of electricity in small communities.

Medical services are available in all communities to varying degrees. Stanton Territorial Hospital in Yellowknife provides most medical services in the region. Behchokǫ̀ and Yellowknife have ambulance services, while other communities are serviced by air ambulance or Medevac. The RCMP provides protective services in the region, and the Yellowknife Fire Department provides emergency response services (e.g., fire control, rescue, hazardous material response).

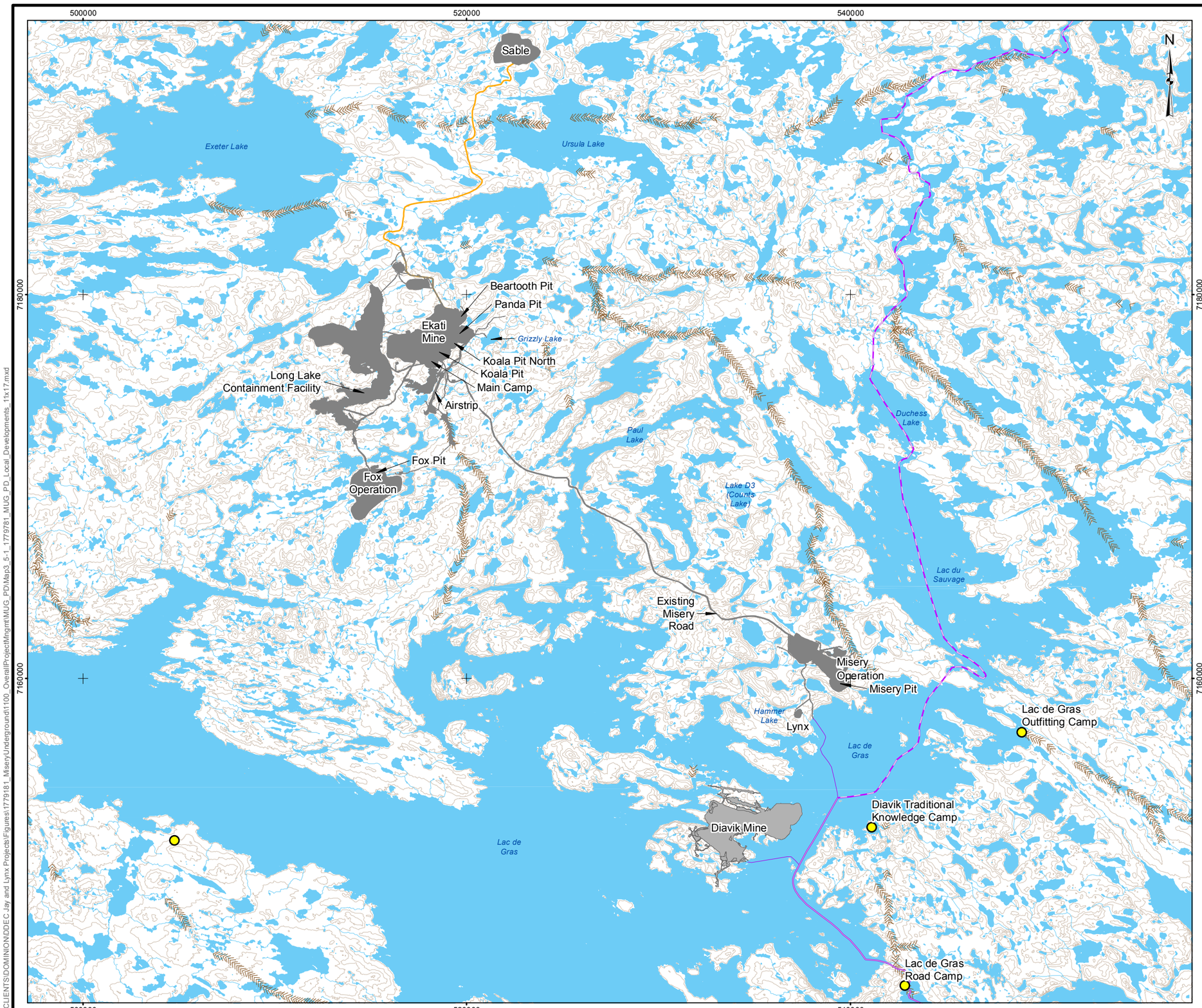
There are a variety of recreation opportunities in the NWT, including fishing, camping, canoeing, and hiking. Most communities also have an arena, community hall, and playground. Tourism in the territory is largely based on the wilderness experience, with tourists visiting for canoeing, guided sightseeing, outfitting and other outdoor recreational activities. Aurora viewing is a particularly important source of tourism visits and revenue in the territory.

3.5 Local Industrial Developments

3.5.1 Diavik Mine

The DDMI Diavik Mine (in operation since 2002) is built on East Island, a small island near the east end of Lac de Gras (Map 3.5-1). At the end of 2016, the total physical development at Diavik encompassed 1,160 ha (11.6 km^2). There are three diamond-bearing kimberlite pipes currently being mined: A154 South, A154 North, and A418. Open pit mining of these pipes has concluded and they are currently mined from underground. In November 2014, development of a fourth pipe, A21, was approved, with construction beginning in 2015. Open-pit mining of A21 will require a rockfill dike. A21 dike construction will take approximately four years with A21 production expected to commence in late 2018. The current mine plan is expected to take the mine's production to 2025.

The main camp at the Diavik Mine contains accommodations, dining rooms, offices, water and sewage treatment plants, a waste facility, maintenance shops, a power plant, boiler plant, Arctic corridors, communications system, and an airstrip. The mine infrastructure includes a processing plant.



LEGEND

- CAMP
- EKATI MINE FOOTPRINT
- DIAVIK MINE FOOTPRINT
- SABLE ALL-SEASON ROAD
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ELEVATION CONTOUR (10 m INTERVAL)
- ESKER
- WATERCOURSE
- WATERBODY

REFERENCE

CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

5 0 5
SCALE 1:200,000 KILOMETRES

PROJECT
DOMINION DIAMOND
MISERY UNDERGROUND PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

LOCAL DEVELOPMENTS

Golder Associates

PROJECT		1779781	FILE No.	
DESIGN	KM	05/07/17	SCALE AS SHOWN	REV 0
GIS	ANK	10/08/17		
CHECK	KM	10/08/17	MAP 3.5-1	
REVIEW	JCC	10/08/17		

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\1779181_Misery\Underground\1100_OverallProjectMngmt\MUG_PD\Map3_5-1_1779781_MUG_PD_Local_Developments_11x17.mxd

3.5.2 Existing Ekati Mine

The physical development at the Ekati mine encompasses 3,525 ha (35.3 km^2) (Maps 1.3-2 and 3.5-1). Construction at the Ekati mine began in 1997 with the erection of an accommodation complex and associated infrastructure (e.g., power, heat, water, sewage treatment, and communication systems) north of Kodiak Lake. This infrastructure was complete and operational by April 1997, at which time the old camp was retained as overflow housing until its closure in 1999. Construction of the truck shop, power generation facility, coarse kimberlite storage building, processing plant, and main fuel storage area continued through late 1997 to early 1998. The mine was officially opened on October 14, 1998.

The Panda Pit was the first pit to be developed at the Ekati mine. Waste rock removal began in 1997 and mining of kimberlite began in 1998. In 1997 and 1998, waste rock (granite) from Panda Pit was used to construct roads, dikes, dams, building foundation pads, and miscellaneous projects around the site. In 1997, the Panda Diversion Channel was completed. In 1999, a 29 km road was built to link Misery Road to the Tibbitt to Contwoyto Winter Road (TCWR) that extends from Yellowknife.

Open pit mining at the Panda Pit ceased in 2003. Underground mining began in 2005 and ended in 2010. Waste rock and coarse kimberlite reject from the underground mine were transported to the Panda/Koala WRSA. Decommissioning of the Panda underground workings for closure is complete.

Waste rock removal for the Koala Pit and Koala North Pit began in 2000 and 2001, respectively. The underground test mine at Koala North began in 2001 and ended in 2002. Kimberlite production from the Koala Pit began in 2003 and ended in 2007. The Koala Underground operation began in 2004, with kimberlite production beginning in 2007. Koala North underground was operated between 2009 and 2011 and the waste rock and processed coarse kimberlite rejects were transported to the Panda/Koala WRSA. Underground mining in the Koala kimberlite pipe is ongoing and commercial underground mining at Koala North was completed in 2015.

Excavation of the Fox Pit began in 2001 and kimberlite production began in 2005. Waste rock was transported to the Fox WRSA. The Nero-Nema Bridge was built in the winter of 2001/2002, extending the Fox Road from the main camp to the Fox Pit.

Waste rock removal from the Misery Pit and the construction of the road and camp for the Misery site began in 1999. Kimberlite production in the Misery Pit began in 2001. Kimberlite production was suspended in April 2005 and stockpiled kimberlite was trucked to the processing plant until 2007. Construction activities at Misery camp were initiated in 2011 and the camp re-opened in early 2012 to mine the deeper portions of the Misery pipe with a pushback of the original open pit. Construction of the Misery WRSA was recommenced in 2012. The Misery operation is active and has included production from the Misery Main Pipe and from the Misery Southwest Extension, Misery South, and Misery Northeast satellite pipes.

Beartooth Pit construction started in 2003 and kimberlite production began in 2005. Open pit mining of the Beartooth kimberlite pipe was completed in April 2009, after which time the pit was integrated into the minewater management system as a minewater retention pond and, in 2012, as a fine processed kimberlite deposition location.

Pre-stripping operations commenced in late 2015 at the Lynx kimberlite pipe located 3 km southwest of Misery. The Pigeon open pit operation commenced in November 2015 and the operation is currently active. A haul road was completed to the Sable open pit project area and a frozen core dam has been constructed. Construction on the Jay Road began in mid-2017.

3.5.3 Tibbitt to Contwoyto Winter Road

The TCWR provides seasonal road access to the Ekati mine. The Ekati mine is located at approximately kilometre 405 of the road. Approximately 85% of the road consists of frozen lakes and ponds, which are connected by short overland portages.

Fuel, large equipment, and heavy consumables are trucked to the site on the TCWR. Ekati mine freight typically varies with up to 4,000 trucks per year. The logistics of planning and expediting the delivery of freight required for a full year of operation by the winter road over an approximately two-month period is critical to successful mining operations.

The TCWR is built, permitted, and operated by a joint venture of mining companies (DDEC, DDMI, and De Beers) operating in the area, and is shared by other industrial users (i.e., exploration companies). The road is open to the public and provides access for hunters and tourists. This seasonal winter road is open for eight to ten weeks each year (i.e., from late January to the beginning of April, depending on weather and the season's load requirements), and must be re-flooded each year to service mines in the area. Occasionally, the winter road is extended by others north from Lac de Gras to Contwoyto Lake.

The road is capable of accommodating high levels of traffic. During peak usage years, over 10,000 truckloads per year were safely transported to the mine sites (Joint Venture 2017). Three seasonal maintenance / staging camps are located along the road. The most northerly is the Lac de Gras camp, which is located on the southeastern shore of Lac de Gras.

3.5.4 Outfitter Camps

There are currently seven fishing and/or hunting operators licensed within the vicinity of the Ekati mine site (Spectacular NWT 2016). These operators (Arctic Safaris, Aylmer Lake Lodge, Bathurst Arctic Services, Mackay Lake Lodge, True North Safaris, Warburton Bay Lodge, and Peterson’s Point Lake Lodge) are located between 50 and 150 km of the Ekati claim block. No outfitting or guiding activities are taking place within the surface lease areas or mineral claim block area held by the Ekati mine.

In the recent past, a single camp was operated on Lac de Gras in the vicinity of the Diavik Traditional Knowledge Camp. The Lac de Gras camp is located on the southern shore of Lac de Gras approximately 3 km southeast of the Lac du Sauvage outflow. It was purchased by John Andre of Shoshone Wilderness Adventures in 1999. Shoshone provided fall barren-ground caribou hunts and fishing from 1999 until 2010. The same company owns an outfitting camp at Courageous Lake and as a result, there are no clear numbers on total number of hunters using each site annually. Hunting activity at the Lac de Gras camp was first limited in 2007, when the GNWT reduced the number of sport hunting tags following concerns about declining numbers of the Bathurst caribou herd (The Hunting Report 2007). The camp was finally closed in 2010 following emergency management measures implemented by the GNWT (The Hunting Report 2010; ENR 2013). The hunting ban for barren-ground caribou has been in effect for a large area of the NWT since 2010, which has affected outfitting services in the region, in addition to subsistence harvesting in communities.

3.6 Ekati Mine Environmental Monitoring Programs

The Ekati mine has existing monitoring programs that provide for the ongoing collection of information related to environmental conditions at the Ekati mine.

Air Quality and Emissions Monitoring and Management Program

The Ekati mine air quality monitoring program (ERM 2015a) provides for the ongoing collection and annual reporting of information about the effects of mine activities on air quality. The air auality Monitoring program provides for annual monitoring and reporting of road dust and air quality at the Ekati mine site, and for a three-year program for regional monitoring and reporting on air quality, snow quality, and lichen. DDEC has also developed the Air Quality Emissions Monitoring and Management Plan (AQEMMP) for the Jay Project (DDEC 2017a). The Jay AQEMMP and the existing Ekati mine air quality monitoring program are being consolidated into one document which will undergo a review and comment process. Results from the air quality monitoring program are provided to, and reviewed by, Aboriginal communities, government agencies and the Independent Environmental Monitoring Agency (IEMA) through report submissions, group workshops, and individual meetings. As the existing air quality monitoring program already encompasses the Misery site and will include the Jay Project once it is developed, DDEC does not anticipate that any revisions to the AQEMMP will be required to incorporate the MUG Project.

Wildlife Effects Monitoring Program

The Ekati mine Wildlife Effects Monitoring Program (WEMP; DDEC 2017b) provides for the ongoing annual collection and reporting of information about the effects of mine activities on wildlife. The WEMP is provided to and reviewed by Aboriginal communities, government agencies and the IEMA through report submissions, group workshops, and individual meetings. Program modifications are proposed by the Ekati mine on an annual basis. The latest version of the WEMP was approved by the GNWT on June 1, 2017, as per Measure 6-1 of the Jay Project REA. Revisions to the WEMP will not be required, as the ongoing mining at the Misery open pit and the associated use of the Misery Road and Misery camp have been considered in the latest version of the WEMP.

Surveillance Network Program

The Ekati mine Surveillance Network Program (SNP) is established at the mine site to ensure compliance with the Water Licence (WLWB 2017), and includes collection and reporting (monthly) of information about flows (rates and quantity) at the Ekati mine and at Discharge locations; as well as information about water quality in minewater management facilities and at Discharge locations. The SNP data are provided to and reviewed by the WLWB, Aboriginal communities, government agencies, and the IEMA through report submissions, group workshops, and individual meetings. If necessary, the existing SNP could be readily expanded to incorporate the Project.

Aquatic Effects Monitoring Program

The AEMP is a requirement of the Water Licence, and involves programs focused on the aquatic Receiving Environment, including hydrology; physical limnology; lake and stream water quality; phytoplankton, zooplankton, sediment quality; lake and stream benthos; and fish. The AEMP provides for hydrometric, water and sediment quality, and aquatic life monitoring in the Receiving Environment, including in the King-Cujo watershed and Lac du Sauvage. No revisions to the AEMP are anticipated to incorporate the MUG Project.

3.7 Meteorology and Climate

The Project is located in a region of the NWT that experiences a sub-Arctic climate characterized by long, dark, very cold winters, and short, cool to mild summers accompanied by long daylight hours. During the approximately seven months when temperatures are below freezing, moisture in the soil and subsoil is frozen. Summer warmth is insufficient to thaw more than the active layer that varies from approximately 1.0 to 2.7 m in thickness, so permafrost prevails under most land areas. In general, permafrost does not exist under large permanent waterbodies such as Lac du Sauvage.

Annual total precipitation averages 345 mm and is composed of almost equal amounts of rainfall and snowfall. Precipitation occurs mainly as rainfall from June through September, with rainfall accounting for 42% of total precipitation in these four months. Precipitation occurs mainly as snowfall in the remaining eight months of the year (October to May), when snowfall represents approximately 50% of total precipitation. The wettest month of the year is August, when 58 mm or 16% of mean annual total precipitation occurs, and the driest month is February, when only 12 mm or 3.3% of mean annual total precipitation occurs.

Mean annual air temperature at the site ranges from -12.1°C to -6.0°C, with a mean value of 9.6°C. Seasonal air temperatures remain below zero for three of the four seasons, from fall through spring. Seasonal air temperatures are lowest in the winter, when the mean air temperature is 27.8°C, and are highest in the summer, when the mean air temperature is 10.0°C. Monthly air temperatures are consistently below 0°C for seven months of the year, from October to April, and are consistently above 0°C for only three months, from June to August. Monthly air temperatures in May and September may be above or below 0°C. February is the coldest month, with a mean air temperature of -27.9°C, and July is the warmest month, with a mean air temperature of 12.5°C. Monthly air temperatures range from 38.0°C in February to 16.2°C in July.

3.8 Geology

The Ekati claim block is located in the Slave Structural Province. The regional geology is based largely on work by Hoffman (1989) and Helmstaedt (2009). The Slave Structural Province represents the exposed part of the Slave Craton, one of the Archean granite-greenstone building blocks of the Precambrian core of North America. Rock types within the Slave Province and defining the bedrock units at the Ekati claim block can be assigned to three broad lithostratigraphic groups: metasedimentary schists, migmatites, and various syn- and post-tectonic intrusive inclusions, made up predominantly of granite, granodiorite, and tonalite. In addition, five mafic Proterozoic dyke swarms, ranging in age from circa 2.23 to 1.27 billion years ago, intrude the area (LeCheminant and van Breemen 1994; Kjarsgaard 2001; Nowicki et al. 2003; Nowicki et al. 2004; Helmstaedt 2009; DDEC 2016a). A regional geology map is provided as Map 3.8-1.

Bedrock is overlain by Quaternary glacial deposits, which range in thickness from veneers (less than 2 m), to blankets (2 to 5 m), to hummocky deposits (more than 5 m up to 15 m). Glaciofluvial deposits are also present, the most prominent being an extensive network of sinuous eskers that transect the Ekati claim block and form part of a large southeast–northwest trending trunk esker. Lacustrine deposits occur in association with the numerous lakes on the claim block. Thin alluvial deposits have formed along streams, and pond deposits have accumulated in shallow depressions (Dredge et al. 1994; Nowicki et al. 2004; DDEC 2016a).

The kimberlite pipes at the Ekati mine are part of the Lac de Gras kimberlite field, which is located in the central Slave Craton. The kimberlites intrude both granitoids and metasediments (Nowicki et al. 2004; DDEC 2016a) (Geology Baseline Report, Annex III of the DAR; DDEC 2014a).

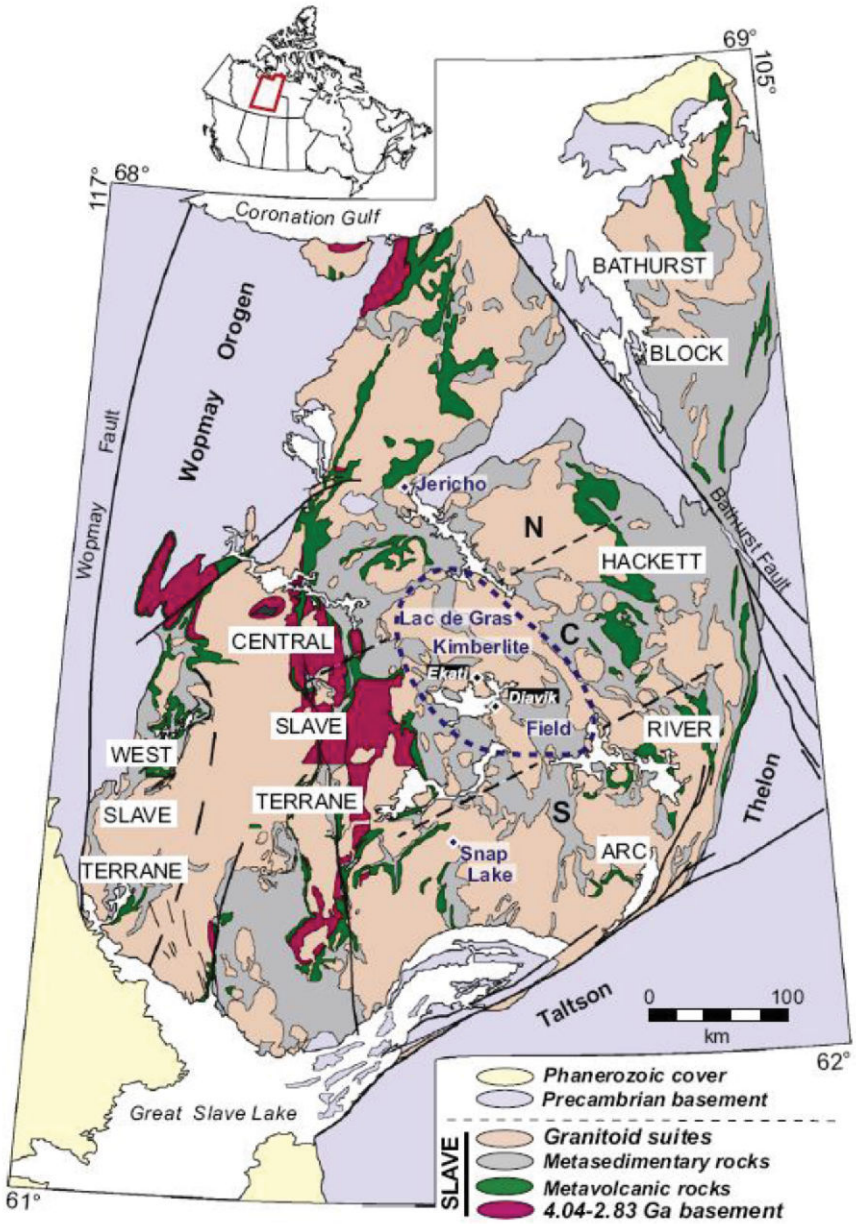
Mudstone xenoliths and disaggregated sediment within the Ekati mine kimberlites and other bodies of the Lac de Gras field indicate the presence of young (late-Cretaceous to early-Tertiary), partially consolidated cover sediments at the time of emplacement (Mineral Services Canada Inc. 2002; Nowicki et al. 2004). The Ekati mine kimberlites range in age from 45 to 75 million years; they are mostly small pipe-like bodies (surface areas are for the most part less than 3 ha, but they can extend to as much as 20 ha) that typically extend to projected depths of 400 to 600 m below the current surface. Kimberlite morphologies are strongly controlled by near-surface structures such as joints and faults (Nowicki et al. 2004). The infill of the kimberlites on the Ekati claim block can be broadly classified into the following six rock types (DDEC 2016a):

- magmatic kimberlite (MK) – hypabyssal;
- tuffisitic kimberlite (TK);
- primary volcaniclastic kimberlite (PVK);
- olivine-rich, volcanoclastic kimberlite (VK);
- mud-rich, resedimented volcaniclastic kimberlite (RVK); and,
- kimberlitic sediments.

The Lac de Gras pipes are typically dominated by olivine-rich and xenolith-poor volcaniclastic kimberlite in which grading and sorting may be recognized to great depth (Mineral Services Canada Inc. 2002; DDEC 2016a). The resedimented volcaniclastic kimberlite represents pyroclastic material that has been transported (e.g., by gravitational slumping and flow process) from its original depositional environment (likely along the crater rim) into the open pipe, and has undergone varying degrees of reworking with the incorporation of surficial material (mudstone and plant material) (Mineral Services Canada Inc. 2002). While occasional peripheral kimberlite dykes are present, geological investigations undertaken to date do not provide any evidence for the presence of complex root zones or markedly flared crater zones (Nowicki et al. 2004).

Economic mineralization is mostly limited to olivine-rich RVK and PVK types. Approximately 10% of the 150 known kimberlite pipes in the Ekati claim block are of economic interest or have exploration potential (DDEC 2016a).

The Misery Kimberlite Complex intrudes along a regional contact between Archean metasediments and granite, on the northeast and southwest sides of the pipe respectively. A diabase dyke of the Contwoyto Lake suite runs northeast to southwest to the west of the Main pipe. The Misery Main pipe and associated satellite pipes and dykes intruded along the regional geological contact between older metasediments and younger Archean granite. This likely represented a zone of weakness that was exploited by the Misery kimberlites during emplacement.



REFERENCE

2016 EKATI DIAMOND MINE NI 43-101 TECHNICAL REPORT, FIGURE 7-1

PROJECT

DOMINION DIAMOND

MISERY UNDERGROUND PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

REGIONAL GEOLOGY MAP

Golder Associates

PROJECT		1779781	FILE No.	
DESIGN	KM	05/07/17	SCALE AS SHOWN	REV. 0
GIS	ANK	10/08/17		
CHECK	KM	10/08/17		
REVIEW	JCC	10/08/17		

MAP 3.8-1

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\1779181_MiseryUnderground\11100_OverallProjectMngmt\MUG_PD\Map3_8-1_1779781_MUG_PD_Regional_Geology_Map.mxd

3.9 Hydrogeology

The Project is located within a region of continuous permafrost. Permafrost (i.e., soil or rock that is continuously below 0°C for two or more years) is present within the area to a depth typically in the order of 350 to 400 m below ground surface. Permafrost underlies smaller lakes such as Misery Lake and prevents groundwater interactions where the open pit remains within permafrost.

In this region, the layer of permanently frozen subsoil and rock is generally deep and overlain by a shallow active layer that thaws during summer. The thickness of the active layer is variable and depends on several factors, including thaw index, thermal resistance of the vegetation cover, moisture content, and composition of soil or rock. In general, the active layer thickness at the end of summer ranges from 1 to 2.7 m. The permafrost layer is interrupted by taliks. Depending on lake size, depth, and thermal storage capacity, taliks beneath lakes may fully penetrate the permafrost layer.

Drilling investigations of permafrost were undertaken at the Misery Pit in 2011 in support of the open pit pushback project. The presence of permafrost was confirmed between the Misery open pit and Lac de Gras to a depth of at least 350 m below ground surface. There is ancient groundwater (connate water that was trapped in pores in the rock when the rock was formed) trapped in bedrock fractures below the permafrost layer. This fossil water is highly saline and its salinity increases with depth.

3.10 Aquatic Environment

3.10.1 Hydrology

The Lac du Sauvage and Lac de Gras drainage basins are located within the Canadian Shield physiographic region. The landscape is dominated by features characteristic of glaciated terrain and exposed bedrock. There are numerous small lakes, wetlands, and creeks in the basin, indicating poorly drained conditions. The upland areas are generally well drained. Periodic ice blockages at outlets of small lakes and wetlands increase downstream flood peak discharges and affect the flood characteristics.

The Project is situated in an Arctic Climatic Region, at an altitude of approximately 465 metres above sea level (masl) (ranging from 400 to 500 masl). The topography is generally flat and the area is typical Arctic tundra, consisting predominately of flat, wet or swampy, terrain with little vegetation. The landscape consists of numerous lakes interspersed among boulder fields, eskers, and bedrock outcrops. Waterbodies within the Project area cover approximately one-third of the Ekati mine claim block.

The low terrain results in a diffuse drainage pattern, and streams typically meander in braided channels through extensive boulder fields between the lakes and ponds. Stream flow is highest at snowmelt in the spring and declines steeply over the summer. Low flows and dry stream channels are typical in late summer. Flows typically increase slightly in September in response to autumn rains. In early October, freeze-up occurs and most streams in the barrenlands freeze completely to the streambed during winter.

Misery Pit is located in the Lac de Gras watershed; however, associated Project infrastructure, including the King Pond Settling Facility, as well as a portion of the Misery Camp and Misery WRSA, is located within the King-Cujo Watershed (within the Lac du Sauvage watershed). Water is pumped from sources such as the Waste Rock Dam, Desperation Pond, Misery Pit, and Lynx Pit to the King Pond Settling Facility for minewater management. Water is then Discharged from the King Pond Settling Facility to Cujo

Lake when the water meets the Water Licence effluent quality criteria (EQC), which flows to Christine Lake and then to the western shore of Lac du Sauvage.

The King-Cujo watershed drains into Lac du Sauvage via Cujo Lake, Christine Lake, and connecting tributaries (Map 3.10-1). Cujo Lake has a surface area of 440,000 m^2, local watershed area of 3.0 km^2, and maximum depth of 9.8 m (ERM 2016a; Rescan 2011). Cujo Lake flows into the larger Christine Lake, which has a surface area of 500,000 m^2 and local watershed area of 13.0 km^2 (ERM 2016a). Lac du Sauvage has a surface area of 86.4 km^2, a basin area of 1,461 km^2, a mean depth of 6.8 m, and a maximum depth of 40.4 m (DDEC 2014a). The Narrows at the outlet of Lac du Sauvage is the largest single tributary to Lac de Gras. Lac de Gras has a surface area of 572 km^2 and a basin area of 3,560 km^2. The average depth of Lac de Gras is 12 m, with a maximum depth of approximately 56 m occurring in several locations within the lake (BHP 1995). Lac de Gras receives inflow from Lac du Sauvage and nine other tributary basins. Lac de Gras is a headwater of the Coppermine River, and its outlet channel flows to Desteffany Lake on the Coppermine River. The Coppermine River flows north into the Arctic Ocean at the Hamlet of Kugluktuk. More than 200 small tributary streams, many of which are ephemeral (i.e., flow intermittently) discharge directly into Lac de Gras.

535000

540000

7165000

7160000

N

B19

B18

B15

B17

B16

B3

Christine Lake (Lake B1)

Lac du Sauvage

Cujo Lake (Lake B4)

King Pond

Ab2

Misery Operation

Misery Pit

Lac de Gras

Lynx

LEGEND

- WATERCOURSE
- KING-CUJO WATERSHED (SUB-BASIN B)
- EKATI MINE FOOTPRINT
- WATERBODY

REFERENCE

CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

1,000 0 1,000

SCALE 1:40,000 METRES

PROJECT

DOMINION DIAMOND

MISERY UNDERGROUND PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

LOCATION OF KING-CUJO WATERSHED AND LAC DU SAUVAGE

Golder Associates

PROJECT		1779781	FILE No.	
DESIGN	KM	05/07/17	SCALE AS SHOWN	REV 0
GIS	JE	11/08/17		
CHECK	KM	11/08/17	MAP 3.10-1	
REVIEW	JCC	11/08/17		

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\1779181_MiseryUnderground\11100_OverallProjectMngmt\MUG_PD\Map3_10-1_1779781_MUG_PD_King-Cujo_Watershed.mxd

3.10.2 Water and Sediment Quality

The lakes and streams of the Project area, in the Ekati claim block, and Lac du Sauvage and Lac de Gras are generally characterized as relatively clear, being well oxygenated (within the streams and throughout the water column in most lakes with some exceptions), very soft in hardness, slightly acidic to pH circumneutral, having low alkalinity (which makes them potentially sensitive to acid inputs), and possessing low concentrations of major ions, nutrients, and metals. These characteristics are typical of Arctic and sub-Arctic freshwater systems. Further, these waterbodies are cold, nutrient poor, and covered with up to 2 m of ice for nine months of the year (Pienitz et al. 1997). The limited nutrient status of these waters is attributable to the presence of permafrost, which limits surface water interaction with nutrients in the soil and their mobilization to receiving waterbodies. Low nutrients and low temperatures in the active layer result in extremely low rates of organic matter decomposition and nutrient release. Consequently, biological productivity and biomasses of plants and animals in the streams and lakes are low compared to streams and lakes in southern Canada.

Potential effects to the Receiving Environment from Mine-related activities are primarily through site Discharges. Currently, water from Waste Rock Dam and Desperation Pond is either released directly to the Receiving Environment (if it meets EQC) or transferred to King Pond Settling Facility as part of minewater management. The King Pond Settling Facility also receives water transfers from Misery Pit and Lynx Pit. Stored water is Discharged from the King Pond Settling Facility to Cujo Lake, which flows to Christine Lake and ultimately to Lac du Sauvage. Currently under the Ekati mine Water Licence (W2012L2-0001; WLWB 2017), annual Discharge from the King Pond Settling Facility to Cujo Lake is required to meet EQC for a number of specific water quality parameters. In the King-Cujo Watershed, there are two SNP stations in the King Pond Settling Facility (1616-43 and 1616-43), as well as AEMP stations downstream of the King Pond Settling Facility in Cujo Lake, Cujo Outflow, Christine-Lac du Sauvage Stream, and Lac du Sauvage (LdS1, LdS2), which provide water quality monitoring data associated with these storages, and downstream waterbodies. In the 2016 AEMP (ERM 2017), 23 water quality parameters were evaluated for lakes and streams in the King-Cujo Watershed and Lac du Sauvage. Of these, the concentration of 17 parameters have changed through time (i.e., are elevated above baseline or reference concentrations) in monitored sites downstream of the King Pond Settling Facility (pH, total alkalinity, water hardness, chloride, sulphate, potassium, total ammonia-N, nitrite-N, nitrate-N, total barium, total boron, total molybdenum, total nickel, total selenium, total strontium, and total uranium have remained elevated above baseline or reference concentrations in 16 cases). Overall, the extent to which concentrations of these water quality parameters have changed through time generally decreases with distance downstream of the King Pond Settling Facility; further, changes to the concentrations of these parameters in Lac du Sauvage offshore of the watershed outfall are not readily discernable with concentrations remaining within the range of natural variability. The observed changes in these parameter concentrations immediately downstream of the King Pond Settling Facility are attributed to the Discharge of water from the King Pond Settling Facility into the Receiving Environment under Water Licence W2012L2-0001 (WLWB 2017). Despite these changes, observed concentrations of these parameters were generally below benchmark values, which suggests that these concentrations remain less than the concentrations at which toxic effects might be expected.

In Lac de Gras, monitoring has shown that the concentrations of a number of water quality parameters are slightly elevated above reference conditions near the Diavik Mine site and in Slipper Bay, downstream of the Ekati mine and the Koala watershed. Increases in TDS, alkalinity, chloride, sulphate, total

molybdenum, and total strontium in the near-field monitoring area of Lac de Gras, with elevated concentrations extending into the mid- and far-field areas, as associated with Discharge from the Diavik Mine. Increased concentrations of TDS, chloride, sulphate, potassium, total molybdenum, and total strontium in Slipper Bay are associated with Discharge from the Long Lake Containment Facility (LLCF) at the Ekati mine, which enters Slipper Bay via the Koala Watershed. However, the concentrations of the elevated parameters in Lac de Gras as a result of the Ekati and Diavik mines remain lower than applicable AEMP benchmarks (DDEC 2016b).

Consistent with northern lakes within the Canadian Shield, baseline and operational monitoring programs in the Ekati mine area indicate that lake sediments have a general silty-clay (fine) composition. The streams possess a variable sediment composition, ranging from very coarse material dominated by sand and gravel to fine sediments dominated by silt. Nutrient concentrations (i.e., nitrogen, organic carbon, and phosphorus) are also variable among lake and stream locations (ERM 2015b).

Sediment quality in Cujo Lake has not changed over time for the majority of sediment quality parameters when compared to reference lakes; the exceptions include an increase in total nitrogen and molybdenum, and a potential increase in strontium (ERM 2015b). Sediment concentrations of arsenic and copper were above sediment quality guidelines in Cujo Lake, but the range of measured concentrations were similar to those in reference lakes, suggesting that these exceedances are related to naturally elevated concentrations, and not mine activities (ERM 2015b).

Sediment data from ongoing monitoring programs suggest the sediment quality in Lac du Sauvage has not changed due to mining development and is similar to reference lakes in the area (DDEC 2016b). Concentrations of some metals above sediment quality guidelines (e.g., arsenic, chromium, copper, and mercury) in Lac du Sauvage show naturally elevated background sediment chemistry and are not deemed attributable to anthropogenic influences.

Sediment quality in the western basin of Lac de Gras (FFA area) is considered reflective of background concentrations and thus also not affected by anthropogenic influences, with naturally elevated arsenic, cadmium, chromium, copper, and zinc concentrations occasionally above sediment quality guidelines. In Lac de Gras, downstream of the Lac du Sauvage outlet (FF2 area), the lakebed sediment is potentially influenced by treated effluent Discharge from Diavik Mine with elevated bismuth concentrations. Within the near-field and mid-field areas in the vicinity of Diavik Mine, elevated concentrations of bismuth, lead, and uranium have been measured in the sediment, which suggest mine influences to sediment chemistry because these concentrations attenuate with distance from the mine. In Slipper Bay in Lac de Gras, downstream of the LLCF and the Koala watershed, there was no temporal change in sediment quality compared to reference areas, with the exception of a potential increase in strontium. Similar to other areas of Lac de Gras, naturally elevated concentrations of arsenic and cadmium were occasionally above sediment quality guidelines (ERM 2015b).

3.10.3 Aquatic Life

Plankton and benthic invertebrate populations in lakes in the study areas are typical of Arctic freshwater systems. Phytoplankton, zooplankton, and benthic invertebrates are sampled in the King-Cujo watershed as part of the Ekati mine AEMP. In the 2016 AEMP, one mine-related change in biological variables was observed in the King-Cujo Watershed: an increase in lake benthos density in Cujo Lake; a possible mine-related increase in phytoplankton density in Cujo Lake was also observed (ERM 2017). No mine effects

were detected with respect to phytoplankton biomass, diversity, or community composition in the King-Cujo Watershed or Lac du Sauvage. Zooplankton biomass, density, diversity, and overall community composition have remained relatively stable through time in Cujo Lake and LdS1 in Lac du Sauvage. Lake benthos density has increased through time in Cujo Lake, but appears to have remained stable, though elevated, since around 2003. Diversity in Cujo Lake also appears to have increased through time, though a similar pattern was observed in two reference lakes (i.e., Counts and Vulture lakes). Shifts in benthos community composition have been observed in Cujo Lake and at LdS1 in Lac du Sauvage.

Historical data available for Lac du Sauvage typically showed the lowest total phytoplankton abundance occurring in the spring, but timing of peak values varied between summer and fall (DDEC 2016b). In 2013 and 2014, the total number of phytoplankton taxa identified in Lac du Sauvage and Lac de Gras downstream of the Lac du Sauvage outlet (i.e., FF2 area) ranged from 42 to 118 taxa. Chlorophytes had the greatest diversity, followed by diatoms, cyanobacteria, and chrysophytes. Dinoflagellates, cryptophytes, euglenoids, and xanthophytes made up relatively small percentages of the total taxa count in each lake. Chrysophytes dominated the community by abundance in Lac du Sauvage throughout the open-water sampling period in 2013 and 2014. Chrysophytes also made up the majority of the phytoplankton assemblage by abundance in the FF2 area of Lac de Gras in late spring, while chrysophytes and cyanobacteria co-dominated the phytoplankton assemblage by abundance in summer and fall (DDEC 2016b). Seasonal and spatial variability was observed in total zooplankton abundance and biomass in Lac du Sauvage and the FF2 area of Lac de Gras (DDEC 2016b). In 2013, zooplankton richness in Lac du Sauvage and Lac de Gras (i.e., FF2 area) ranged from 19 to 25 taxa; rotifer taxa were present in the highest numbers, followed by cladocerans, calanoid copepods, and cyclopoid copepods. In 2014, the total number of zooplankton taxa identified in Lac du Sauvage and Lac de Gras FF2 area ranged from 19 to 37 taxa. In general, rotifers and copepods dominated the zooplankton community in most lakes with available historical data in Lac du Sauvage and Lac de Gras FF2 area (DDEC 2016b).

In 2014 and 2015, the total number of phytoplankton taxa identified in Slipper Bay (i.e., Stations S2 and S3), downstream of the LLCF and the Koala Watershed, ranged from 11 to 32 taxa. Chrysophyceae dominated the phytoplankton composition by density at Station S3 in 2014; whereas in 2015, the composition was mainly comprised of bacillariophyceae, chrysophyceae, and myxophyceae. At Station S2, the dominant taxonomic group was myxophyceae in 2014 and chrysophyceae in 2015. Mean density of phytoplankton ranged from 1,070 to 2,414, and 740 to 832 cells/mL at Station S3. In 2014 and 2015, the total number of zooplankton in Slipper Bay ranged from 8 to 12 taxa; *Conochilus unicornis* were present in the highest numbers at Station S2 (2014 and 2015), and at Station S3, *Kellicottia longispina* dominated in 2014, with cyclopoida – copepodites dominating in 2015. In Slipper Bay, the zooplankton mean density ranged from 30,679 to 112,912 organisms/m^3 and the mean biomass ranged from 68.5 to 102.6 milligrams dry weight (mg dw)/m^3. Detailed phytoplankton and zooplankton data for Lac du Sauvage and Lac de Gras FF2 area is provided in DDEC (2016b) and for Slipper Bay is provided in ERM (2015c and 2016a).

Historically, benthic invertebrate communities in lake habitats in Lac du Sauvage and Lac de Gras FF2 area were characterized by low to moderate density and richness. Total density has typically ranged from 1,000 to 8,000 organisms/m^2, with occasional values above 10,000 organisms/m^2 at shallow stations in Lac du Sauvage (DDEC 2014b, 2015); lowest densities (<2,000 organisms/m^2) were typically observed at deep (>10 m) stations. Richness has ranged from 5 to 40 taxa/station in these lakes, with lower richness values also at the deep stations. Simpson's diversity index values were generally close to 0.8, indicating a

high level of diversity. Benthic invertebrate communities were dominated by Chironomidae (non-biting midges) and Pisidiidae (fingernail clams) (DDEC 2016b). Chironomidae dominated the majority of the lake stations; however, Pisidiidae was the dominant group at several deep stations, and Gastropoda (snails) were common at littoral stations in Lac du Sauvage. Other groups such as Oligochaeta (worms), Acari (mites), Turbellaria (flatworms), Eubranchiopoda (tadpole shrimp), Ostracoda (seed shrimp), and other Diptera (true files) contributed smaller proportions of the benthic community (DDEC 2014b, 2015, 2016b). In 2014 and 2015 at Station S2 in Slipper Bay, benthic invertebrate density ranged from 904 to 6,680 organisms/m^2, and richness ranged from 9 to 15 taxa. The benthic invertebrate community at Station S2 was dominated by Chironomidae and molluscs (ERM 2015c, 2016a).

Fish baseline sampling and monitoring programs have included small-bodied and large-bodied fish programs. For small-bodied fish, Slimy Sculpin sampling was conducted in the King-Cujo Watershed in the 2015 AEMP (ERM 2016c). While some clear shifts have been observed in benthos communities in past years, these do not appear to have influenced Slimy Sculpin populations (e.g., biological characteristics) to date. The 2015 fish sampling program has found no evidence of strong mine effects on monitored Slimy Sculpin populations in the King-Cujo Watershed, which is consistent with results from the most recent large-bodied fish program (i.e., 2012 AEMP; ERM 2016c). The large-bodied fish program included sampling of Lake trout and Round Whitefish.

Arctic Grayling, Lake Trout, Lake Whitefish, Round Whitefish, Burbot, Slimy Sculpin, Cisco, Ninespine Stickleback, and Northern Pike have been captured or observed in Lac du Sauvage. Lake Trout, Cisco, Round Whitefish, Lake Whitefish, Arctic Grayling, Burbot, Longnose Sculpin, Slimy Sculpin, and Ninespine Stickleback have been captured or observed in Lac de Gras (DDEC 2014a). Additional information on fish and fish habitat in Lac du Sauvage and Lac de Gras is included in Annex XIV of DDEC (2014a).

3.11 Terrestrial Environment

3.11.1 Soils

The Ekati mine is within the continuous permafrost zone, where a layer of permanently frozen subsoil and rock is generally 300 m deep and overlain by a 1 to 2 m active layer that thaws during summer (Heimersson and Carlson 2013). Talik zones occur beneath water bodies and, depending on the thermal storage capacity of the lake, may fully penetrate the permafrost horizon.

Glacial till is the dominant surficial material in the area. Soils in the area are predominantly of the Cryosolic order. These soils form where permafrost occurs within 1 to 2 m of the ground surface. The Cryosols in the claim block are characterized by cryoturbation (i.e., horizons or layers that have been disrupted, mixed, or broken by freeze-thaw activity).

3.11.2 Vegetation

Typical for the area, the predominant vegetation/land cover types are heath tundra (less than 30% boulder), heath tundra with boulders (30% to 80% boulder), heath tundra with bedrock (30% to 80% bedrock), and tussock/hummock types (9%). Heath tundra is the most widespread and characteristic vegetation/land cover type.

The terrestrial vegetation community is composed of species adapted to freezing temperatures, low nutrients, and localized areas of drought and standing water. The short growing season, cool soil temperatures, and lack of soil development limit the establishment of productive, diverse plant communities. The most common plant species associated with the predominant vegetation/land cover type (i.e., heath tundra types) are dwarf birch (*Betula glandulosa*), Labrador tea (*Ledum palustre decumbens*), crowberry (*Empetrum nigrum*), and bearberry (*Arctostaphylos rubra*). Lichen dominated communities are found in areas with very thin layers of soil that are typically associated with health bedrock and/or boulder land cover types. Taller shrubs, such as willows (*Salix* spp) and dwarf birch, are found in sheltered riparian areas along streams and lakeshores where there are depressions in the depth of the permafrost. The vegetation surrounding lakes and streams is dominated by sedges (*Carex* spp) and cottongrasses (*Eriophorum* spp), which are characteristic of the sedge wetlands and tussock-hummock land cover types that occur in low lying depressions.

3.11.3 Wildlife

The Ekati mine area is characterized by a mixture of landscape features and habitat types that support an array of wildlife species. Despite the harsh climate, the area supports many species of mammals and birds. Eighty-four bird species and sixteen mammals have been confirmed as permanent or summer residents, migrants, or summer visitors. Most of these animals are migratory (e.g., caribou, wolf, peregrine falcon), others are non-migratory (e.g., grizzly bear, wolverine, Arctic fox, red fox, Arctic hare, and raven). Although uncommon, moose and muskox have been observed in the Ekati mine area (DDEC 2014a). Half of the bird species breed in the area (all year residents include ravens and snow owls [*Bubo scandiacus*]), while the remainder are migrants (loons, sandpipers, passerines, and a few raptor species) or uncommon visitors.

The Bathurst caribou herd migrates through the area to access spring calving and winter forage grounds, specifically, the outlet of Lac du Sauvage into Lac de Gras and along the esker on the west side of Lac du Sauvage are known to be important caribou movement site. Caribou in the Ekati mine area are typically from the Bathurst herd, and some seasonal patterns are evident in their behaviour and distribution (DDEC 2017b). Bathurst caribou movements through the area surrounding the Ekati mine have historically occurred from July through October annually, but the timing has varied by year. Results from aerial surveys indicate that Bathurst caribou tend to move through the Ekati mine area in pulses where large numbers of caribou are present for approximately two weeks. From 1998 to 2005, when the Bathurst herd size was likely greater than 100,000 individuals (Adamczewski et al. 2009), peak numbers of caribou were typically observed during July; since then, peak caribou movements have occurred later from September to mid-October (DDEC 2017b). Caribou are not typically present in the Ekati regional study area during winter.

Grizzly bears, wolves, foxes, wolverines and small mammals are present at different times of the year. Several large eskers in the study area, in addition to travel routes for caribou, provide denning habitat for wolves and grizzly bears. Numerous grass and sedge wetland areas provide food for grizzly bears in the spring and breeding habitat for migrating shorebirds, waterfowl, and some songbird species.

3.12 References

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4.0 PROJECT DESCRIPTION

4.1 Approach to Misery Underground Project

The Misery Underground (MUG) Project is an important development that extends the mine life of the existing Ekati Diamond Mine (Ekati mine) which continues to provide benefits to the economy of the Northwest Territories. The MUG Project will be an extension of the mining operations at the Misery Pit area involving the use of existing infrastructure, along with the development of some new infrastructure to support underground mining operations at Misery to allow for the recovery of high value kimberlite from the Misery Main kimberlite pipe. The Project is a small but critical economic "bridge" for the Ekati mine and will ensure a steady supply of ore between the end of the Misery open pit and Sable Pit operations and the start of production from the Jay Project.

4.2 Project Overview and Schedule

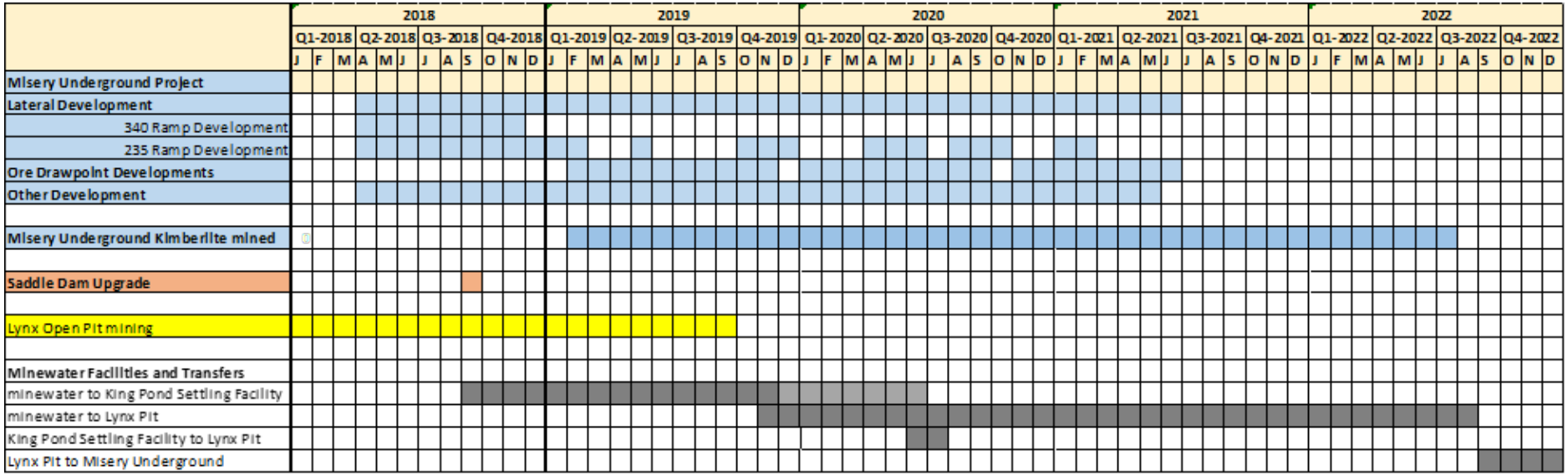
The MUG Project mining method was selected by comparing alternatives as discussed in Section 4.3. The timing of MUG and Jay Projects are related by the use of Misery Pit for the final Dewatering and minewater management for the Jay Project. The MUG Project will be completed ahead of final Dewatering of the Jay diked area to the Misery Pit. The Jay Project involves up to four years of construction (early works, dike construction, and diked area Dewatering) prior to requiring the Misery Pit for Dewatering and minewater management.

The MUG Project would be developed and operated concurrent with the Jay Project construction. Minewater management will make use of the existing King Pond Settling Facility and the mined-out Lynx Pit during the operating period. The MUG Project would be completed ahead of final Dewatering of the Jay diked area, and the mined-out Misery Pit and underground workings will become the minewater management facility for the MUG Project minewater at closure of the MUG Project, followed by the Jay Project minewater during Jay Project operations.

The proposed MUG Project includes development starting in April 2018, followed by kimberlite mining in early 2019. Approximately 2 million wet metric tonnes of kimberlite will be mined over roughly 3.5 years. The MUG Project will be completed by mid-2022.

A tentative schedule of the MUG Project is presented in Figure 4.2-1. This schedule indicates the interactions of the MUG Project with other key developments (e.g., completion of Lynx open pit mining and use of King Pond Settling Facility).

Figure 4.2-1 Misery Underground Project Schedule



Note: Time required for minewater to King Pond Settling Facility is estimated as a range depending on the groundwater inflows to the Misery Underground.

4.3 Project Alternatives

An alternative analysis was carried out to select the mining method for the Misery Main kimberlite pipe which is located below the currently planned and permitted Misery Pit. The Misery Main Pipe is located near vertically below the current pit bottom with near cylindrical (pipe) shape.

4.3.1 No Project

The main consequence of not developing the MUG Project is missing the opportunity to develop a valuable asset. If the Project does not proceed, the overall economics of the Ekati mine will diminish as a valuable asset would be stranded.

4.3.2 Mining Methods

Three mining methods have been considered for the development of the Misery Main kimberlite pipe: open pit mining, vertical mining, and underground mining operations.

A continuation of the open pit mining method beyond the current planned and permitted Misery Pit base of elevation 150 m would require a large pushback to the open pit walls to reach the deeper kimberlite and would require significant time and resources to mine the pushback in both the granite and metasediment zones. This method would require a considerable expansion of the existing Misery waste rock storage area (WRSA).

Considering the kimberlite pipe shape and proximity to the bottom of the pit, the use of a vertical mining method to drill out the kimberlite below elevation 150 m was considered to recover kimberlite from the below the open pit bottom. This method would require working at the open pit base over the life of the project and the stability of the access ramp which is in kimberlite at the pit bottom and was identified as a risk to this method. Trials have been undertaken at Misery Pit using a Bauer vertical mining drill; however, this method has not been proven for full scale production, and there is some uncertainty in the recovery and rate of mining and ability for winter operations.

A sub-level retreat underground mining method was selected in a study (Stantec 2009) among several underground mining options as the optimal method to recover kimberlite below the 150 m elevation. The sub-level retreat selection justification includes that this method is currently being employed successfully at other areas of the Ekati mine on other kimberlite resources (Panda pipe), it has a lower initial capital cost compared to other underground alternatives, and does not require permanent infrastructure in the kimberlite ore.

A summary of advantages and disadvantages of the mining methods considered is presented in Table 4.3-1.

Table 4.3-1 Summary of Mining Methods Alternatives

Mining Method Alternative	Advantages	Disadvantages
Open pit mining	• Existing infrastructure in place and equipment already on site • Existing site open pit development experience	• Open pit to mine kimberlite below the elevation 150 m pit base would require a significant pushback expansion, and develop large quantity of additional granite and metasediment waste • A significant expansion of the existing Misery WRSA would be required • Very high waste rock stripping ratio to release the deeper kimberlite compared to the other alternatives • Could affect Jay Project schedule, as the Jay Project plans to use the mined-out Misery Pit as a minewater management facility
Vertical drilling	• Access to the kimberlite from pit base following open pit mining • No significant quantity of waste rock is produced	• Limited experience with this method which is not proven for full scale production mining in the northern environment • Requires the stability of the ramp over the life of the extraction • High risk with the ramp in kimberlite • More technical uncertainty; limitations on winter operations • Overall, the disadvantages and increased risk result in vertical mining not being a feasible option
Underground mining using a sub-level retreat (SLR)	• Method employed successfully at the Ekati mine on other kimberlite resources • Low quantity of additional waste rock is developed • Development ramps to reach underground kimberlite can be advanced in the granite zone • Low business risks associated with SLR mining method	• May require adjustments to Jay Project schedule, as the Jay Project plans to use the mined-out Misery Pit as a minewater management facility • Dilution of kimberlite with waste rock from the contact zone between kimberlite and bedrock can be high and may increase with depth, requiring additional effort to sort kimberlite before processing

The selected mining method is an underground mine with a sub-level retreat method.

4.4 Mine Geology and Underground Mine Design

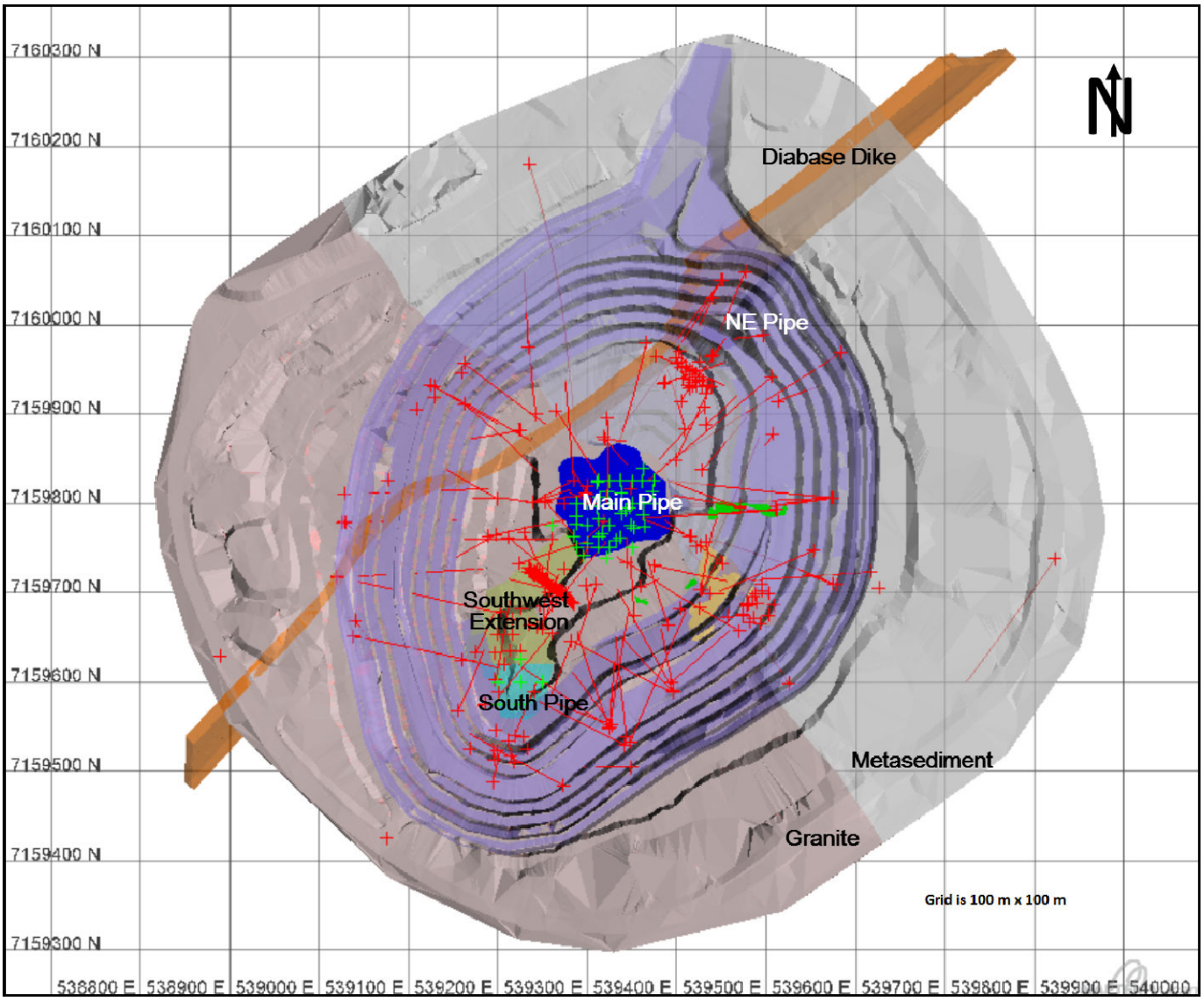
4.4.1 Geology

A summary of the regional geology is presented in Section 3.8. Rock types at the Ekati claim block and in the Misery area can be assigned to three broad lithostratigraphic groups: metasedimentary (biotite schists); migmatites; and various granite, granodiorite, and tonalite.

The Misery Main kimberlite pipe and associated satellite pipes and dykes intruded along the regional contact between older metasediments and younger Archean granite. A diabase dyke of the Contwoyto Lake suite runs northeast to southwest to the west of the Main kimberlite pipe. The metasediments are weathered and commonly foliated, containing trace andalusite and porphyroblasts that are typically overgrown by sillimanite. The granitic rocks are weathered to a white to light grey colour and contain abundant primary muscovite. The granitic rock textures vary from fine to coarse grained pegmatitic and equigranular to weakly porphyritic. The granite is generally massive. The main structural features that characterize the area are the steeply dipping contact between the metasediments and two-mica granite and diabase dyke emplacement. The granite/metasediment contact appears to be defined by a sharp contact surface with little intermixing. The diabase dykes generally trend perpendicular to the metasediment-granite contact.

The Misery kimberlite pipes are currently being mined through open pit operations. Misery Lake, which overlaid the Main pipe prior to mining, was drained and the overlying lake bottom sediments and glacial till was removed in the open pit area. Mining of Misery Main, satellite kimberlites, and associated country rocks within the final pit design will be completed by mid-2018.

Figure 4.4-1 presents a plan of the current Misery Pit area, local geology, and the Misery kimberlite pipes. The Misery Main kimberlite pipe is central to the Misery Complex, and is the largest pipe in the cluster followed by the Southwest Extension and South kimberlite pipes. There are other small kimberlite dykes and pipe-like bodies throughout the complex. Figure 4.4-2 presents a cross section of the Misery Pit and kimberlite pipes.



REFERENCE

2016 EKATI DIAMOND MINE NI 43-101 TECHNICAL REPORT, FIGURE 7-7

PROJECT

DOMINION DIAMOND

MISERY UNDERGROUND PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

MISERY COMPLEX KIMBERLITE BODIES PLAN VIEW

Golder Associates

PROJECT		1779781	FILE No.	
DESIGN	KM	03/08/17	SCALE AS SHOWN	REV. 0
GIS	MP	11/08/17		
CHECK	KM	11/08/17		
REVIEW	JCC	11/08/17		

FIGURE 4.4-1

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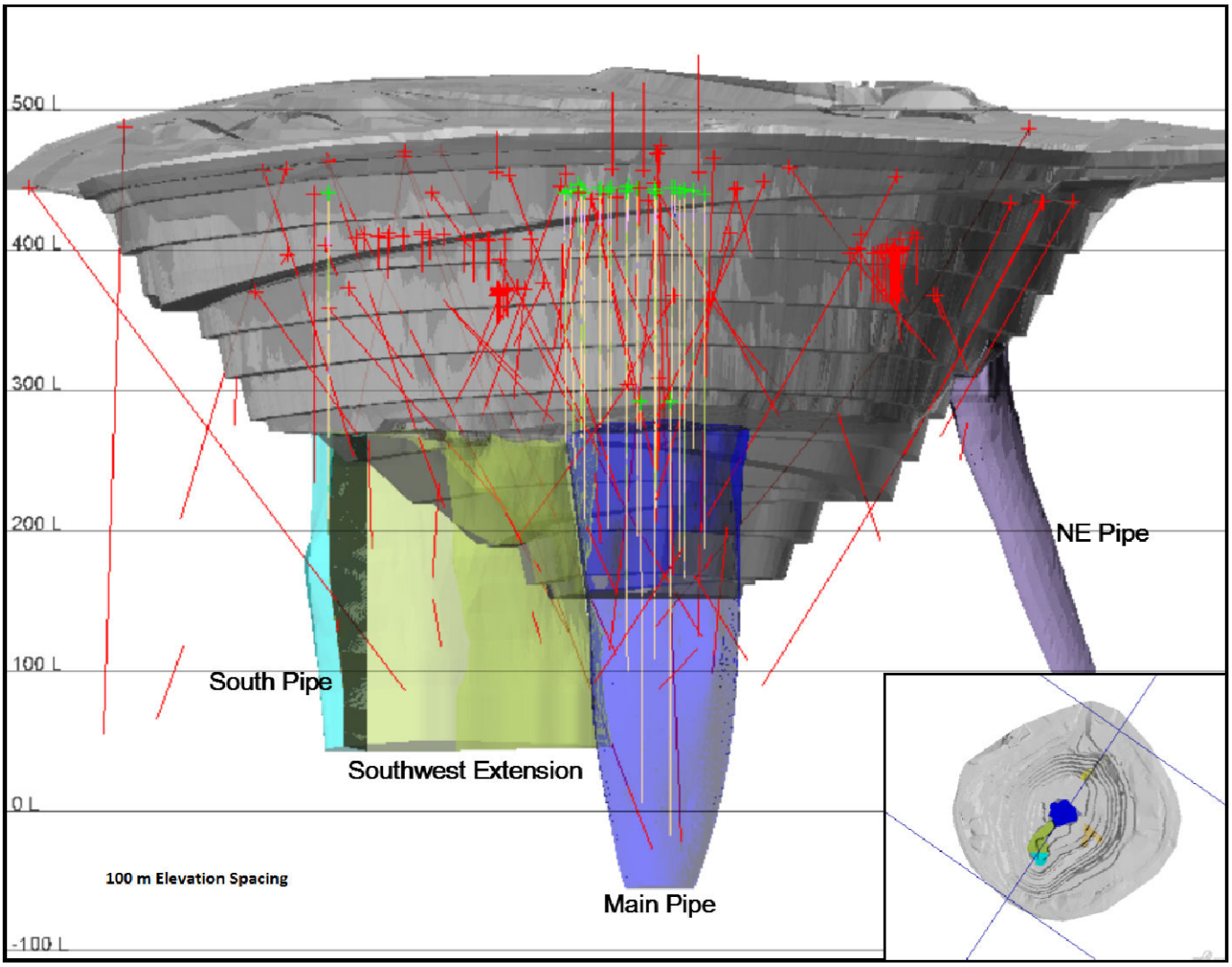


PROJECT

DOMINION DIAMOND

MISERY UNDERGROUND PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

MISERY COMPLEX KIMBERLITE BODIES PROFILE

Golder Associates

PROJECT		1779781	FILE No.	
DESIGN	KM	03/08/17	SCALE AS SHOWN	REV. 0
GIS	MP	11/08/17		
CHECK	KM	11/08/17		
REVIEW	JCC	11/08/17		

FIGURE 4.4-2

REFERENCE

2016 EKATI DIAMOND MINE NI 43-101 TECHNICAL REPORT, FIGURE 7-8

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\1779181_MiseryUnderground\2000_TechComponents\20_StorageEval\Figure4_4-2_1779181_MU_KimberliteBodies_Profile.mxd

4.4.2 Geotechnical Conditions

Structural and rock mass information was collected through Misery open pit surface photogrammetry mapping on highwalls above elevation 230 m. The Misery Main kimberlite pipe host rock is primarily comprised of granite on the southern domain and metasediment (biotite schist) on the northern half. The amount of exposed metasediment wall is reduced at depth and terminates in the exposed pit wall below elevation 164 m as the granite-schist contact dips towards northeast.

The proposed underground portion of the kimberlite pipe at Misery is mainly encompassed by granite host rock. The rock mass fabric in both granite and biotite schist are fairly distinctive and relatively consistent in discontinuity characteristics such as joint set orientation, roughness, and spacing throughout the exposed open pit highwall. The current structural mapping predicts that similar rock fabric and structural orientation exposed in open pit host rock can be expected at depth in the Misery underground. The most prominent structures identified in the host rock include the northeast–southwest trending diabase dyke and the contact between the granite and the biotite schist.

The host rock strength data were compiled during the 2011 Misery open pit execution study completed by Zostrich Geotechnical (2011), showing an average intact rock strength of 212 MPa for granite and 124 MPa for biotite schist. The proposed underground portion of the kimberlite pipe is mainly encompassed by granite host rock.

The rock mass rating (RMR) system used for logging and mapping at Ekati is based on the Laubscher RMR system, the geotechnical assessment outlined in the Ekati Mine 43-101 Technical Report (DDEC 2016a) rated/estimated both the metasediment and granite with an RMR in the range of 40 to 80 which equates to an upper bound ‘poor’ to ‘good’ rock strength description. The average RMR value for metasediment was 53, correlating to a mid-range rock strength description ‘fair’, and the granite to an average RMR value of 60, also in the fair range (upper bound).

Geotechnical recommendations for the MUG Project have been developed by Zostrich Geotechnical (2016a,b, 2017) who were engaged to conduct geotechnical assessment on the following:

- Misery Pit – Deep Slope Stability Analysis – Brief Review to assess the risk level of various options for an in-pit portal location.
- Misery Underground – Sub-Level Retreat Opening Stability – Prefeasibility analyses to evaluate the deformation rate on the kimberlite developments, and any adverse effects for a sub-level retreat (SLR) mining method.
- Misery Underground Prefeasibility – Slope Stability – to provide a numerical assessment on the deep slope stability of Misery East biotite schist wall, SE pipe, and SW extension highwall throughout the life of Misery underground mining.

Recommendations from these studies include:

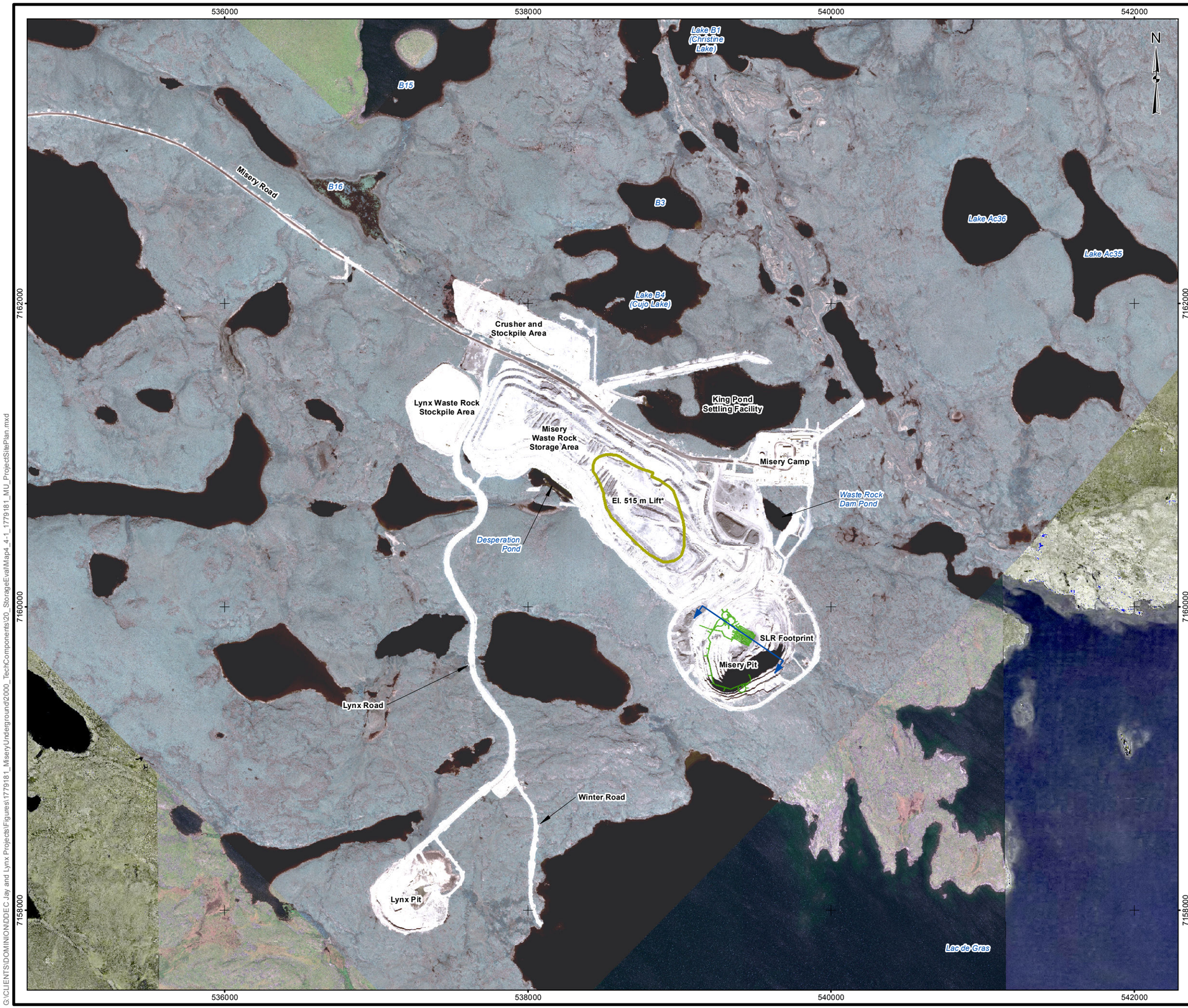
- an operational consideration that the preference is to develop laterally within the granite host rock versus the metasediment where possible;
- the primary portal access be placed at elevation 340 m in granite away from the SE pipe and SW extension;
- two slope stability monitoring units such as the radar will be required to monitor the SE and SW extension;
- a Trigger Action Response Plan should also be set in place to protect both surface and underground workforce when radar readings indicate potential for imminent multi-bench failures;
- the mine design and production plan should account for the likelihood of these slope failures potentially adding dilution material onto the Misery Underground ore blanket;
- since development profile yields increasingly more with exposure time, it is recommended that Misery underground sublevels only be developed as necessary. Development too far in advance is likely to result in significant level of additional support and rehabilitation work;
- to minimize stress and yield, 18 m should be utilized as the optimal sublevel spacing, and development sequence should consider only minimum amount of necessary drawpoints on one level at a time retreating from one side of kimberlite contact to another; and,
- developing simultaneously on multiple levels at a time or initiating mining sequence from the centre of the sublevel in a v-shaped SLR fashion is not recommended.

4.4.3 Misery Underground Mine Development Design

The MUG Project will be mined using the sub-level retreat mining method. The process of underground mining using a SLR method starts with an access ramp development, which involves drilling, blasting, and excavating a tunnel that descends; this is also called a decline. Typically, the underground ramp leading to the top of the kimberlite below the pit is developed as a spiral shape to establish first access to the kimberlite. Deeper kimberlite is accessed by development of additional ramps in the granite bedrock adjacent to the kimberlite.

Map 4.4-1 presents a plan view of the Misery Pit area with the proposed SLR mining development.

SLR is a “top down” method that is applied over the full width of the orebody. In this method, the kimberlite ore is typically drilled in rings (upholes) from multiple crosscut tunnels on each sublevel. Figure 4.4-3 presents a cross section of the kimberlite pipe below the open pit being mined out by an SLR method. Each sublevel is mined out (mucked) in a controlled manner. Blasting is used to break up the kimberlite. The SLR footprint is shown in plan on Map 4.4-1.



LEGEND

- CROSS SECTION SHOWN IN FIGURE 4.4-4 MISERY UNDERGROUND PROJECT OPEN PIT AND SUB-LEVEL RETREAT CONFIGURATION (APPROXIMATE)
- MISERY WASTE ROCK STORAGE AREA EL. 515 m LIFT (APPROXIMATE)*
- SUB-LEVEL RETREAT (SLR) FOOTPRINT

NOTES

*MISERY UNDERGROUND WASTE ROCK TO BE PLACED IN THE PLANNED EL. 515 m LIFT.

REFERENCES

1. ORTHOPHOTO RECEIVED FROM DDEC, DATED: 18 MAY 2017.
FILE NAME: 2016 EKATI MOSAIC.TIF. PHOTO ACQUIRED BETWEEN JULY 28 AND AUGUST 2, 2016.
DATUM: NAD83 PROJECTION: UTM ZONE 12N

500 0 500
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PROJECT
DOMINION DIAMOND
MISERY UNDERGROUND PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE
MISERY UNDERGROUND PROJECT SITE PLAN

Golder Associates

PROJECT	1779181.2000		FILE No.	
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CHECK	KM	11/08/17		
REVIEW	JCC	11/08/17		

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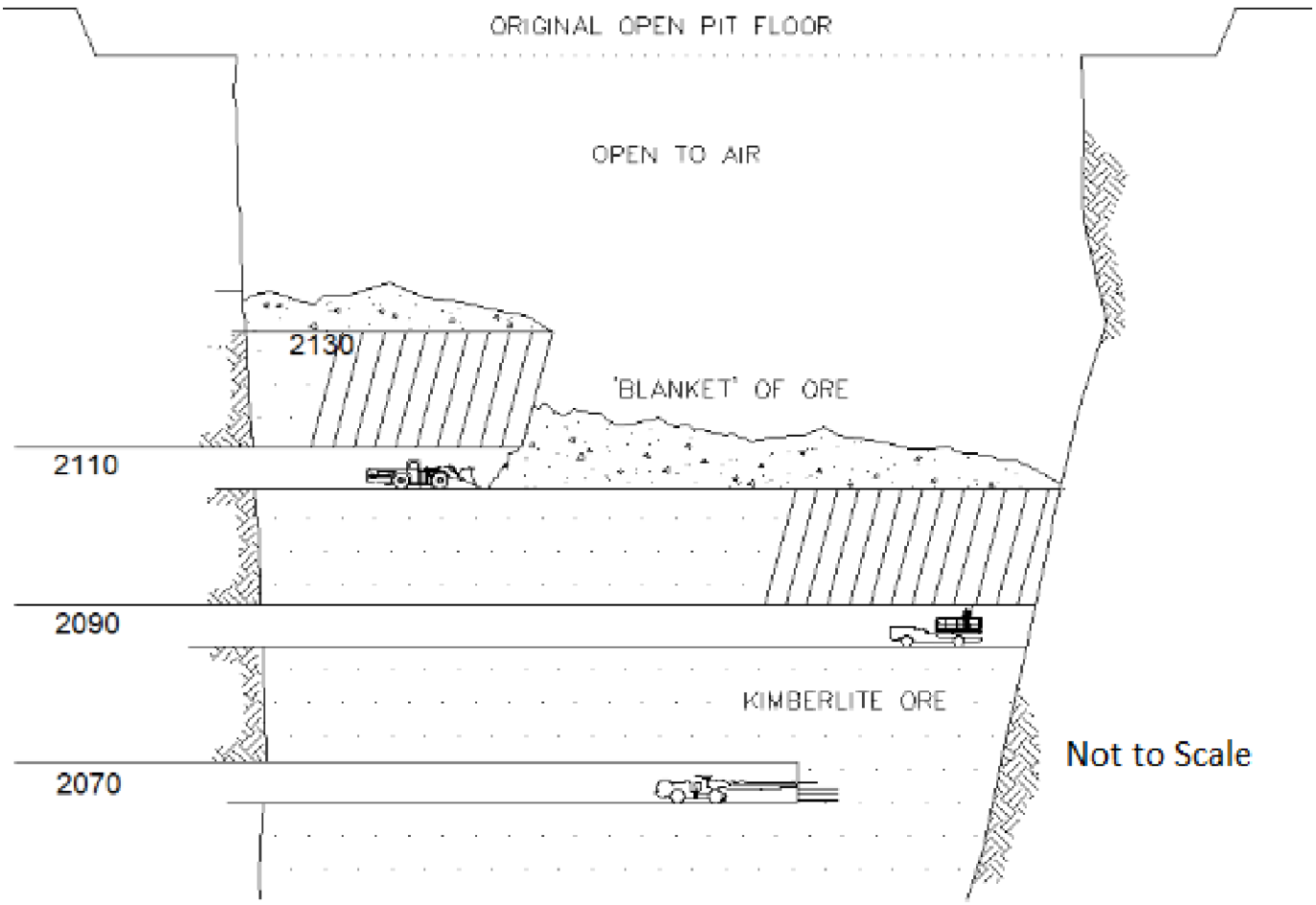


PROJECT

DOMINION DIAMOND

MISERY UNDERGROUND PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

TYPICAL SLR MINING METHOD DEVELOPMENT SEQUENCE AT THE MISERY UNDERGROUND PROJECT

Golder Associates

PROJECT		1779781	FILE No.	
DESIGN	KM	03/08/17	SCALE AS SHOWN	REV. 0
GIS	MP	11/08/17		
CHECK	KM	11/08/17		
REVIEW	JCC	11/08/17		

FIGURE 4.4-3

REFERENCE

MISERY UNDERGROUND (MUG) PREFEASIBILITY STUDY, MAY 2017, FIGURE 13

G:\CLIENTS\DOMINION\DDEC Jay and Lynx Projects\Figures\1779181_MiseryUnderground\2000_TechComponents\20_StorageEval\Figure4_4-3_1779181_MU_SLRMiningSequence.mxd

Underground mines require extensive ventilation, dewatering systems, and carefully developed safety and emergency procedures. Safe areas with independent air supply will be located in areas of the MUG Project to provide refuge for workers in case of fire or explosion. Communication systems are in place to warn underground workers of potential hazards, and specially trained emergency response teams are always on standby.

The upper mining limit is the 2150 level, which corresponds to the planned open pit floor at elevation 150 m. As the kimberlite pipe extends below elevation 0 m, a value of 2000 is added to the elevations and used as underground levels. The lower mining limit is the 2030 level, or at elevation 30 m, and is based on the ability to extract SLR production rings prior to the use of the Misery Pit for the Jay diked area Dewatering. Further indicated resource remains below the lower 2030 mining limit.

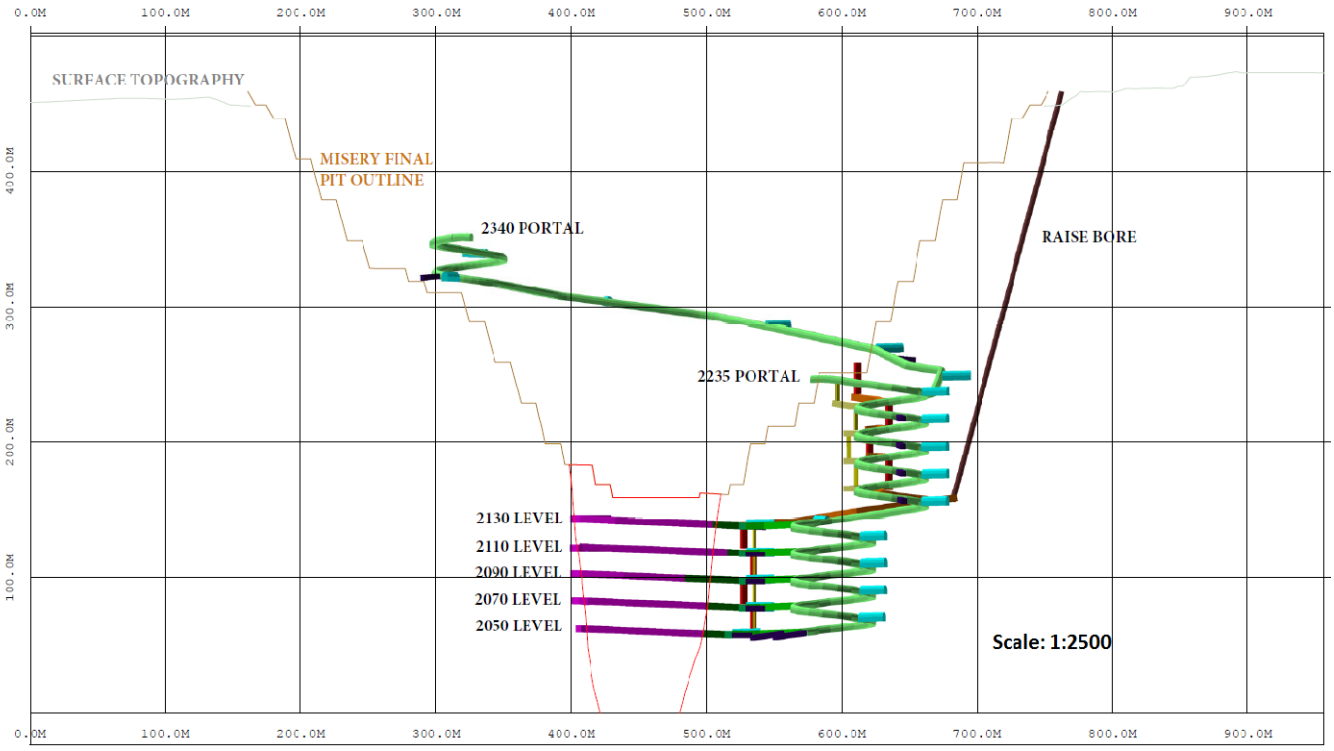
The Misery Main underground production zone is to be accessed via dual declines ramps (the 2235 and 2340 ramps) with collar locations within the existing Misery Pit. The 2235 decline ramp is to be collared within the north-western face of the pit at elevation 235 m and will advance as a spiral ramp down to the 2150 level, at which point the ramp centroid will shift to the south-east to provide closer proximity access to production levels. The 2340 decline is to be collared within the south-eastern face of the pit at the elevation 340 m and will advance around the western edge of the pit wall and link to the upper spiral decline at the 220 m elevation. All development ramps are mined in granite or diabase dike.

Access/haulage ramps will be used for daily transportation of personnel, materials, and equipment. In addition, development waste rock will be hauled (in diesel trucks) via the 2340 access ramp to surface. Extracted ore will be also hauled to a temporary stockpile adjacent to the portal (2340) from which it will be rehandled into surface Cat 777 trucks by CAT 992, taken to an ore pad for loading into ore carrier trucks, and hauled to the processing plant. Waste rock, from development, will be handled similarly and transported direct to the designated area within the Misery WRSA.

As detailed in Section 4.4.2, a diabase dyke runs in a north-south direction and intersects proposed capital development along the western side of the Misery Pit. The 2340 ramp and 2235 ramp level accesses have been designed with an azimuth variation to accommodate perpendicular intersection angle through the diabase dyke, in efforts to minimize potential geotechnical instability along the contact. All primary development has been placed in the granite host rock as the schist host rock would be challenging for support on a geotechnical basis.

Mining levels will be located every 20 m vertically. Access drifts at each level will be driven from the haulage ramp to an “extraction” drift, which will be driven nominally parallel to one side of the orebody. The configuration of the MUG Project open pit and SLR is presented in Figure 4.4-4.

The primary fresh air intake is designed at a 75 degree dip with the connection on the 2150 level with a total reamed length of 313 m to surface.



REFERENCE

MISERY UNDERGROUND (MUG) PREFEASIBILITY STUDY, MAY 2017, FIGURE 22

PROJECT

DOMINION DIAMOND

MISERY UNDERGROUND PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

MISERY UNDERGROUND PROJECT
OPEN PIT AND SUB-LEVEL RETREAT CONFIGURATION

Golder Associates

PROJECT		1779781	FILE No.	
DESIGN	KM	03/08/17	SCALE AS SHOWN	REV. 0
GIS	MP	11/08/17		
CHECK	KM	11/08/17		
REVIEW	JCC	11/08/17		

FIGURE 4.4-4

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4.5 Misery Underground Project Components

The Project will use the existing mining infrastructure already in place at the Misery site and the Ekati main camp. The Project components required are described below and shown on Map 4.5-1.

4.5.1 Misery Accommodations Complex

The existing accommodations complex at the Misery site will be used to house the workforce for the Project. These facilities currently include accommodations for 115 people, consisting of single-occupancy rooms, a kitchen complex, recreation room, and exercise gym. This facility will be expanded to accommodate an additional 80 people for the MUG Project. The expansion of the Misery accommodations complex does not require an expansion of the already established Misery camp pad.

4.5.2 Fresh Air Raise

A fresh air raise (FAR), which is a borehole constructed using a raise bore drilling method, will be required as part of the system to supply fresh air to the underground work area. The fresh air raise consists of surface excavation and construction of pad suitable to setup a raise bore drill rig. The FAR borehole is designed at a 75 degree dip that extends from surface to the 2150 level, as shown in section on Figure 4.4-4. Once the raise bore is completed, mechanical and electrical components will be installed at surface as part of the system to deliver fresh air to the underground mine.

4.5.3 Emergency Response Team Hall

A new Emergency Response Team (ERT) hall will be required for the MUG Project, as the current hall at the Misery site is not large enough for the added underground rated ambulance and for storing enough closed circuit breath apparatus for multiple response teams. The new ERT Hall will be foldaway style structure to house the surface and underground equipment for quick response from the ERT members. The structure will be installed in an area that is readily accessible from Misery accommodations to minimize response time, potentially next to the Utility Service Building.

4.5.4 Misery Underground Dry

An underground dry capable of storing personal effects of 80 men and women for underground duties will be required as part of the Misery complex. The current ERT Hall at the Misery site will be rehabilitated to become the underground dry. The ERT equipment will be moved to the new ERT Hall and a basket and hanger system will be installed along with benches. The dry is attached to washroom and lockers facilities.

4.5.5 Sprung Structure

A Sprung structure will be required for maintenance on heavy equipment. The selected contractor will be responsible for bringing in a shop/building. This structure will be located in the vicinity of Misery camp (Map 4.5-1).

4.5.6 Shotcrete Batch Plant

The existing Ekati mine shotcrete system will be used for the MUG Project, with the use of surface and underground flat deck trucks to move bulk bags. It is expected that upgrades to the Ekati shotcrete batch plant adjacent to the underground building complex will be required.

536000
538000
540000
7162000
7160000
7158000

Misery Road
Lake Ac36
Lake B4 (Cujo Lake)
Crusher and Stockpile Area
76D/9-10-2
Lynx Waste Rock Stockpile Area
King Pond Settling Facility
76D/9-4-2
Misery Waste Rock Storage Area
Misery Camp
El. 515 m Lift
Waste Rock Dam Pond
Desperation Pond
SLR Footprint
76D/9-3-2
Misery Pit
Lynx Road
76D/9-11-2
Winter Road
Lynx Pit
Lac de Gras

N

LEGEND

PROJECT COMPONENTS*

- CAMP EXPANSION (TWO 44 PERSON ATCO TRAILERS)
- ERT BUILDING
- FRESH AIR RAISE (FAR) LOCATION
- IN PIT PORTAL ACCESS TO UNDERGROUND RAMPS AND WORKINGS
- SPRUNG STRUCTURE
- POWER LINE TO FAR LOCATION FROM MISERY SUBSTATION
- SURFACE LEASE BOUNDARY
- MISERY WASTE ROCK STORAGE AREA EL. 515 m LIFT
- POTENTIAL SURFACE PORTAL LOCATION
- TEMPORARY KIMBERLITE STOCKPILE
- SUB-LEVEL RETREAT (SLR) FOOTPRINT

NOTES

*LOCATIONS AND CONFIGURATIONS OF PROJECT COMPONENTS ARE APPROXIMATE ONLY AND WILL BE REFINED THROUGH DETAILED DESIGN.
MISERY UNDERGROUND WASTE ROCK TO BE PLACED IN THE PLANNED EL. 515 m LIFT.

REFERENCES

1. ORTHOPHOTO RECEIVED FROM DDEC, DATED: 18 MAY 2017.
FILE NAME: 2016 EKATI MOSAIC.TIF. PHOTO ACQUIRED BETWEEN JULY 28 AND AUGUST 2, 2016.
DATUM: NAD83 PROJECTION: UTM ZONE 12N

500 0 500
SCALE 1:20,000 METRES

PROJECT
DOMINION DIAMOND™
MISERY UNDERGROUND PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE
MISERY UNDERGROUND PROJECT COMPONENTS

Golder Associates

PROJECT	1779181.2000		FILE No.	
DESIGN	EFR	02/06/17	SCALE AS SHOWN	REV 0
GIS	AK/MP	11/08/17	MAP 4.5-1	
CHECK	KM	11/08/17		
REVIEW	JCC	11/08/17		

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4.5.7 Compressed Air Supply

Two portable compressors (mounted in shipping containers) will be on site to supply the required compressed air for the underground mine. Each compressor will have a capacity of 1,000 cubic feet per minute. Typically one unit will operate while the other is a spare or down for maintenance. A 250 mm (8 inch) airline from the compressed air plant to the Misery portal will be installed to provide compressed air delivery to the underground. The equipment to be used at Misery will be similar to the equipment currently in use at the Koala operations.

4.5.8 Misery Underground Power

Power supply is required for the Misery underground operation. Misery currently is powered by an existing 69 kV overhead powerline which follows the Misery Road between the Ekati main site and Misery camp. This 69 kV powerline terminates at the substation at Misery camp.

It is anticipated that the power to the underground would come from tapping into the 69 kV line through a skid-mounted 69 kV to 15 kV surface main transformer and installation of armoured 15 kV power cable from the transformer to the Misery Pit. The cable would be laid out on pipe supports along the ground surface, at the edge of the road. At the pit, the cable would terminate at a 15 kV circuit breaker, and the voltage would be stepped down again by a 15 kV to 5 kV transformer which would be connected to the Misery FAR.

4.5.9 Portals

Access to Misery underground operation will either be through two in pit portals or by one surface portal (Map 4.5-1). The in pit portal locations and the surface location are all within the footprint of the current Misery open pit. Detailed design and portal selection is in progress and will be confirmed in the future.

4.5.10 Mine Water Management

The goal of the mine water management is to mitigate the impact of the MUG Project on the aquatic ecosystem surrounding the Project area, in terms of both water quantity and quality. The Mine Water Management Plan for the MUG Project (Golder 2017a; Appendix E of the Water Licence and Land Use Application) describes the strategies proposed for water management and the water balance throughout the main stages of MUG Project development: Construction, Operations, and Closure/Post-closure. Closure for the MUG Project is a transition from the MUG Project to the Jay Project, as the mined-out Misery Pit will be the primary minewater management facility for the Jay Project, starting with the final Dewatering of the diked area (Golder 2016a). The MUG Project would be completed ahead of final Dewatering of the Jay diked area; minewater considerations for the MUG Project closure phase need to account for the requirements of the Jay Project, which is scheduled to commence immediately after the MUG Project closure phase. The MUG Project Mine Water Management Plan was developed assuming that the closure of the Misery Pit and Underground and Lynx Pit will be completed as per the approved and permitted Jay Project. However, the Mine Water Management Plan was also evaluated to determine that closure could proceed without the Jay Project; a “No Jay” scenario was evaluated where Misery and Lynx pits would be back-flooded with freshwater from Lac de Gras at the completion of the MUG Project (Golder 2017a).

The MUG Project is expected to be mined below permanently frozen bedrock after about five months of the 235 ramp development. Once below permafrost, groundwater inflows to the mine are expected.

Based on the range of estimated quality of groundwater inflows to the Misery underground developments (Golder 2017a; Appendix B), it is not anticipated that water in King Pond Settling Facility will be suitable for Discharge to the environment after mixing with minewater from underground developments. As such, the water management plan is centred on the containment of minewater throughout the MUG Project construction and operations phase. However, if the King Pond Settlement Facility does meet Water Licence effluent quality criteria, operations would continue as per current minewater management strategies.

The MUG Project Mine Water Management Plan will be achieved using: King Pond Settling Facility during Lynx Pit operations; Lynx Pit after Lynx Pit mining is completed and until Misery underground mining is completed; and Misery Pit and underground workings for storage of minewater collected in Lynx Pit. The MUG Project water management concept includes the following strategies throughout the different Project Phases:

- **Current minewater management strategy** —Desperation Pond (as required), Waste Rock Dam Pond (as required), Misery Pit sump and Misery WRSA runoff and seepage report to King Pond Settling Facility. In current practices, the King Pond Settling Facility is pumped down in the fall to Cujo Lake, meeting established effluent quality criteria (EQC) for the pumped Discharge as per the Water Licence. King Pond Settling Facility continues to be used for water management with Discharge to the environment. Under the current minewater management strategy, the Misery Pit is active and the Lynx Pit is active.
- **Project Construction and Operations**
  - Once minewater from the Misery Underground is encountered, it will be pumped to King Pond Settling Facility. This is anticipated to occur in early September 2018.
  - King Pond Water Management—While Lynx Pit is in operations, the groundwater from the Misery underground developments is managed at King Pond Settling Facility, together with other minewater sources as per current conditions. For the MUG Project Mine Water Management Plan, the King Pond Settling Facility is assumed to no longer Discharge to the environment, holding all inflows until Lynx Pit becomes available for water storage. However, Discharge may occur to Cujo Lake if water quality in the King Pond Settling Facility meets Water Licence Discharge criteria. The King Pond Water Management phase will end when King Pond Settling Facility has reached capacity and minewater will start to be transferred to Lynx Pit (actual date is dependent upon groundwater inflows).
  - Lynx Pit Water Management—When mining of Lynx Pit is completed and the Lynx Pit is available for water management, minewater from Misery underground developments and from King Pond Settling Facility will be pumped to Lynx Pit, while minewater from Misery Pit will be transferred to Lynx Pit via King Pond Settling Facility. An initial volume of water will be pumped from King Pond Settling Facility to Lynx Pit to lower water levels in King Pond Settling Facility to previous operational levels. Misery Pit and Misery Underground developments are anticipated to be available for the transfer of minewater from Lynx Pit in early September 2022, one month after the MUG Project is complete.

- **MUG Project Closure**
  - Misery Water Management—Once Misery underground mining is completed, Lynx Pit will be pumped out to start flooding the Misery underground developments and Misery Pit. Water from King Pond Settling Facility will be pumped to Misery Pit until water quality in King Pond Settling Facility has returned to levels acceptable for Discharge to the environment, at which time King Pond Settling Facility will be Discharged to Cujo Lake as per current practice. Site runoff to King Pond Settling Facility, Desperation Pond inflows, and Waste Rock Pond Dam Pond inflows will be managed as per current practice.
  - Interaction with Jay Project—Once pumping from Lynx Pit to Misery underground developments and Misery Pit is completed, the MUG Project is completed and Lynx Pit and Misery Pit will become available to support the Jay Project. The Jay Project will provide completion of closure back-flooding for Lynx Pit and Misery Pit. Further breakdowns of the Jay Project water management components can be found the Jay Project Mine Water Management Plan (Golder 2016a).

The following timeline is proposed for water management associated with the MUG Project, by year, based on an anticipated start of Misery underground construction in April 2018. Timeline for the various water management activities presented below derive from this start date, the anticipated MUG Project construction schedule, and the results of the water balance.

2018 – Development of the Ramp

- Start of Misery underground construction.
- Annual Discharge to the environment of King Pond Settling Facility to elevation 443 m after freshet but before the start of pumping from Misery underground developments.
- Upgrade to Saddle Dam at the Kind Pond Settling Facility, which include liner installation at the Saddle Dam (any seepage losses from the upgraded Saddle Dam will report to the Waste Rock Dam Pond) (Golder 2017b).
- In early September 2018, underground construction is estimated to be advanced below the permafrost base and groundwater inflows to Misery Underground are expected to commence; minewater collected in the underground will be pumped to the King Pond Settling Facility.

2019 – MUG Project Operations

- Management of Misery underground minewater in King Pond Settling Facility.
- Completion of mining at the Lynx Pit prior to King Pond Settling Facility reaching capacity.
- Management of Misery underground developments minewater in Lynx Pit and transfer of excess minewater from King Pond Settling Facility to Lynx Pit.

2020 – MUG Project Operations

- Continued management of Misery underground developments minewater in Lynx Pit and transfer of excess minewater from King Pond Settling Facility to Lynx Pit.

2021 – MUG Project Operations

- Continued management of Misery underground developments minewater in Lynx Pit.

2022 – MUG Project Closure and Transition to the Jay Project

- Completion of mining at Misery underground by end of July 2022.
- Decommissioning of the Misery underground developments, by end of August 2022.
- Pumping of minewater stored in Lynx Pit to the Misery Pit and underground workings, prior to the start of Final Dewatering of the Jay diked area.
- Final Dewatering of Jay diked area into the top of Misery Pit and to Lynx Pit (Golder 2016a).

Starting with the final Dewatering of the Jay diked area, Lynx Pit and Misery Pit become water management facilities for the Jay Project (Golder 2016a).

Additional information, including volumes of minewater transfers, is provided in the MUG Project Mine Water Management Plan (Golder 2017a; Appendix E of the Water Licence and Land Use Permit Application).

4.5.10.1 Adaptive Management

Since operations began in 1998, the Ekati mine has demonstrated a commitment to adaptive management and an ability to implement effective adaptive management. The need to implement potential adaptive management strategies for operational water management for the MUG Project, if necessary, is expected to relate to the following:

- Groundwater inflows to the Misery underground developments are greater than predicted, and due to the larger volume of water to be managed, King Pond Settling Facility reaches capacity sooner than predicted.
- Surface water inflows managed by the various water management structures (King Pond Settling Facility, Lynx Pit, and Misery Pit) are greater than predicted, and due to the larger volume of water to be managed, King Pond Settling Facility reaches capacity sooner than predicted.

The following potential adaptive management strategies have been identified to address a greater volume of water to be managed in the King Pond Settling Facility:

- using storage capacity available at the Ekati main site (e.g., trucking from the Misery site to the Ekati site)

- discontinuing Lynx Pit mining (i.e., finish mining Lynx Pit earlier so that is available as a water management facility)
- discontinuing pumping of MUG Project water and allowing the facility to flood to prevent discharge

The need for implementing any or all of the above water quantity potential adaptive management strategies will be determined based on the results of the monitoring programs at the site. Other appropriate adaptive management strategies may be identified at the time based on the circumstances at hand.

4.5.11 Mine Waste Management

4.5.11.1 Waste Rock

All waste generated from the underground will be hauled to surface (via the main access ramp) for disposal in the designated areas of the Misery WRSA (Map 4.4-1).

An estimated total of 530,000 wet metric tonnes of waste rock is expected to be generated from the Misery underground development. This includes 430,000 wet metric tonnes of granite and diabase dike waste rock from the lateral and vertical developments which includes an allowance for the additional cutouts required for safety bays and electrical rooms. During the SLR mining, an additional 100,000 wet metric tonnes of waste rock from the contact zone between the host bedrock and the kimberlite pipe are expected to be mined out (dilution). Based on the geology of the area, it was assumed that dilution of this Rocky Ore will consist primarily of granite, with minor inclusions of metasediment material. This material will be hauled up with the kimberlite ore and sorted at the Misery kimberlite ore transfer pad. Metasediment waste rock will be managed following existing practices in the Ekati mine Waste Rock and Ore Storage Management Plan (WROMP; DDEC 2016b).

Alternative sites for MUG Project waste rock disposal were not considered as it would require disturbance of additional area.

Waste from the underground development is estimated to require about 250,000 m^3 of storage space. Map 4.5-1 shows the area designated for the final elevation 515 m lift which is planned for the Misery WRSA. The MUG Project waste rock will be placed in a portion of this planned final elevation 515 m lift area.

The Misery WRSA is constructed to encapsulate all potentially acid generating metasediments within the permanently frozen portions of the pile. Methods used include 10 m thick alternating layers of potentially reactive metasediments and 5 m thick non-reactive granite and diabase. A final 5 m thick granite cap was placed over the interim storage area in May and June of 2005 and will be placed over the final WRSA upon completion. This is done to maintain the active freeze/thaw zone within the upper granite layer to minimize potential oxidation within the metasediments.

All MUG Project development is located in granite with the only source of metasediments being from contact dilution. Metasediment waste will be segregated and handled in full accordance with established handling procedure specific to the Misery site Waste Management Plan. The Misery WRSA is included in the Ekati mine WROMP. The WROMP would be reviewed and amended as required to incorporate the

relatively small quantity of waste rock and coarse kimberlite rejects produced as a result of the MUG Project.

4.5.11.2 Processed Kimberlite

The Project design makes full use of existing Ekati mine facilities for the processing of kimberlite ore and deposition of processed kimberlite. The existing Ekati mine processing plant will accommodate ore from the MUG Project. Fine processed kimberlite (FPK) slurry from the processing plant will be transported via slurry pipelines, as is current practice at the Ekati mine and will be deposited in the Long Lake Containment Facility (LLCF) or the mined-out Panda and Koala pits and associated underground workings. Coarse processed kimberlite (CPK) will be deposited into the Panda and Koala pits or the Coarse Kimberlite Storage Area. FPK is managed under the Wastewater and Processed Kimberlite Management Plan (WPKMP) and CPK is currently managed under the WROMP.

Processed kimberlite (PK) generated from the MUG Project will be managed according to current approved practice of using the LLCF and Beartooth Pit for FPK and the Coarse Kimberlite Storage Area for CPK. Based on the planned ore tonnage, there is adequate capacity at the LLCF, Beartooth Pit, and the Coarse Kimberlite Storage Area to store all the FPK and CPK that will be generated throughout the life of the Project.

The Wek'èezhìı Land and Water Board (WLWB) has approved the use of Panda and Koala pits as Processed Kimberlite Containment Areas, pending approval of a Deposition Study prior to deposition of PK into the pits (WLWB 2017). PK from the MUG Project is expected to be deposited into the Koala and Panda pits once in-pit deposition has been approved by the WLWB and deposition infrastructure has been installed; until this time, deposition will be into the existing facilities, as per existing practices at the Ekati mine.

4.6 Key Ekati Mine Infrastructure and Facilities to Support the MUG Project

The existing facilities at the Ekati mine will support the construction and operations of the Project, as an extension of the Ekati mine. The principal facilities at the Ekati mine include the following:

- main accommodations complex: dorm-style sleeping rooms for 700 persons; dining, kitchen, and recreation areas; first aid station, emergency response/mine rescue stations; maintenance shops; sewage treatment plant; potable water treatment facility; and incinerator room;
- ore processing plant, Koala Pit, Panda Pit, Beartooth Pit, Fox Pit, and Pigeon Pit;
- Panda/Koala/Beartooth WRSA, Fox WRSA, and Pigeon WRSA (under development);
- LLCF;
- Grizzly Lake freshwater supply system;
- truck shop/office/warehouse complex that provides for heavy and light vehicle maintenance, heated warehouse storage, change rooms, an environmental laboratory, and an administration office;
- bulk storage for diesel fuel;

- bulk lubrication facility, that is situated adjacent to the truck shop and holds bulk lubricant and glycol;
- site roads and existing Misery Road;
- gravel surfaced airstrip, helicopter facility, and control building; and,
- all related support facilities and equipment for operation of the above.

Ancillary buildings/facilities located at the Ekati main camp area include the following:

- power plant with seven 4.4 megawatt diesel-powered generators;
- ammonium nitrate storage facility;
- emulsion plant;
- waste management building, where waste is prepared for transport to off-site management facilities;
- site maintenance shed and Sprung facility, which is used for shipping and receiving;
- airport building;
- landfill for inert solid waste;
- landfarm;
- contaminated snow containment facility;
- incineration facilities; and,
- geology (core logging) that consists of a few small structures on the geology laydown pad to support exploration drilling activities.

The principal facilities at the Misery site include the following:

- Misery Pit and Lynx Pit (under development);
- Misery WRSA;
- Lynx WRSA (under development);
- accommodation complex for 115 people, consisting of single-occupancy rooms, kitchen complex, recreation room, and exercise gym;
- mine office and dry;
- three Type 4 explosive magazines;
- mine maintenance shop and wash bay;
- utility service building;
- communication tower and trailer;

- powerline from Ekati powerhouse;
- three 44 kilowatt diesel powered generators with electrical substation (standby status only after activation of power line from Ekati powerhouse);
- 9-ML fuel tank farm with off-loading and dispersing;
- landfill for inert solid waste; and,
- rock crusher with its own diesel powered generator.

A description of the existing primary facilities that relate directly to the MUG Project are provided in the following subsections.

4.6.1 King Pond Settling Facility

The King Pond Settling Facility is the primary minewater management pond at the Misery site prior to Discharge to the Receiving Environment (Cujo Lake to Christine Lake, and then into Lac du Sauvage) based on Discharge criteria specified in the Water Licence. The King Pond Settling Facility will be used to manage minewater for the MUG Project.

Minor modifications of the King Pond Settling Facility Saddle Dam are anticipated to accommodate the MUG Project. An upgrade to the Saddle Dam at the south end of the King Pond Settling Facility will be carried out to reduce seepage, as detailed in Golder (2017b).

4.6.2 Temporary Kimberlite Storage

A temporary kimberlite ore storage area is currently being used to store kimberlite from Misery Pit prior to haulage to the processing plant at Ekati main camp. This area will continue to be used during the MUG Project. Seepage flows towards Waste Rock Dam, which is a water management facility.

4.6.1 Misery Road

Personnel, diamond-bearing kimberlite, supplies, and equipment are transported between the Ekati main camp and the Misery camp on the existing Misery Road. The road is approximately 29 km long and connects to the Tibbitt to Contwoyto Winter Road (TCWR) just southwest of the Misery site.

The use of the road will be extended to encompass the life of the MUG and Jay projects. The Misery Road will be monitored for caribou movement as per the Ekati mine Wildlife Effects Monitoring Program and the Caribou Road Mitigation Plan.

4.6.2 Processing Plant

A single, centralized processing plant is located within the Ekati main camp, just southwest of the Koala Pit. Kimberlite processing through the plant typically averages 10,500 tonnes per day as a continuous operation (i.e., 24 hours a day, 365 days a year).

The processing of kimberlite is a physical process rather than a chemical process. No processing reagents are used in this facility. Settling aids such as flocculants are stored and handled according to established operating procedures. Simplified, the general process can be described by: size reduction (crushing); washing (also referred to as scrubbing); screening (filtering the material by size); and primary

and secondary concentration (separating the material by density). This process is described in more detail in the WPKMP (DDEC 2016c). Processing plant efficiency is evaluated and operational refinements are implemented on an ongoing basis.

4.6.3 Misery Powerline

Misery is powered by an existing 69 kV overhead line consisting of three 477 MCM Hawk ACSR phase conductors and OPGW suspended on wood poles following the access road between the main camp and Misery camp. This 69 kV power transmission line terminates at the substation at Misery camp, with a step-down transformer to 4,160 V at a capacity of 10 mega-volt amperes, and another step-down transformer to 600 V with a capacity of 2 mega-volt amperes. Misery has backup power provided by a single prime power 920KW CAT diesel generator.

4.6.4 Long Lake Containment Facility

The LLCF is located at the headwaters of the western Koala watershed, which feeds into the Lac de Gras watershed. The LLCF currently includes the following components:

- five containment cells: Cells A, B, and C currently receive and store FPK and waste water; Cell D is currently used as a water management area and may receive FPK in the future; and Cell E acts as a water management pond prior to Discharge to the Receiving Environment;
- three filter dikes: Dikes B, C, and D are designed to retain processed kimberlite solids within the upstream cell while allowing water to filter through to the downstream cell;
- the outlet dam: serves as the downstream water control structure that retains water until sampled, authorized, and then pumped to the Receiving Environment;
- water pumps: pumps on the upstream side of Dike C are used seasonally to pump water from Cell C to the reclaim barge in Cell D; pumps in Cell D supply recycle water to the processing plant; pumps at Dike D are used seasonally to transfer water to Cell E; and pumps in Cell E transfer the water that meets Water Licence Discharge criteria to the Receiving Environment (Discharge point is Leslie Lake);
- access roads: roads are located along the north side of Cell A, around the perimeter of Cell B, and the east and south sides of Cell C and D; and,
- associated pipelines.

The operating plan for the LLCF maximizes the use of the upstream areas (Cells A, B, and C) for FPK deposition combined with the use of the mined-out Beartooth Pit, and contingency use of Cell D. Deposition into Cell B is primarily complete and reclamation field trials are underway.

4.6.5 Panda and Koala Pits

Open-pit mining at the Panda Pit commenced in August 1998 and continued through to July 2003. Underground production at the Panda Pit began two years later in June 2005 and was completed in 2010, after which the underground workings were decommissioned for closure. Open-pit mining at the Koala Pit commenced in 2003 and was completed in 2007. Underground production at the Koala Pit commenced in 2007 and is anticipated to continue until 2019. For the MUG Project, PK will be deposited into the

Koala and Panda pits once in-pit deposition has been approved by the WLWB and deposition infrastructure has been installed. Until that time, FPK deposition will continue into the LLCF or Beartooth Pit, and CPK into the Coarse Kimberlite Storage Area.

4.6.6 Coarse Kimberlite Storage Area

The coarse kimberlite storage area within the Panda/Koala/Beartooth WRSA was commissioned in 1998. The screened coarse fraction of kimberlite feed and heavy media separation light fraction from the processing of kimberlite at the processing plant is trucked to this location. The runoff from this storage area drains to the LLCF. The coarse kimberlite storage area will continue to serve as the deposition area for Project CPK until in-pit deposition has been approved by the WLWB and deposition infrastructure has been installed.

4.6.7 Lynx Pit

Construction for the Lynx open pit commenced in 2015 and mining is scheduled through to September 2019. Without other projects at the Ekati mine, reclamation of the Lynx open pit was planned to be accomplished by back-flooding with water from Lac de Gras.

During the MUG Project, the Lynx Pit will be used for operational minewater management. The Lynx Pit has an estimated maximum storage capacity of approximately 6.7 million m^3. The range of water to be stored in Lynx Pit as a result of the MUG Project is between 3.9 and 5.7 million m^3. At the end of the MUG Project, the water will be pumped back to the bottom of the Misery Pit. With the Jay Project, reclamation back-flooding of the Lynx Pit will be accomplished by pumping water containing elevated total suspended solids (TSS) during the later stages of Dewatering of the diked area in Lac du Sauvage (Golder 2016a). Once the storage capacity of the Lynx pit lake is filled and acceptable water quality has been confirmed, runoff reporting to the Lynx pit lake will overflow through the original Lynx channel to Lac de Gras.

4.6.8 Fuel Storage

Fuel storage on site has a capacity of 96 ML, with plans in place to increase total capacity to 98 ML for the Jay Project. A central bulk fuel farm that contains 8 tanks and approximately 68 ML is located at the Ekati main camp. Other satellite fuel farms are currently located at the Misery (9 ML fuel tank with dispensing and offloading facilities), Fox (18 ML), and Koala North sites (1 ML). Planned fuel storage at the Sable site is 2 ML, with four 50,000 L tanks. To support the logistics of fuel delivery to the site, the Ekati mine leases a tank farm in Yellowknife with a capacity of 80 ML. The fuel tanks are double-lined and housed within bermed areas on an impervious liner.

Fuel storage, dispensing, and offloading activities are covered under the Ekati mine Spill Contingency Plan. The Spill Contingency Plan was developed to establish and document practices for responsible management of controlled substance spills and focuses on spill prevention and spill response. The MUG Project does not require any increase or procedural modification to current fuel storage, handling, and spill contingency plans.

4.6.9 Tibbitt to Contwoyto Winter Road

The TCWR provides seasonal road access to the Ekati mine. The Ekati mine is located at approximately kilometre 405 of the road. Approximately 85% of the road consists of frozen lakes and ponds, which are connected by short overland portages.

Fuel, large equipment, and heavy consumables are trucked to the site on the TCWR. Ekati mine freight typically varies with up to 4,000 trucks per year. The logistics of planning and expediting the delivery of freight required for a full year of operation by the winter road over an approximately two-month period is critical to successful mining operations.

The TCWR is built, permitted, and operated by a joint venture of mining companies (DDMI, DDEC, and De Beers Canada Inc.) operating in the area, and is shared by other industrial users (i.e., exploration companies). The road is open to the public and provides access for hunters and tourists. This seasonal winter road is open for eight to ten weeks each year (i.e., from late January to the beginning of April, depending on weather and the season's load requirements), and must be re-flooded each year to service mines in the area. Occasionally, the winter road is extended by others north from Lac de Gras to Contwoyto Lake.

The road is capable of accommodating high levels of traffic. During peak usage years, over 10,000 truckloads per year were safely transported to the mine sites (Joint Venture 2017).

Three seasonal maintenance / staging camps are located along the road. The most northerly is the Lac de Gras camp, which is located on the southeastern shore of Lac de Gras.

No modifications or refurbishments of the TCWR are anticipated to accommodate the Project.

4.7 Anticipated Human Resources

Mine operations staff currently employed at the Misery site, as well as staff in the processing plant and other support functions at the Ekati mine will have the opportunity for extended employment by integrating the MUG Project into mine operations. Construction ramp-up will occur in 2018, requiring a small number (around 27 positions at peak) of personnel, largely in managerial and planning roles. As construction continues into 2019, both the direct DDEC and contracted workforces will increase, with large growth in the number of specialized trades and operators required for underground mine construction. There will also be some requirement for entry-level general construction labour. Peak employment (175 positions) is expected to be reached in November of 2019, extending into December. As construction activities come to a close in 2020, and operational activities ramp up into 2021 and 2022, average annual operation labour requirements are expected to remain stable between 152 to 163 positions, with peak employment ranging from 153 to 172 positions. Operations would ramp-down during the beginning of 2023, with a peak to 165 positions during the middle of this year associated with labour required during the cessation of mining activities at the MUG Project.

The Ekati Socio-Economic Agreement (SEA) sets targets for Northern and Northern Aboriginal hiring at 33% and 15% (or 44% of the total northern employment target), respectively, during construction, and at 62% and 31% (or 50% of the total northern employment target), respectively, during operations. The Ekati mine has performed well against these, and other, targets and reports on its performance annually. Given the heavy requirement for a highly specialized, contracted workforce associated with underground mining activities, these targets may be difficult to achieve. DDEC is committed to continuing to prioritize Northern and Northern Aboriginal employment candidates and contractors, and will look for options to source locally wherever practical.

4.8 Support for Sustainable Northern Community and Culture

As outlined in the 2015 Ekati Diamond Mine Socio-Economic Agreement Report (DDEC 2015):

> *"Dominion Diamond is committed to the people and communities of the North and aims to make a positive difference through employment, community development, and business opportunities.*
>
> *We firmly believe that promoting the health and well-being of our people, protecting the environment, and investing in northern communities are not just the right things to do, they are also critical for our business. They help us build trust and credibility, pursue new opportunities, manage business risk, and maintain our social license to operate.*

The Ekati mine Impact Benefit Agreements (IBAs) establish requirements for funding, training, preferential hiring, business opportunities, and communications. These agreements extend over the life-of-mine. Relationships with each of the IBA groups are maintained through regular meetings and communications. As part of these agreements, DDEC provides financial support for projects that aim to advance long-term sustainable community initiatives.

The Ekati mine SEA establishes a target of 70% northern purchase of goods and services.

In the event of any additional procurement, DDEC will continue to work to meet the northern business procurement targets outlined in the Ekati mine SEA, thereby continuing sustained business opportunities for northern goods and services providers during the life of the MUG Project. The Ekati mine has performed well against these measures, and targets and reports on its performance annually.

4.9 Closure and Reclamation

4.9.1 Ekati Mine Interim Closure and Reclamation Plan (ICRP)

The Ekati mine is required under the Water Licence and the Environmental Agreement to have a closure plan. Version 2.4 of the Interim Closure and Reclamation Plan (ICRP; BHP Billiton 2011) was approved by the WLWB in November 2011 and addresses reclamation obligations at the Ekati mine. Reclamation progress and ICRP updates are reported to the WLWB annually. An update to the ICRP is in progress, to be completed within 12 months of the issuance of the Jay Project Water Licence amendment (i.e., July 6, 2018).

4.9.2 Reclamation Goals and Objectives

The reclamation goal for the Ekati mine, as approved by the WLWB through the ICRP report (BHP Billiton 2011), is "to return the Ekati mine site to viable, and wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment, human activities, and the surrounding environment." The reclamation goal is supported by specific objectives and completion criteria for each type of development (e.g., open pits, underground workings, roads). The proposed closure and reclamation plan for the MUG Project facilities has been designed to fit into this established framework. Where applicable, the closure and reclamation activities for temporary closure, progressive reclamation, and permanent closure have been adopted from the ICRP and the annual ICRP progress reports. The *Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories* issued by the Mackenzie Valley Land and Water Board and Aboriginal Affairs and Northern Development Canada

(MVLWB/AANDC 2013) have been considered in the development of proposed closure and reclamation activities.

4.9.3 Temporary Closure Measures

Temporary closure occurs when a mining operation ceases with the intent of later resuming activities. Temporary closure could be due to an unplanned closure or a planned closure of certain facilities in a complex mining project (MVLWB/AANDC 2013). These temporary closures could be short term (last for weeks) or long term (last for years). The goal of temporary closure activities is to ensure the ongoing protection of humans, wildlife, and the environment, including necessary environmental monitoring during the cessation of mining activities until the mining operations can resume. Temporary closure assumes that full operations will resume when the factors causing the shutdown are normalized. Therefore, it is assumed that no final closure of major mine components will be completed during this period and the current licencing and permitting agreements will continue to be in force.

The required monitoring and reporting during the temporary closure will be the same as the required monitoring procedures and reporting requirements carried out during operations and in compliance with all applicable federal and territorial laws and regulations. The monitoring procedures and reporting requirements during operations will be defined in the Water Licence, Land Use Permit, *Fisheries Act* Authorizations, and other environmental agreements for the Misery site and the MUG Project. In the case of a temporary closure, the numbers of personnel on site will be reduced considerably relative to operational numbers. Staff present on site during temporary closure will be sufficient in number and expertise to successfully carry out care, maintenance, and monitoring duties and to respond to unplanned occurrences. Sufficient equipment and supplies/reagents will be left on site for any maintenance or environmental protection activities that may need to take place.

4.9.4 Progressive Reclamation

Progressive reclamation may be undertaken where beneficial use of the operational resources available at the Ekati mine can allow the work to be conducted more efficiently and where the work will lead to reduction of financial security. Progressive reclamation activities are scheduled for mine areas where there is no potential for future benefits or business opportunities or in areas where there is an opportunity to mitigate potential environment risk. Reclamation is scheduled to continue throughout the life of the Ekati mine DDEC has adopted a progressive reclamation feasibility evaluation approach, which means mine areas that are no longer needed for operations are evaluated that reclamation will begin as early as possible, starting with areas no longer needed for mine operations.

4.9.5 Permanent Closure and Reclamation

Permanent closure is the final closure of a mine site with no foreseeable intent by the existing proponent to return to either active exploration or mining. Permanent closure indicates that the proponent intends to have no activity on the site aside from post-closure monitoring and potential contingency actions. Permanent closure does not, however, preclude the proponent or another party from pursuing opportunities at the existing site or in the area at a time beyond the foreseeable future (MVLWB/AANDC 2013). It is possible that viable opportunities for ongoing use of site facilities by others may be identified, and these will be considered.

The following sections provide the permanent closure and reclamation activities for the facilities directly related to the MUG Project. Where applicable, the closure and reclamation activities have been adopted from the existing approved ICRP (BHP Billiton 2011) and ICRP updates approved as part Annual Reclamation Reports for the Ekati mine. An update to the ICRP is in progress, to be completed within 12 months of the issuance of the Jay Project Water Licence amendment. The updated ICRP will include the WLWB supported closure concepts outlined in Jay Project Conceptual Closure and Reclamation Plan (Golder 2016b) submitted as part of the Jay Project Water Licence Application.

Misery Underground Workings and Infrastructure

The Misery underground workings will be reclaimed as described in the Ekati mine ICRP for underground mines (Section 5.3; BHP Billiton 2011). Surface installations, such as ventilation fans will be removed and engineered plugs will be installed in surface raises. Portals will be sealed to prevent human or wildlife access.

At closure, mobile equipment and vehicles that can be salvaged and sold from the Misery Underground mine will be removed. Pipes, cables, electrical gear and fixed equipment that have remaining salvage value will be removed, but other equipment will be left in place (e.g., mobile equipment, rock breaker and conveyor system that have been cleaned of fuels and lubricants). Oxygen bottles and chemical cleaners and materials with potential for chemical degradation that are located in the maintenance shops (e.g., petroleum products, batteries) will be removed from the underground. Material and equipment that is not considered as salvageable and/or will not negatively impact water quality will remain in the underground, rather than be hauled to surface and buried in a landfill.

Explosives supplies are only maintained in one to two day quantities underground, so there will be limited amounts on-site when underground mining is complete. Any inventory of explosives remaining underground will be removed and disposed of safely. All portals into the underground mines and fresh air raises will be sealed as per the Northwest Territories *Mine Health and Safety Act*.

4.9.5.1 Misery Temporary Kimberlite Storage Pad

Kimberlite ore will be removed from the temporary ore storage area at the Misery site and the pad will be re-contoured and scarified as necessary.

4.9.5.2 Misery Waste Rock Storage Area

The Misery WRSA has been designed to remain in place after operations and it will be reclaimed in a manner similar to the existing WRSAs at the Ekati mine (BHP Billiton 2011). It has been designed to be physically stable, both during mine operations and in the long term. It has been designed, and will be constructed, to minimize runoff and encourage permafrost formation through the sequence of materials placement. Reclamation will focus on providing a thermally protective surface cover over potentially acid generating materials (i.e., metasediment rock). The design provides a relatively flat upper surface that discourages snow accumulation and provides for wildlife safety through caribou emergency egress ramps. For the Misery WRSA, the proportion of granite waste rock is more than sufficient to provide for a minimum 5 m thick cover of granite that will maintain permafrost within the underlying metasediment rock. The MUG Project does not affect the closure plan for the Misery WRSA, due to the small quantity of waste rock that will be generated by the Project, anticipated to be primarily granite.

4.9.5.3 Lynx Pit

During the MUG Project, the Lynx Pit will be used for operational minewater management. The Lynx Pit will hold minewater from the MUG Project that contains elevated concentrations of total dissolved solids (TDS). At closure, the water will be pumped to the bottom of the Misery Pit.

Reclamation of the Lynx Pit is described in the Jay Project Conceptual Closure and Reclamation Plan (Golder 2016b). After mining is completed, the pit will be partially filled with TSS-laden water. The rest of the pit will be filled using pumping, natural precipitation and surface water inflow. This allows time for the TSS to settle prior to the Lynx pit lake naturally discharging to Lac de Gras. Once the storage capacity of the pit lake is filled and acceptable water quality has been confirmed, runoff reporting to the Lynx pit lake will overflow through the original Lynx channel to Lac de Gras. In the absence of the Jay Project, Lynx Pit would be back-flooded with freshwater pumped from Lac de Gras at closure.

Other aspects of reclamation of the Lynx Pit will proceed as described in the existing approved closure plan for pit lakes (Golder 2016b; BHP Billiton 2011).

4.9.5.4 Misery Open Pit

At the end of the MUG Project, the minewater stored in the Lynx Pit will be pumped to the bottom of the Misery Pit and underground workings. The Misery Pit will then become the primary minewater management facility for the Jay Project.

Final closure of the Misery Pit will be as described in the Jay Project Conceptual Closure and Reclamation Plan (Golder 2016b). The in-pit water level will be lowered to approximately 60 m below the final overflow elevation by pumping water into the mined-out Jay Pit once the Jay Project operations have ceased. A 60 m cap of freshwater pumped from Lac du Sauvage will be deposited above the minewater in the Misery Pit. Using monitoring results obtained during operations, DDEC will conduct an optimization study to evaluate the optimal depth of the Misery Pit freshwater cap required to maintain meromictic conditions in the pit, per Measure 4-2b of the Report of Environmental Assessment (MVEIRB 2016) and the amended Ekati mine Water Licence to include the Jay Project (WLWB 2017).

Water remaining in the lower part of the Misery Pit will have elevated concentrations of TDS. Following pumping of freshwater from Lac du Sauvage, a density gradient will form in the pit resulting in meromixis, preventing the higher TDS water from mixing with the overlying freshwater cap. A combination of catchment area runoff, precipitation, and freshwater pumped from Lac du Sauvage will be used to create the freshwater cap.

In the event that the Jay Project is not advanced, completion of back-flooding of the Misery Pit will be accomplished by pumping freshwater from Lac de Gras over the MUG Project water at the bottom of the pit. Meromixis will form in the Misery Pit preventing the higher TDS water from mixing with the freshwater cap.

Post-closure water quality predictions for the Misery Pit for both scenarios are summarized in Golder (2017c) in Appendix F of the Water Licence and Land Use Application package for the MUG Project.

A detailed design of the Misery Pit back-flooding plan will be developed for the Final Closure and Reclamation Plan based on site-specific monitoring and industry experience. During back-flooding, water

quality will be monitored to confirm the progression and formation of meromictic conditions before releasing water to the Receiving Environment. In the highly unlikely event that meromixis does not establish, and if water quality in the water from the Misery pit lake is not acceptable for release by the time the lake is nearing discharge elevation, adaptive management will be implemented.

Once the freshwater cap is created and water quality has been demonstrated to be suitable for release, a hydraulic connection to the natural channel to Lac de Gras will be re-established to allow for overflow of water from the surface of the Misery pit lake to the environment as described in the existing approved ICRP. As operational monitoring data from the Misery Pit become available, DDEC will update water quality predictions in parallel with ongoing operational and closure monitoring and planned pit lake research studies in the ICRP so that Misery Pit satisfies closure goals and objectives.

Other aspects of reclamation of the Misery Pit will proceed as described in the existing approved ICRP.

4.9.5.5 Mined-out Panda and Koala Pits

The permanent reclamation of the Panda and Koala pits will proceed by pumping freshwater into the pits as a cap overlying the PK. As part of the finalization of the operational and closure planning for the Panda and Koala pits, DDEC will conduct an optimization study for the depth of the freshwater cap in the WPKMP and the ICRP as per the requirements of the amended Ekati mine Water Licence (WLWB 2017). Without placement of PK in the pits, the closure scenario includes pumping from Upper Exeter Lake and requires substantively more freshwater.

When water quality monitoring in the back-flooded pits indicates closure criteria have been achieved, the Panda/Koala pit lakes will be reconnected to the Koala watershed and flow into Kodiak Lake. Other aspects of reclamation of the Panda and Koala pits will proceed as described in the existing approved ICRP.

4.9.5.6 Ekati Mine Facilities Used by the MUG Project

The use of the many Ekati mine facilities will continue during the MUG Project, and the closure and reclamation of these facilities will be carried out after the Ekati mine operations, including the Jay Project, have ceased and there is no further value in them. The closure and reclamation plan for the facilities listed below will not require modifications and will be undertaken as part of the existing approved ICRP:

- processing plant and associated facilities;
- Ekati main camp, airstrip, explosives storage and manufacture facilities, and associated facilities;
- Misery camp and associated facilities;
- King Pond Settling Facility;
- Cells D and E of the existing LLCF; and,
- Misery Road and powerline.

4.9.6 Reclamation Research

Reclamation research is undertaken to evaluate and better understand uncertainties that may exist in the type and extent of environmental effects remaining after mine closure. Research plans assist in the identification and design of closure and reclamation activities, and define quantitative closure criteria so that closure objectives can be set. Traditional Knowledge, which is given consideration alongside western science, is also included in reclamation research. The MUG Project does not require any reclamation research.

4.9.7 Post-Closure Monitoring

Monitoring for physical and chemical stability and maintenance of the reclaimed facilities will be required after closure and during post-closure until closure objectives and criteria are met (ultimate closure conditions are reached). Post-closure monitoring is discussed in the ICRP (BHP Billiton 2011, Appendix 5.1-6). The monitoring programs that will be in place for mine operations will be used as a basis and adapted to meet closure and post-closure specific needs. The MUG Project does not introduce any additional requirements for post-closure monitoring beyond what is described in the ICRP and subsequent updates. The ICRP establishes general post-closure monitoring timeframes of 5 to 10 years following reclamation of an area or facility. Individual component timeframes will be established and periodically reviewed on a case-by-case basis depending on monitoring results and other circumstances. Monitoring of the water quality in the pit lakes (i.e., Lynx, Misery, Panda, Koala) is a component of the post-closure monitoring programs.

4.10 Accidents and Malfunctions

This section outlines potential accidents and malfunctions that could occur during construction and operations of the MUG Project and the associated mitigation measures. Potential risks from accidents and malfunctions considered the following categories:

- Environment: potential impacts to land, water resources, air, ecosystems, biodiversity, archaeological aspects and community (includes water quality, fish and fish habitat, vegetation caribou, wildlife, terrain, and cultural aspects)
- Public Health and Safety: potential impacts to public such as injury and health issues resulting from accidents and malfunctions of project components (does not consider potential impacts to workers' or mine personnel health and safety)

Table 4.10-1 lists the potential risks from accidents and malfunctions associated with the MUG Project and existing management systems or plans in place at the Ekati mine to manage these risks. Open pit operation at the Misery Pit started in 2002 and underground mining has been carried out at the Ekati mine since underground production began at the Panda Pit in June 2005; therefore, no new risks associated with the MUG Project have been identified for the Ekati mine. The risk assessment that was developed for the evaluation of accidents and malfunctions associated with the Jay Project, and Jay Project components, is included in Appendix 3C of the DAR (DDEC 2014).

Table 4.10-1 Risk Management for Environment and Public Health and Safety

Project Component	Failure	Existing Management Control Systems
Construction of the MUG Project	• Failure of water management system • Failure of infrastructure and equipment • Release of contaminants • Haulage and transportation	• Construction QA/QC • Hazardous Waste Management Plan • Hydrocarbon Impacted Material Management Plan • Emergency Response and Spill Contingency Plans • Traffic Management Standard • Winter Road Regulations and Rules of the Road
Failure of dewatering systems	• Pipeline rupture • Pumping failure	• Water Management Plan • Regular inspection and maintenance Contingency Storage
Erosion or failure of King Pond Storage Facility	• Failure of storage facility	• Construction QA/QC for Saddle Dam upgrades • Maintenance of freeboard allowance • Regular inspection • Contingency storage in Waste Rock Dam pond • Emergency Response and Spill Contingency Plans
Power system distribution	• Leaks or spills from transformers	• Operational diligence and management • Emergency Response and Spill Contingency Plans
Drilling and blasting	• Ground instability • Falling material	• Operational diligence and management
Misery Pit slope failure	• Unexpected falling material • Earth tremors • Breached access routes	• Pit management throughout Life of Mine Emergency Response Plans • Spill Contingency Plans
Misery Pit dewatering failure	• Pipeline rupture • Pumping failure • Seepage flow rates exceeding pumping rates • Contamination event	• Construction QA/QC • Pit management throughout Life of Mine • Water Management Plan • Emergency Response Plans • Spill Contingency Plan
Haulage and transportation	• Erosion/damage to infrastructure • Small fuel spills • Large fuel spills	• Emergency Response Plans • Spill Contingency Plan • Traffic Management Standard • Driver training • Speed restrictions
Waste rock systems	• Acid drainage	• Waste Rock and Ore Storage Management Plan • Geochemical Characterization and Metal Leaching Management Plan • Operational diligence and management

QA/QC = quality assurance/quality control.

4.10.1 Risk Mitigations

Mitigations of risks considered in the preliminary assessment design controls, monitoring and inspections, quality assurance (QA) and quality control (QC) during construction and maintenance during operation

and closure. In addition, mitigation of risks was considered to be further controlled through implementation of the various operational management plans currently in place at the Ekati mine, which include the following:

- Waste Management Plan;
  - Incinerator Management Plan;
  - Hazardous Waste Management Plan;
  - Solid Waste Landfill Plan;
  - Hydrocarbon Impacted Material Management Plan
- Waste Rock and Ore Storage Management Plan
- Wastewater and Processed Kimberlite Management Plan
- Interim Closure and Reclamation Plan
- Winter Road Regulations and Rules of the Road
- Traffic Management Standard
- Emergency Response and Spill Contingency Plans
- Water Management Plan
- Archaeological Management Plan; and,
- Geochemical Characterization and Metal Leaching Management Plan.

4.11 References

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5.0 COMMUNITY ENGAGEMENT

5.1 Pre-Application Engagement

The Dominion Diamond Ekati Corporation (DDEC) community engagement process is based on open and honest engagement with people affected by the Ekati Diamond Mine (Ekati mine) operations, and taking their views and concerns into account in decision making process. The primary regulatory guidance document followed is the *Engagement Guidelines for Applicants and Holders of Water Licences and Land Use Permits June 1, 2013*, issued by the Land and Water Boards of the Mackenzie Valley (MVLWB 2013).

The pre-application engagement for the Misery Underground (MUG) Project concentrated on the Ekati mine affected and potentially affected parties, as well as regulatory agencies and the Independent Environmental Monitoring Agency (IEMA). Engagement has previously been conducted on all aspects of the Ekati mine as part of environmental assessment and regulatory processes, including the issuance of the most recent Water Licence (WL) amendment to include the Jay Project in July 2017.

From the time of the announcement that DDEC would purchase the Ekati mine in November 2012, DDEC has been clear and transparent about its vision to extend the operating life of the mine and its associated benefits. Upon taking ownership in April 2013, DDEC initiated a series of engagement meetings with the leadership of the Impact Benefit Agreement (IBA) groups and potentially affected communities. The purpose of these meetings was to share DDEC's intentions on extending the life of the Ekati mine and potential of future projects. DDEC has maintained regular and ongoing engagement on a variety of issues, including potential extension projects, with each of its affected and potentially affected parties since taking ownership of the Ekati mine in 2013. The extension of the Ekati mine has been achieved through the development of the Lynx and Sable pits, and the permitting and approvals for the Jay Project. Development of the MUG Project is another key venture to extend the life of the mine, by bridging production from Sable to the Jay Project.

Feedback from engagement meetings has consistently identified several priority areas of interest, including caribou, water quality, fish, and mine closure. These topics, as they apply to the Project, are addressed through Project design, and the environmental mitigation and monitoring measures described in this report.

Engagement meetings were held with communities from June through August 2017 to talk about aspects of the MUG Project. The engagement log for this application is provided as Appendix B of the Water Licence and Land Use Permit Application for the MUG Project (DDEC Engagement Log, August 2017).

5.2 Community Engagement Plan

DDEC's approach to engagement is set out in the Ekati mine Engagement Plan, which is approved by the Wek'èezhìı Land and Water Board (WLWB). The most recent version of the Engagement Plan is Version 3.0 (DDEC 2016) found in the WLWB's online registry (http://registry.mvlwb.ca/Documents/W2012L2-0001/W2012L2-0001 - Ekati - Engagement Plan - Version 3.0 - May 13_16.pdf). The Engagement Plan is a culmination of successful engagement activities that have been developed and have become well established since the Ekati mine was first licenced and operational. DDEC undertakes community engagement activities on a regular and routine basis as part of its management of the Ekati mine.

The engagement activities include:

- quarterly engagement meetings between DDEC Senior Management and communities
- formal IBA meetings with leadership from each of the Ekati mine IBA groups;
- workshops on specific issues; and,
- site based activities wherein leadership, Elders, and youth are invited to visit the Ekati mine for site visits or to take part in the environmental monitoring programs.

There are also a number of routine report submissions to the WLWB, all of which are posted to the Board's public registry (http://www.mvlwb.ca/Registry.aspx?a=W2012L2-0001&c=Dominion%20Diamond%20Ekati%20Corporation) where any party can provide comment or questions.

Ongoing engagement on the Project will be incorporated into the well-established and ongoing engagement activities of the Ekati mine. This approach also acknowledges that the Project is a direct extension of the same mining activities that have been undertaken at the Ekati mine for the past 18 years.

The key engagement activities that will be used to incorporate ongoing engagement about the MUG Project are as follows:

- planned engagement meetings on possible future development projects;
- routine IBA meetings with IBA community leadership;
- annual community presentations on environmental monitoring programs;
- twice yearly routine implementation meetings with the IEMA, plus other ad hoc meetings throughout the year (typically four to five meetings);
- annual elder/youth site visits for environmental monitoring programs (typically two to three site visits);
- WL and Environmental Agreement Annual Report, which is provided in plain language and is circulated to all parties and communities for comment and review;
- quarterly meetings of the Ekati mine Inter Agency Coordinating Team, one of which is typically held at the Ekati mine;
- site inspections and reports of the Government of the Northwest Territories Water Inspector, which are carried out on behalf of the WLWB and are posted to the WLWB's public registry; and,
- annual site visit by the WLWB.

These engagement activities equally involve all of the affected and potentially affected parties. Past environmental assessment processes and the Environmental Agreement document the Company's commitment to continue work on traditional knowledge (TK) projects and to incorporate TK into environmental management. The Environmental Agreement states the following:

> *"Dominion Diamond Ekati Corporation shall incorporate all available traditional knowledge in the Environmental Plans and Programs and shall give all available traditional knowledge full consideration along with other scientific knowledge as the Environmental Plans and Programs are developed and revised" (Article X1, Item 11.3).*

The recent focus of the Ekati mine's TK programs has been Aboriginal engagement in the environmental programs at the Ekati mine, and the continuation of community-based TK engagement projects. The overall intent of these programs are as follows:

- to provide opportunities for community members (elders, adults, and youth) to visit the site and allow for incorporation of TK into various aspects of the Ekati mine to improve the overall performance of the mine;
- to demonstrate and provide hands-on-experience for community members in gaining a general awareness as active participants on how the Environmental Team at Ekati mine conducts its day-to-day site-based environmental monitoring programs; and,
- to provide support for community-based TK and for sharing of information and knowledge from all of these programs.

Over the past few years, with support from the Ekati mine, local community organizations have initiated and facilitated successful community TK projects. The goals are to preserve, share and promote their TK and to provide a lasting, meaningful benefit to their communities. The goal for DDEC, moving forward is to strengthen relationships with local Aboriginal groups through on-going community engagement and enhanced TK programs that respect values, beliefs, knowledge and experiences, and that builds on the success of the community environmental engagement programs.

The Engagement Plan undergoes an annual review and does not require changes to incorporate the Project. Please see the WLWB online public registry for the most recent approved version of the Engagement Plan. Note that the plan will be revised and resubmitted for approval as per amendments to the Ekati WL for the Jay Project (Part B Condition 11).

DDEC welcomes feedback on the MUG Project as well as other plans, reports, applications at any time and will respond accordingly.

5.3 References

DDEC (Dominion Diamond Ekati Corporation). 2016. Ekati Mine Engagement Plan V3.0. HSE RCD ENV 341. May 2016.

MVLWB (Mackenzie Valley Land and Water Board). 2013. Engagement Guidelines for Applicants and Holders of Water Licences and Land Use Permits. Mackenzie Valley Land and Water Board. Yellowknife, NWT.

6.0 ENVIRONMENTAL AND SOCIO-ECONOMIC RISKS AND MITIGATION

6.1 Introduction

This section identifies all potential Misery Underground (MUG) Project interactions and describes the approach used to assess potential Project interactions and the corresponding potential effects to valued components (VCs). The assessment approach considers how Project components and activities may interact with the environment and result in an effect on one or more environmental components (VCs). Interactions are linkages between Project components or activities and potential changes to the VCs, which are then used to assess residual effects (i.e., after mitigation) on VCs.

The approach considers a number of factors, including information from baseline studies, effects predictions from previous assessments (BHP and Dia Met 1995; BHP Billiton 2012; DDEC 2014), results from existing monitoring and follow-up programs, the Project Description (Section 4.0), and existing conditions in the Dominion Diamond Ekati Corporation (DDEC) Ekati claim block. Although all potential Project-environment interactions are evaluated, the intent is to focus on those interactions with the greatest potential to result in residual effects to VCs of the biophysical and socio-economic environments. The Project is located within the existing Misery Pit development area and the socio-economic benefits of the Ekati Diamond Mine (Ekati mine) will be maintained with MUG Project approval.

Certain components and activities of the proposed MUG Project have already been subject to environmental assessment (BHP and Dia Met 1995; BHP 2012; DDEC 2014). For example, project components such as processing facilities, primary access roads, an airstrip, and waste storage facilities are not required as part of the MUG Project.

The following activities will be undertaken to enable underground mining at Misery:

- mining of the Misery main kimberlite pipe using the Sublevel Retreat mining method;
- placement of underground waste rock at the existing and permitted Misery waste rock storage area (WRSA);
- operational management of minewater during underground mining; and,
- reclamation of the constructed facilities.

With the change in mining methods from open pit to underground, new infrastructure required at the Misery site will be:

- 80 person addition to the existing Misery camp;
- portals for underground access – two in pit locations and possibly a surface portal;
- expansion to the existing surface sprung structures;
- additional dewatering lines;

- development and construction of an underground mine fresh air raise (FAR) and supply of compressed air to deliver fresh air to the underground work area;
- addition of an Emergency Response Team (ERT) building (to be a fold-away structure); and,
- connection to the Misery powerline to the underground.

In addition to the above noted new infrastructure components for the MUG Project, there will be:

- minor modifications to the Saddle Dam at the King Pond Settling Facility;
- possible upgrades to the existing shotcrete plant;
- rehabilitation of the existing ERT hall to become the underground dry building; and,
- a temporary ore stockpile to be located within the footprint of the Misery Pit area.

Underground construction and operations activities have been completed at other locations at the Ekati mine (e.g., Koala, Koala North, and Panda underground operations). An adaptive management approach has been successfully applied to address effects that differed from the original predictions, or those that were not anticipated in the Environmental Assessment (EA). In addition, multiple monitoring programs are in place for the Ekati mine.

6.2 Assessment Approach

This section describes the approach used to carry out the effects assessment for the Project. The approach involved completion of the following tasks:

- determine the scope of the Project (Section 4.0);
- identify the Project phases that are relevant to the assessment (Section 6.2);
- select VCs to be considered (Section 6.3);
- identify existing programs and plans that are relevant to the Project (Section 6.4);
- describe and assess the likely effects of the Project on VCs, including mitigation measures to be incorporated into the Project (Section 6.5); and,
- identify residual environmental effects of the Project (Section 6.6).

The Ekati mine Water Licence amendment to include the Jay Project was approved by the Minister of the Government of the Northwest Territories in July 2017 (WLWB 2017). As such, the effects assessment considers that the approved and permitted Jay Project will proceed following the MUG Project. This approach is consistent with standard EA procedures to include the cumulative effects of all existing and approved projects in the underlying assumptions applied to the assessment. Many of the aspects of the MUG Project have been through EA, as part of the Jay Project Developer's Assessment Report (DAR; DDEC 2014). Note, however, that the water balance and water quality modelling completed to support the

MUG Project (Golder 2017a,b) has also considered a scenario where the Jay Project does not immediately follow the MUG Project, to evaluate closure conditions under this scenario.

The Scope of the Project, as it is planned to proceed through construction, operations, closure, and post-closure phases of the MUG Project, is described in detail in Section 4.0. This description includes a detailed timeline for all phases of the Project and a discussion of Project components and activities, including supporting infrastructure that are proposed to advance the Project.

The Project phases considered in the assessment include Project construction, operations, closure, and post-closure, as outlined below. Underground mining of the MUG Project has been scheduled to occur in advance of the Jay Project. The timing of MUG and Jay Projects are related by the use of Misery Pit for Dewatering and minewater management for the Jay Project. Closure of the MUG Project will overlap with Jay Project construction and operations, as some project components used for the MUG Project will also be used for the Jay Project. A detailed Project Schedule for the MUG Project is presented in Section 4.2.

Construction (2018 to 2019)

- Annual Discharge from King Pond Settling Facility to Cujo Lake after freshet but before the start of pumping of minewater from Misery underground developments
- Upgrades to King Pond Settling Facility Saddle Dam water control structure
- Expansion of Misery Camp
- Installation of new infrastructure required for the Project (e.g., ventilation/heating and compressed air facilities, power transmission line, underground mine access locations)
- Underground mine ramp and level development (and corresponding infrastructure)
- Management of MUG Project minewater in King Pond Settling Facility

MUG Project Operations (2019 to 2022)

- Underground mining of the Misery main kimberlite pipe and operation of surface infrastructure and support facilities
- Storage of waste rock at the existing Misery WRSA
- Hauling of kimberlite from the Misery site to the Ekati main site along the Misery Road
- Deposition of processed kimberlite (PK) in the Long Lake Containment Facility (LLCF) or mined-out Beartooth, Panda and Koala Pits
- Continued management of MUG Project minewater in King Pond Settling Facility until Lynx Pit is available
- Completion of mining at the Lynx Pit (estimated to be late 2019)

- Management of MUG Project minewater in the mined out Lynx Pit and transfer of minewater from King Pond Settling Facility to Lynx Pit, late September 2019
- Completion of mining at Misery Underground in mid-2022

MUG Project Closure and Transition to Jay Project Construction and Operations

- Decommissioning of the Misery Underground mine, in mid-2022, which includes the removal of infrastructure and mining equipment from the underground workings
- Pumping of minewater stored in Lynx Pit and King Pond Settling Facility (as required) to the mined out Misery underground workings (approximately 3 months)
- Jay diked area final Dewatering into the top of Misery Pit (and Lynx Pit) as per plan for Jay Project
- Operation of the Misery Pit minewater management facility, as per Jay Project plan

Post-closure Following Jay Project Closure

- Reconnection of the Misery Pit to the local hydrological system after closure of the Jay Project and upon approval from the Wek'èezhìı Land and Water Board (WLWB)

The VCs chosen to focus the assessment are described in Section 6.3. This description includes a summary of the procedure used to select VCs and rationale for their selection, and is based on an initial screening of expected Project-environment interactions. The selected VCs have been used for previous environmental assessments for the Ekati mine, including for the Misery open pit development (BHP and Dia Met 1995) and the recent Jay Project (DDEC 2014). Definitions of key properties of each VC that require protection to be sustainable and the measurable indicators of change that are important for predicting the significance of residual effects and for monitoring and managing these effects are also discussed.

Existing programs and plans that are relevant to the Project and to the assessment are summarized as follows and described in more detail in Section 6.4:

- Waste Management Plan;
- Waste Rock and Ore Storage Management Plan (WROMP);
- Wastewater and Processed Kimberlite Management Plan (WPKMP);
- Interim Closure and Reclamation Plan (ICRP);
- Wildlife Effects Monitoring Program (WEMP);
- Surveillance Network Program (SNP);
- Aquatic Effects Monitoring Program (AEMP);
- Air Quality and Emissions Monitoring and Management Program (AQEMMP);

- Engagement Plan; and,
- Spill Contingency Plan.

A description and evaluation of the likely effects of the Project on VCs is provided in Section 6.5. This section also describes the relevant environmental design features and mitigation that will be incorporated into the Project to remove or limit effects on VCs. An assessment of Project interactions that are anticipated to result in a residual environmental effect on a VC is provided in Section 6.6.

6.3 Valued Components

6.3.1 Selection of Valued Components

Valued components represent physical, biological, cultural, social, and economic properties of the environment that are considered to be important by society. The inter-relationships between components of the biophysical and human environments provide the structure of a social-ecological system (Folke 2006). The concept of using VCs as a fundamental aspect of EA in Canada, and elsewhere, was established approximately 30 years ago (Beanlands and Duinker 1983).

Examples of physical properties that can be considered VCs include groundwater, surface water, terrain, and air. Aquatic and terrestrial plant and animal populations represent biological properties that can be considered VCs. Traditional and non-traditional uses of water, plants, and animals and other biophysical properties (e.g., ecological resources) can be VCs of the cultural, social, and economic environment.

A number of biophysical VCs have been defined and were used for previous assessments (BHP and Dia Met 1995; BHP 2012; DDEC 2014); these VCs will be used for the assessment of effects for the MUG Project. The final list of VCs for the MUG Project and rationale for the selection of these VCs is provided in Table 6.3-1.

Table 6.3-1 Valued Components Selected for the Project

Category	Valued Component	Rationale for Selection
Air	Air Quality	• Used in previous assessments for the Ekati mine • Close link between air quality and other VCs (i.e., surface water quality, aquatic life other than fish, fish, soils, vegetation, caribou, carnivores, breeding birds, and community health and well-being)
Water	Groundwater	• Used in previous assessments for the Ekati mine • Underground mining may extend below the permafrost and result in upward movement of groundwater • Changes to groundwater can affect quantity and quality of surface water, which can subsequently affect the aquatic and terrestrial environments and people that use these resources
	Surface Hydrology	• Used in previous assessments for the Ekati mine • Changes to surface hydrology can affect other VCs (i.e., fish, vegetation/wildlife habitat, wildlife, and surface water quality)

Table 6.3-1 Valued Components Selected for the Project

Category	Valued Component	Rationale for Selection
Water (continued)	Water Quality	• Used in previous assessments for the Ekati mine • Changes to water quality can affect other biophysical and socio-economic VCs that depend on suitable surface water quality (i.e., fish, vegetation, wildlife, land use and traditional land use, and community health and well-being)
	Aquatic Life Other than Fish	• Used in previous assessments for the Ekati mine • The distribution, abundance, and productivity of the plankton and benthic invertebrates that make up a large proportion of the food base for fish are influenced by changes to water quality
	Fish	• Used in previous assessments for the Ekati mine • A subsistence food; fishing is also a source of recreation for local communities • Have historical cultural value • Important indicators of the health of aquatic ecosystems as they are at the top of the food chain in aquatic environments and are a food source for some large wildlife • A vital part of traditional life in the region and continue to be prepared for consumption based on local cultural practices
Land	Permafrost	• Used in previous assessments for the Ekati mine
	Physical/Terrestrial Environment (Soils and Vegetation)	• Used in previous assessments for the Ekati mine • Includes the physical loss of land (soils and vegetation) • Close links between soils and other VCs (i.e., vegetation/wildlife habitat, wildlife, and surface water quality) • Vegetation provides food and habitat for wildlife • Protection of listed (rare) plant species designated by federal and NWT legislation • Some plant species are used for traditional and economic purposes
	Archaeology and Heritage Resources	• Used in previous assessments for the Ekati mine • Important for revealing past and present land use, cultural identity, and relationships with other cultures and the social and biophysical environments
Wildlife	Caribou	• Used in previous assessments for the Ekati mine • Important subsistence, cultural, and economic species (i.e., the Bathurst caribou herd) • Migratory species with extensive range requirements • Primary prey species for large carnivores in northern environments • Barren-ground caribou are listed as threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2017) and as sensitive in the NWT (NWT Infobase 2016) • Can be sensitive to noise disturbance, dustfall from construction and mine operations, and other human activities
	Carnivores	• Used in previous assessments for the Ekati mine • Includes grizzly bear, wolverine, and wolf • Grizzly bears have cultural value and are listed as of special concern by COSEWIC (COSEWIC 2017) and sensitive in the NWT (NWT Infobase 2016) • Wolves have cultural and commercial value, and are ecologically important because they are the main predator of caribou • Wolverine are generally not migratory, but long distance movements are made by transient individuals; large home range; can be attracted to human disturbance; listed as special concern by COSEWIC (COSEWIC 2017) and sensitive in the NWT (NWT Infobase 2016)

Table 6.3-1 Valued Components Selected for the Project

Category	Valued Component	Rationale for Selection
Wildlife (continued)	Breeding Birds	• Used in previous assessments for the Ekati mine • Upland breeding birds may be affected by habitat loss because of small territory size • Migratory birds are susceptible to population declines as a result of changing environmental conditions on breeding and overwintering habitats • Waterbirds may be affected by loss of shoreline habitat for breeding • Can be sensitive to noise disturbance and human activity • Some species of waterbirds are important for subsistence hunting • Includes some federally listed species – Species at Risk (e.g., common nighthawk, rusty blackbird, horned grebe, peregrine falcon)
Human	Land Use and Traditional Land Use	• Several fish, plant, and wildlife species are considered to be VCs by local Aboriginal people for hunting, trapping, fishing, and gathering for domestic and commercial use • Traditional Aboriginal use sites • Changes to the environment and aesthetics can affect quality of life
	Employment and Economy	• Potential to both sustain existing, and generate new economic and employment opportunities
	Community health and Well-being	• Labour demand can induce movement between communities, which can in turn place differential demand on housing, infrastructure and services • Changes in household incomes, family structures, and community cohesion may influence social disparity and maladies

VCs = valued components; COSEWIC - Committee on the Status of Endangered Wildlife in Canada; NWT = Northwest Territories.

6.3.2 Measurement Indicators and Assessment Endpoints

The definitions of the measurable indicators of change (i.e., measurement indicator) and the aspect or key properties of the VC that requires protection to be sustainable (i.e., assessment endpoint), help to focus baseline studies and screening of Project interactions, but are also important for predicting the significance of residual effects and for monitoring and managing these effects (Noble 2010). Assessment endpoints represent the key properties of VCs that should be protected for future human generations (i.e., incorporates sustainability). For example, maintenance or suitability of water quality, self-sustaining and ecologically effective fish and wildlife populations, and continued opportunities for traditional and non-traditional use of these ecological resources or goods and services may be assessment endpoints for surface water, fish and wildlife, and traditional and non-traditional land use.

Assessment endpoints are typically not quantifiable and require the identification of one or more measurement indicators that can be directly linked to the assessment endpoint. Measurement indicators represent properties or attributes of the biophysical and socio-economic environments that can be used to characterize changes to VCs in a meaningful way, and when changed, could result in, or contribute to, an effect on assessment endpoints. Measurement indicators may be quantitative (e.g., concentrations of metals in surface water, number of employment positions or increased incomes) or qualitative (e.g., movement and behaviour of wildlife in response to noise or human activity, community cohesiveness). Measurement indicators also provide the primary factors for discussing the uncertainty of effects on VCs and, subsequently, can be key variables for study in follow-up and monitoring programs.

All VCs have measurement indicators, but not every VC has an assessment endpoint. For example, VCs such as permafrost, groundwater, surface hydrology, and soils are strictly considered as measurement indicators for other VCs, and do not have assessment endpoints. VCs without assessment endpoints represent supporting components, and are important aspects of the natural and human environments for the assessment of effects to VCs with assessment endpoints, and in follow-up and monitoring programs. The same rigorous and comprehensive analysis is applied to VCs with and without assessment endpoints, but only VCs with assessment endpoints are evaluated for significance of residual effects. The results of the analysis of changes in measurement indicators for VCs such as permafrost, groundwater, surface hydrology, and soils are provided to other VCs with assessment endpoints (e.g., vegetation, fish and wildlife populations, land use and traditional land use, and community health and well-being) for inclusion in the analysis and evaluation of significance of residual effects.

The significance of effects from the MUG Project on VCs is evaluated by linking changes in measurement indicators to effects on an assessment endpoint. For example, changes in habitat quantity and quality (measurement indicators) are used to assess the significance of effects from the MUG Project on the ability of a wildlife population to remain self-sustaining and ecologically effective (an assessment endpoint). VCs, assessment endpoints, and measurement indicators used for the above purposes are presented in Table 6.3-2.

Table 6.3-2 Valued Components, Associated Assessment Endpoints and Measurement Indicators

Category	Valued Component	Assessment Endpoint	Measurement Indicator
Air	Air Quality	• No assessment endpoint; results of the assessment are used in the effects analysis for other VCs	• Total suspended particulates, coarse particulate matter, and fine particulate matter • Sulphur dioxide, nitrogen oxides, carbon monoxide, dioxins, furans • Metals (e.g., arsenic) • Deposition rates
Water	Groundwater	• No assessment endpoint; results of the assessment are used in the effects analysis for other VCs	• Groundwater levels and flow rates • Spatial and temporal distribution of groundwater • Concentrations of physico-chemical constituents (e.g., pH, conductivity) • Concentrations of major ions and nutrients • Concentrations of total and dissolved metals
	Surface Hydrology	• No assessment endpoint; results of the assessment are used in the effects analysis for other VCs	• Lake water levels and outflow discharge rates • Stream channel parameters (e.g., channel depths, widths) and shoreline integrity • Basin water yields
	Water Quality	• Suitability of surface water quality for healthy and sustainable ecosystems and traditional use	• In situ water quality parameters (e.g., temperature, dissolved oxygen, pH, conductivity) • Major ions, suspended solids, nutrients, and metals in water • Distribution of particle size in surficial sediment • Nutrients and metals in sediment

Table 6.3-2 Valued Components, Associated Assessment Endpoints and Measurement Indicators

Category	Valued Component	Assessment Endpoint	Measurement Indicator
Water (continued)	Aquatic Life Other than Fish	• Self-sustaining and ecologically effective fish populations (including listed species) • Ongoing fisheries productivity	• Concentrations of chlorophyll a, nutrients • Phytoplankton species composition, abundance, and biomass • Zooplankton species composition, abundance, and biomass • Benthic invertebrate species composition, richness, abundance, and biomass
	Fish		• Habitat quantity (includes surface hydrology and water quality indicators) • Habitat arrangement and connectivity (fragmentation) • Habitat quality (includes surface hydrology and water quality indicators) • Survival and reproduction • Abundance and distribution of fish
Land	Permafrost	• No assessment endpoint; results of the assessment are used in the effects analysis for other VCs	• Permafrost distribution • Terrain and slope stability
	Soils	• No assessment endpoint; results of the assessment are used in the effects analysis for other VCs	• Soil quality, quantity, and distribution
	Vegetation	• Self-sustaining and ecologically effective plant populations and communities (including listed species)	• Quantity, arrangement and connectivity (fragmentation) of plant communities • Plant community health and diversity • Abundance and distribution of plant populations and communities • Abundance and distribution of habitat for listed and traditional use plants • Presence of invasive species
	Archaeology and Heritage Resources	• Protection and preservation of heritage resources	• Value and quantity of archaeological and sacred sites

Table 6.3-2 Valued Components, Associated Assessment Endpoints and Measurement Indicators

Category	Valued Component	Assessment Endpoint	Measurement Indicator
Wildlife	Caribou Carnivores Breeding Birds	• Self-sustaining and ecologically effective wildlife populations (including listed species)	• Habitat quantity • Habitat arrangement and connectivity (fragmentation) • Habitat quality (occupancy, movement, and behaviour) • Survival and reproduction • Abundance and distribution of VCs
Human	Land Use and Traditional Land Use	• Continued opportunity for traditional and non-traditional activities such as hunting, fishing, trapping, and plant and berry gathering	• Tourism potential and wilderness character • Viewscape • Access to caribou, other wildlife, and fish • Availability of caribou, other wildlife, and fish • Human health risks from consumption of water, fish, caribou, and other wildlife
	Employment and Economy	• Sustainability of employment and economic activity	• Employment and incomes • Business activity • Education and training • Community and Impact Benefit Agreement (IBA) contributions
	Community Health and Well-being	• Avoidance of adverse impacts to community health and well-being	• Population • Community infrastructure and services • Income disparity • Social maladies (e.g., substance abuse and addictions, communicable diseases, domestic violence, crime)

VCs = valued components.

6.4 Existing Programs and Plans

The Ekati mine currently has environmental management plans relevant to the Project in place for the existing operations. If necessary, these plans will be amended to encompass the Project as the most effective means of incorporating existing practices and past Ekati mine operating experience in the management of environmental risks for the Project. Each of the plans undergoes, and will continue to undergo, periodic review and amendment according to current circumstances and in accordance with the principles of adaptive management. Many of the plans are requirements of the Ekati mine Water Licence and as such, are also subject to the public review and approval process conducted by the WLWB. The primary monitoring programs and plans at the Ekati mine that are relevant to the MUG Project are noted below.

6.4.1 Environmental Management Plans and Monitoring Programs

6.4.1.1 Waste Management Plan

The objective of the Waste Management Plan is to maintain a safe and healthy workplace at the Ekati mine, and to work to minimize potential adverse effects to the environment through sound waste

management practices. The plan addresses the specific requirements of the Ekati mine Water Licence, and has been approved by the WLWB.

The Waste Management Plan (Version 3.1; DDEC 2016a) provides clear direction to Ekati mine staff, contractors, and the public on how waste is managed through each of the waste streams to final disposal. The scope of the plan covers all activities associated with the mine including the Ekati main camp, the Misery site, and exploration activities. The Ekati mine follows the principles of Reduce, Reuse, Recycle, and Recover. Waste is preferentially avoided if possible to minimize environmental impact. Waste that cannot be avoided is treated and disposed of appropriately. The first step in ensuring appropriate waste treatment and disposal is proper waste classification. Once waste is designated to the correct waste stream, a classification-specific management plan governs the treatment and disposal of the material.

There are two broad classifications of waste at the Ekati mine: non-mineral waste and mineral waste. Waste rock, kimberlite, and coarse kimberlite rejects are mineral waste and are handled in accordance with the WROMP (Section 6.4.1.2). Minewater, fine processed kimberlite (FPK), and sewage are also mineral waste and the handling of these materials is completed in accordance with the WPKMP (Section 6.4.1.3). The Incinerator Management Plan, Hazardous Waste Management Plan, Solid Waste Landfill Management Plan, Hydrocarbon Impacted Materials Management Plan, and Compost Management Plan are all sub-plans of the Waste Management Plan.

Kitchen waste, and camp and office waste (not including wood, metal, paper, cardboard, or plastic) are non-mineral waste and handled in accordance with the Incinerator Management Plan. All compostable waste (e.g., organic substances, such as, food waste, food contaminated cardboard packaging, and paper office waste and cardboard products) is diverted to the composting process according to the Compost Management Plan. Inert waste including wood, metal, and concrete is also non-mineral waste, but the handling of these materials is conducted in accordance with the Solid Waste Landfill Management Plan. Hazardous waste, such as Workplace Hazardous Materials Information System (WHMIS) Controlled Products, is classified as non-mineral waste. These materials are properly treated and disposed of in accordance with the Hazardous Waste Management Plan. Hydrocarbon-impacted materials, such as rock, soil, or snow that has been exposed to hydrocarbon contamination, are also classified as non-mineral waste. These materials are properly treated and disposed of in accordance with the Hydrocarbon-Impacted Materials Management Plan. Activities associated with the Project will be covered under the existing Waste Management Plan, Incinerator Management Plan, Composter Management Plan, Landfill Management Plan, and Hazardous Waste Management Plan. The Waste Management Plan does not require amendment to incorporate the MUG Project.

6.4.1.2 Waste Rock and Ore Storage Management Plan

The WROMP describes the environmental characteristics of waste rock and kimberlite, and the design approach that is used at the Ekati mine to mitigate environmental risks. The WROMP provides information on the following:

- The current conditions at the Ekati mine including geology, production history, and descriptions of the existing waste rock storage facilities;
- Existing geochemical characterizations of waste rock and the coarse processed kimberlite (CPK) including acid/alkaline drainage potential;

- Current temperature trends in the WRSA; and,
- Existing drainage, seepage monitoring methods, and seepage water quality.

Version 6.2 of the WROMP (DDEC 2016b) was submitted to the WLWB in December 2016 and approved by the WLWB in February 2017. Version 7.0 of the WROMP has recently been submitted to the WLWB for review. An amendment to the WROMP has been prepared to incorporate the MUG Project and has been provided to the WLWB for review and approval in support of the Water Licence amendment application.

6.4.1.3 Wastewater and Processed Kimberlite Management Plan

The WPKMP addresses the specific requirements of the Water Licence, and describes the management of FPK and minewater. Version 6.1 of the WPKMP (DDEC 2016c) was submitted to the WLWB in September 2016 and approved in November 2016. The plan describes the processes, plans, and monitoring for the management of wastewater and FPK tailings at the Ekati mine. The information also includes the geochemical characterization of the FPK.

An amendment to the WPKMP has been prepared to incorporate the MUG Project and has been provided to the WLWB for review and approval in support of the Water Licence amendment application. The minor revisions and changes made to the WPKMP are as follows:

- the initial Discharge from King Pond Settling Facility during the early operations phase of the Project;
- the storage of groundwater from Misery Underground in King Pond Settling Facility during operations;
- the transfer of water from King Pond Settling Facility to Lynx Pit;
- the transfer of water back from King Pond Settling Facility and Lynx Pit to the mined-out Misery Pit and underground workings at closure; and,
- the incorporation of a new minewater pipeline that will tie into the existing water management system at the Misery site.

6.4.1.4 Interim Closure and Reclamation Plan

Reclamation of the Ekati mine is described in the Ekati mine ICRP. This plan is an integrated and all-inclusive plan as required under the Water Licence and Environmental Agreement. DDEC is required under the Ekati mine Water Licence to have in place an approved ICRP during active mining operations. The plan is updated as required during Mine operations. A Final Closure and Reclamation Plan will be required two years prior to mine closure.

The current version of the ICRP (Version 2.4; BHP Billiton 2011) was approved by the WLWB in November 2011. Since 2011, reclamation progress and ICRP updates are reported to the WLWB annually. The ICRP was developed with input from Aboriginal communities and governments (Inuit of Kugluktuk, Łutsel K'e Dene First Nation, Yellowknives Dene First Nation, the Tłįchǫ Government, and the North Slave Métis Alliance), the Independent Environmental Monitoring Agency (IEMA), and regulatory agencies, and incorporates specific reclamation activities and objectives detailed in conformance

documents that include water licences, the Environmental Agreement, land use permits, land leases, and fisheries authorizations. Reclamation of the mine site is guided by the reclamation goal to return the Ekati mine site to viable, and wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment, human activities, and the surrounding environment. The ICRP includes reclamation research plans that address key uncertainties related to mine closure, such as water quality, wildlife safety, and sustainability of vegetation cover. Monitoring programs are in place to evaluate whether reclamation work has been successful, or whether there is a need for further reclamation work.

Version 3.0 of the ICRP will be completed as a requirement of the Water Licence amendment (Part K condition 12) . A minor revision to the closure planning related to the Ekati mine will be made to incorporate the MUG Project (Section 4.9 of the Project Description).

6.4.1.5 Wildlife Effects Monitoring Plan

The WEMP (DDEC 2017a) describes how DDEC intends to monitor the effects to wildlife that may occur within and beyond the Ekati mine footprint, and contribute to regional monitoring initiatives. The WEMP also details the mitigation policies, designs, practices, and procedures that will be implemented to avoid and reduce direct and indirect Mine-related effects to wildlife and wildlife habitat.

The WEMP serves to meet DDEC's obligations to a range of authorities. This includes various Acts and regulations relevant to wildlife in the NWT, such as the Environmental Agreement, engagement with Aboriginal communities, the Government of the Northwest Territories (GNWT) Department of Environment and Natural Resources, and the IEMA. The WEMP also serves to meet the requirements of both the GNWT Draft Wildlife and Wildlife Habitat Protection Plan and Wildlife Effects Monitoring Program Guidelines (GNWT 2014) and the *Wildlife Act*.

The Caribou Road Mitigation Plan (CRMP) is an appendix to the WEMP and was developed during the Jay Project EA process through engagement with communities, government, and the IEMA. The objectives of the CRMP are to:

- avoid and minimize (reduce) the risk of caribou and other wildlife mortalities from vehicle traffic;
- avoid and minimize the barrier effect of the Jay and Misery roads (and other Ekati mine roads) to caribou movement and migration; and,
- limit the effect of sensory disturbance from roads and traffic on caribou behaviour.

Also during the Jay Project EA process, DDEC developed the framework for a Caribou Mitigation Plan to compensate (offset) the residual adverse effects from the Jay Project on caribou. Some of the components of the Caribou Mitigation Plan are described and included within the WEMP. A recent draft of the Caribou Mitigation Plan was submitted to the Mackenzie Valley Environmental Impact Review Board in May 2017.

The WEMP has been developed with input from Aboriginal community representatives, the IEMA, and government and will remain a living document that DDEC will adjust based on adaptive management. As per Measure 6-1 of the Report of Environmental Assessment (REA) for the Jay Project (MVEIRB 2016), the WEMP was approved by the GNWT on June 1, 2017 (GNWT 2017).

The WEMP provides information for the overall Ekati mine and does not require amendment to incorporate the MUG Project.

6.4.1.6 Surveillance Network Program

The Ekati mine SNP is established at the mine site to ensure compliance with the Water Licence, and includes collection and reporting (monthly) of information about flows (rates and quantity) at the Ekati mine and at Discharge locations, as well as information about water quality in minewater management facilities and at Discharge locations. The SNP data are provided to and reviewed by the WLWB, Aboriginal communities, government agencies, and the IEMA through report submissions, group workshops, and individual meetings. If necessary, the existing SNP could be readily expanded to incorporate the MUG Project.

6.4.1.7 Aquatic Effects Monitoring Program

The AEMP is one of a number of monitoring and management plans that employ an adaptive approach to reduce the magnitude, frequency, and extent of effects of the Project on the aquatic environment. An AEMP is a requirement of the Water Licence, and involves programs focused on the aquatic Receiving Environment. Aquatic effects are monitored every year at 14 lakes and 8 stream sites, as part of the existing site-wide AEMP. The AEMP evaluates on an annual basis the physical, chemical, and biological components of the aquatic ecosystem and includes:

- hydrology;
- physical limnology;
- lake and stream water quality;
- sediment quality
- phytoplankton, zooplankton, lake and stream benthos; and;
- fish (on 3- and 6-year cycles).

Meteorological data collected as a requirement of the Surveillance Network Program monitoring as per the Water Licence, are also reported in the AEMP because of the relationship to site hydrology.

Sampling locations (watersheds) for the Ekati mine AEMP include the Koala Watershed, internal-watershed reference areas, the King-Cujo watershed, and two external reference watersheds.

The Koala Watershed contains the majority of the existing Ekati mine infrastructure, including the main camp, the processing plant, the Panda, Koala, Koala North, Fox, and Beartooth pits and associated WRSAs, the LLCF, and the airstrip. In the Koala Watershed, the AEMP examines waters downstream of the LLCF including the LLCF Discharge (SNP station 1616-30), Leslie Lake, Leslie–Moose Stream, Moose Lake, Moose–Nero Stream, Nema Lake, Nema–Martine Stream, Slipper Lake, and Slipper–Lac de Gras Stream. The northern bay of Lac de Gras near the inflow from Slipper Lake is also monitored.

The internal-watershed reference area (Vulture Lake, Vulture-Polar Stream) is located 5 km upstream of the Ekati camp at the north end of the Koala Watershed. Although the Lower Panda diversion channel, Kodiak Lake, and Kodiak–Little Stream are not downstream of the LLCF, they are monitored and evaluated as part of the AEMP because of their proximity to mine operations. Grizzly Lake is the source of potable water for the Ekati main camp, and was added to the AEMP in 2009.

The King–Cujo Watershed contains the Misery Camp, Misery Pit and associated WRSAs, and the King Pond Settling Facility. In the King–Cujo Watershed, monitored locations include the King Pond Settling Facility Discharge (SNP Station 1616-43), Cujo Lake, Cujo Outflow Stream and Christine–Lac du Sauvage Stream. The western bay of Lac du Sauvage near the inflow from Christine Lake is also monitored.

Sampling for the AEMP also includes two external watershed reference lakes and streams (Nanuq and Counts lakes and their outflows), which are located outside of the zone of influence of mine activities. Nanuq Lake is located in the northeast corner of the Ekati claim block approximately 26 km from the mine. Counts Lake is located southeast of Ekati camp, approximately halfway between the camp and Misery Lake and is approximately 5 km from the closest reach of Misery Road.

As per the Sable AEMP Design Plan Version 1.2 (ERM 2017a), the proposed Sable AEMP involves monitoring in the Horseshoe Watershed where the majority of Sable project infrastructure will be located. The Sable development is located approximately 27 km north of the Ekati mine main camp, and does not overlap spatially with the MUG Project.

An AEMP Design Plan for the construction phase of the Jay Project (DDEC 2016d) has been prepared that provides an overview of the scope of monitoring planned for the first iteration of the AEMP Design Plan (i.e., dike construction and Dewatering). Monitoring will be focused in Lac du Sauvage, including a near-field area close to the dike and two transects extending away from the near-field area, as well as a reference lake. Monitoring will also be conducted, for some components, in the Narrows (Lac du Sauvage outlet), Lake C1, Stream C1, and the Coppermine River (Lac de Gras outlet).

The Ekati mine Aquatic Response Framework Version 1.2 was developed to meet the requirements of the existing Water Licence and was approved by the WLWB. Version 2.0 of the Aquatic Response Framework was submitted to the WLWB in July 2017 (ERM 2017b). The overall objective of the Aquatic Response Framework is to link the results of the AEMP with actions necessary to make sure that project-related effects in the Receiving Environment remain within an acceptable range.

The AEMP is not expected to require a revision to incorporate the MUG Project, as the existing monitoring stations and monitoring frequency in the King–Cujo Watershed are considered sufficient to evaluate effects of the MUG Project on the Receiving Environment.

6.4.1.8 Air Quality and Emissions Monitoring and Management Program

An air quality management and monitoring plan has been in place at the Ekati mine since 1995. The AQEMMP includes the following components:

- air emissions and greenhouse gas calculations;

- total suspended particulate matter (TSP) measurements through high volume air sampling;
- continuous ambient air sampling of oxides of nitrogen (NOx), oxides of sulphur (SOx), TSP, and particulate matter ($PM_{2.5}$);
- snow sampling; and
- lichen sampling.

Emissions calculations and high volume air sampling is completed annually, and snow and lichen sampling is completed every three years. Results from air quality monitoring indicate that environmental design features and mitigation measures implemented at the Ekati mine are effective at mitigating the effects of the Mine on air quality.

DDEC developed an AQEMMP (DDEC 2017b) for the Jay Project, which includes monitoring provisions for the Jay Project and addresses air quality monitoring and management using an adaptive response approach. As per Measure 6-3 of the Jay REA, the AQEMMP for the Jay Project was approved by the GNWT on May 31, 2017. The Jay AQEMMP and the existing Ekati mine air quality monitoring program are being consolidated into one document which will undergo a review and comment process.
The AQEMMP provides information for the Ekati mine and does not require amendment to incorporate the MUG Project.

6.4.1.9 Engagement Plan

DDEC's approach to engagement is set out in the Ekati Mine Engagement Plan (DDEC 2016e), which is approved by the WLWB. The Engagement Plan is a culmination of successful engagement activities that have been developed and become well established since the Ekati mine was first licenced and operational. DDEC undertakes community engagement activities on a regular and routine basis as part of its management of the Ekati mine. The engagement activities include: quarterly engagement meetings between DDEC Senior Management and communities, formal Impact Benefit Agreement (IBA) meetings with leadership from each of the Ekati mine IBA groups; workshops on specific issues; and site based activities wherein leadership, elders, and youth are invited to visit the Ekati mine for site visits or to take part in the environmental monitoring programs. The Engagement Plan also includes engagement activities related to the inclusion of traditional knowledge (TK) into ongoing environmental monitoring programs, which may include Ekati mine visits/workshops, Elders meetings, and support for community TK database development. Furthermore, as per Measure 7-1 of the REA for the Jay Project, DDEC has developed a Traditional Knowledge Management Framework which is intended to outline how DDEC will use TK in environmental decisions for the Ekati mine and Jay Project. (DDEC 2017c).

The Engagement Plan does not require amendment to incorporate the MUG Project. A new version of the Engagement Plan is required to be submitted to the WLWB for approval as per Part B condition 11 of Water Licence W2012L2-0001 (amendment #4).

6.4.1.10 Spill Contingency Plan

This Spill Contingency Plan (DDEC 2016f) was developed to establish and document practices for responsible management of controlled substance spills at the Ekati mine, including satellite facilities such as Misery camp, Sable, and exploration activities. The Spill Contingency Plan provides:

- A clear chain of command for all spill related emergency activities;
- Accountability for the performance of the spill response;
- Well-defined expectations regarding spill response and subsequent clean-up programs;
- Well-defined task and operational hazards/risk;
- Comprehensive hazard prevention and control methods; and,
- Reporting and record keeping requirements to track program progress.

This Spill Contingency Plan has been developed with the Ekati mine and area specific hazardous/risk analysis in mind. It outlines the necessary resources, personnel, logistics and initial actions to facilitate a prompt, coordinated and rational approach to emergency incidents. The Spill Contingency Plan contains sufficient detail to enable those who are involved to respond effectively.

6.4.2 Adaptive Management and Operational Experience

The inherent unpredictability of natural ecosystems requires the practice of adaptive management. Adaptive management is defined as a systematic approach for continually improving management policies and practices by learning from the outcomes of operational programs. In practice, it is an iterative process of anticipating potential environmental effects (based on trends observed as a result of environmental monitoring programs), developing appropriate mitigation strategies to stop and/or reverse those trends, monitoring the success or failure of the strategies, and then using this information to improve operational management.

Adaptive management is a structured process of decision making to deal with uncertainty.
The objective of adaptive management is to reduce uncertainty through monitoring, or “learning by doing” (WLWB 2010). Adaptive management is generally considered to include four themes (Greig et al. 2008; WLWB 2010):

- learning to reduce management uncertainties;
- using what is learned to change policy and practice;
- focusing on improved management; and,
- basing adaptive management on a structured and systematic approach.

Adaptive management has been applied to environmental issues at the Ekati mine over the years. Examples are provided below in Table 6.4-1.

Monitoring programs must also be flexible enough to include an adaptive management approach by incorporating comments, suggestions, and information based on science and local traditional knowledge. For example, following the principles of adaptive management, wildlife monitoring has undergone changes since the initial development of the WEMP in 1998 and 2000. These changes have been implemented following the results of monitoring and effectiveness of mitigation, recommendations and suggestions from communities, the IEMA, and government agencies. Similar changes and adjustments

have occurred in the AEMP where the reporting process allows for ongoing adaptive management considerations. The AEMP Design Plan is updated on an approximately three-year cycle, and the timing of these updates follows the AEMP Re-evaluation Report, which is prepared on a three-year cycle and provides feedback on improvements to the AEMP based on past experience.

Table 6.4-1 Adaptive Management of a Selection of Environmental Issues at the Ekati Mine

Valued Component	Issue	Adaptive Management Actions
Caribou	Limit disturbance to caribou	• Used observations of caribou crossing Misery Road to shape design of berms around Misery and Beartooth pits • Traditional Knowledge study led to the installation of inuksuit as deterrents to caribou approaching the mine site • Identification of caribou crossings with road signage • Established speed limits on all roads to prevent wildlife-vehicle collisions • Radio communication among drivers and main camp staff to alert drivers to caribou sightings on or near the road • Constructed caribou crossing at Misery Road in areas of high usage • Evaluated dust suppression techniques and materials to reduce dust
Permafrost	Reduce disturbance of permafrost layer	• Winter construction in permafrost areas where lakes and streams are potentially affected by sedimentation (dams, dikes, culverts, and bridges) • Capping of exposed permafrost to reduce thermal degradation and erosion
Groundwater, Physical/ Terrestrial Environment	Reduce seepage from waste rock piles and kimberlite stockpiles	• Build toe berms to prevent seepage where necessary and practical • Build granite pad underneath Fox kimberlite stockpile to prevent interaction between kimberlite and tundra and reduce seepage • Refine engineering design to encourage convective super-cooling of the margins of the waste rock pile and the development of permafrost within the piles • Monitor for seepage twice each year • Initiated long-term field reactivity test for various rock types • Relocation of metasediment rock from perimeter to central area of Misery waste rock storage area • Detailed scientific study of SEEP 018/019 area, as a follow up to unusual monitoring results • Include adaptive management in the seepage monitoring program to increase monitoring frequency for problematic seeps
Physical/ Terrestrial Environment	Reclamation	• Complete progressive revegetation research on Long Lake Containment Facility (LLCF) kimberlite surfaces • Ecological risk assessments of the potential for metal uptake from vegetated LLCF cover to wildlife and humans • Progressive development of the long-term re-vegetation program based on research results and Board approved objectives

Table 6.4-1 Adaptive Management of a Selection of Environmental Issues at the Ekati Mine

Valued Component	Issue	Adaptive Management Actions
Water Quality	Water quality	• Addition of flocculent to Fox Lake during Dewatering to reduce total suspended solids in the LLCF • Use of water from underground operations for processing of Fox kimberlite (fine particles associated with this kimberlite) to enhance settling of fine particles and reduce the amount of chloride added in the process plant • Withheld Discharge into the LLCF in spring 2008 while studying the potential effects of nitrate • Completed an intensive sampling variability study to verify that the Aquatic Effects Monitoring Program (AEMP) was providing valid results • Developed Aquatic Response Framework and associated action plans as part of the AEMP
Fish	Fish and fish habitat	• Constructed and operated the Panda Diversion Channel to compensate for lost stream habitat; tested fish habitat structures provided in the Panda Diversion Channel • Implemented Panda Diversion Channel Management Plan • Developed fish-out plans for the Lynx and Sable fish-outs taking into account lessons learned at Ekati and other mines • Developed Aquatic Response Framework and associated action plans as part of the AEMP

6.4.3 Socio-Economic Agreement and Impact Benefit Agreements

Socio-Economic Agreements (SEAs) are signed between the GNWT and operators following the environmental and socio-economic assessment of a proposed project, representing a partnership agreement between the two parties outlining future expectations such as training and employment. The Department of Industry, Tourism and Investment negotiates SEAs on the behalf of the GNWT, and has signed SEAs with the operators of the Ekati, Diavik, Prairie Creek, Snap Lake and Gahcho Kué mines. The original Ekati mine SEA has been extended to apply to the MUG Project.

The purpose of an SEA is to establish terms and conditions for cooperation between the GNWT and the operator with regard to socio-economic benefits, and includes a socio-economic monitoring component. SEAs require the operator to make contributions to training initiatives, set and take steps to achieve employment targets for local (i.e., NWT residents, including Aboriginal content) involvement through employment and business opportunities, and monitor select social issues related to employment at the mine (e.g., community contributions, advancement of women). The operator's focus is on tracking their labour force activity, rather than on changes in communities, the latter being the focus of government. Training initiatives, employment, and business opportunities are reported directly by the operator in the form of annual SEA monitoring reports. The SEA also outlines socio-economic monitoring and reporting requirements for the GNWT with respect to community-level socio-economic indicators. Social issues, and the associated indicators used to measure social change, are then monitored by the industry-funded Communities and Diamonds monitoring initiative

The requirements outlined in the SEAs for the NWT diamond mines have varied little over time. A notable exception to this is the increasing emphasis placed on worker and community health and well-being, and the associated obligations of both the GNWT and the operator. Local hiring and procurement targets vary

between SEAs, and are typically reflective of the level of local involvement that is realistically predicted in a project's environmental impact assessment. Targets have decreased in recent years. This is in part due to the changing availability of the local labour force in the face of growing demand from the mining industry over time, and a need to be prudent and realistic when putting forward statements about a project's benefit. The same is true for operational procurement targets. Table 6.4-2 presents the employment and procurement targets for the Ekati mine.

Table 6.4-2: Socio-Economic Agreement Employment and Procurement Targets

Diamond Mine	SEA Date	Employment						Procurement	
		Northern		Northern Aboriginal (% of Northern)		Northern Aboriginal (% of Total)		Northern	
		C	O	C	O	C	O	C	O
Ekati Mine	1996	33%	62%	44%	50%	14.5%	31%	28%	70%

SEA = Socio-Economic Agreement; n/a = not available; C = Construction Target; O = Operations Target.

IBAs and Participation Agreements are reached between operators and stakeholder groups (typically Aboriginal groups and communities) following a period of negotiation. These agreements are negotiated between communities and operators in an effort to address adverse effects and maximize benefits of proposed developments. They may build upon measures identified in the SEAs, or define new ones based on needs and interests of the particular group. While SEAs are required by the GNWT and validated by regulatory authorities, IBAs are not a formal requirement of operators. They have, however, been required by stakeholder groups, in particular Aboriginal communities – both cultural and geographic.

For each project, IBAs are signed with impacted communities. Given the close geographic concentration of the NWT's existing diamond mines, this has resulted in a number of agreements signed between the mines, and the same set of individual communities. DDEC holds IBAs with the following signatories:

- Tłı̨chǫ First Nation;
- Akaitcho Treaty 8 (Łutsel K'e Dene First Nation and Yellowknives Dene First Nation);
- North Slave Métis Alliance; and,
- Hamlet of Kugluktuk and the Kitikmeot Inuit Association.

While not holding an IBA with DDEC, Fort Resolution has been identified as a community potentially impacted by the Ekati mine and the Jay Project. As such, DDEC works to find areas where benefits to the community can be maximized.

The terms of an IBA are not prescribed by any particular government agency; rather, terms are based on precedent and the operator's policies and funding priorities. These agreements allow the operator to effectively negotiate with the signatory stakeholders to a point that satisfies both parties, helps to establish the operator's social licence to operate, and influences future relationships with the beneficiary community. There is now considerable research on IBAs, and the agreements have become, part of the development landscape in Canada, as in many other countries (although under different names).

6.5 Project-Environment Interactions and Mitigation

6.5.1 Screening of Project Interactions

Interactions or linkages between MUG Project components or activities, and the corresponding potential changes to measurement indicators of the environment are identified through a screening process. This screening step is largely a qualitative assessment, intended to focus the residual effects analysis on interactions that will require a more comprehensive assessment of effects on VCs (i.e., those interactions that may result in residual effects after mitigation).

The screening process is completed to remove Project interactions that are predicted to have no linkage to residual effects or are expected to result in minor changes to measurement indicators and a negligible effect on the assessment endpoint, after applying mitigation. Interactions are evaluated using scientific knowledge, experience with similar developments at the Ekati mine and other mine sites, and the effectiveness of mitigation measures. This screening step is intended to focus the residual effects analysis on Project interactions that have potential to result in significant residual effects on VCs.

The first part of the screening step is to produce a list of all potential interactions between the MUG Project and the biophysical and human environments. Each interaction is initially considered to have a linkage to potential effects on environmental components. This step is followed by the application of environmental design features and mitigation that can be incorporated into the Project to remove an interaction or limit (mitigate) effects to environmental components. Environmental design features include Project design elements, environmental best practices, management policies and procedures, and social programs, and are developed through an iterative process between the Project's engineering and environmental teams to mitigate effects.

Knowledge of the environmental design features and mitigation is then applied to each of the interactions to determine the expected amount of Project-related changes to the environment and the associated residual effects (i.e., effects after mitigation) on VCs. Changes to the environment can alter physical measurement indicators (e.g., water and soil chemistry, and amount of habitat), biological measurement indicators (e.g., animal behaviour, movement, and survival), and socio-economic indicators (e.g., number of jobs, incomes levels, human health). For a residual effect to occur there has to be a source (Project component or activity) that results in a measurable environmental change and a correspondent residual effect on VCs.

Project activity → measurable environmental change → residual effect on a VC

Interactions are determined to be primary, secondary (minor), or as having no linkage using scientific knowledge, and experience with similar Project activities at the Ekati mine and environmental design features. Each potential interaction related to the MUG Project are assessed and described as follows:

- no linkage – interaction is removed by environmental design features and mitigation so that the Project results in no detectable (measurable) change and no residual effect to a VC relative to baseline or guideline values;

- secondary - interaction could result in a minor change, but would have a negligible residual effect on a VC relative to baseline or guideline values, and is not expected to change from previous, existing or reasonably foreseeable developments to a significant effect; or,
- primary - interaction is likely to result in a measurable change that could contribute to residual effects on a VC relative to baseline or guideline values.

Primary interactions are those that are anticipated to result in a residual effect to the VC, and therefore require further analysis (residual effects analysis). For VCs with assessment endpoints, a classification of the residual effect, and a determination of the significance of the residual effect is also provided. For those VCs with no assessment endpoints, the classification of residual effects and the determination of significance are not completed. Interactions with no linkage to a change or changes that are considered minor (secondary) are not analyzed further or classified because environmental design features remove the interaction (no linkage) or because residual effects can be determined to be negligible through a simple qualitative or quantitative evaluation. Interactions determined to have no linkage to VCs or those that are considered secondary are not predicted to result in significant effects to VCs.

Project interactions to the biophysical and socio-economic environments that could result during the construction, operation, and reclamation phases of the Project are outlined in Table 6.5-1, and include mitigation that will be implemented. The proposed MUG Project activities and the proven mitigation practices already implemented at the Ekati mine were taken into consideration in the classification of the MUG Project interactions.

Table 6.5-1 MUG Project Activities, Potential Project Interactions, Mitigation and Environmental Design Features, and Interaction Classification

MUG Project Component/Activity	Potential Interaction	Valued Component	MUG Project Mitigation and Design Features	Interaction Classification
• Physical Disturbance from the Project Footprint o Expansion of the existing Misery camp o Construction of new infrastructure (e.g., ventilation/heating and compressed air facilities, power transmission line, underground mine access locations) o Modifications to the Kind Pond Settling Facility Saddle Dam structure o Use of Misery WRSA for storage of waste rock	• Changes to local hydrology (surface water flows and drainage patterns) from the Project footprint and possible effects to water quality	• Surface Hydrology • Water Quality • Aquatic Life other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use	• The Project will make full use of existing surface infrastructure to avoid additional loss and alteration of undisturbed aquatic and terrestrial land cover (i.e., habitat). • Waste rock will be disposed of in the existing Misery WRSA established for open pit mining at the Misery Pit. • The existing road between the Ekati main camp and the Misery site will be used to access the underground mine. Culverts along the access road will be maintained or upgraded as necessary to maintain drainage. • Infrastructure that serves the Ekati mine (i.e., airstrip, main camp, fuel tank farm, LLCF, Misery haul road and other roads), is satisfactorily sized and requires no replacement or modification due to the Project. • Runoff and seepage from Project facilities is managed, as appropriate, to avoid adverse environmental effects in downstream waterbodies. • Erosion and sediment control practices (e.g., silt fences, runoff management) applicable to northern environments and already in place at Ekati will be used during construction around disturbed areas, where appropriate.	No Linkage
	• Changes to permafrost conditions from the Project footprint	• Permafrost • Groundwater • Surface Hydrology • Physical/Terrestrial Environment (Soils and Vegetation) • Land Use and Traditional Land Use	• Design of the MUG Project minimizes the construction of new surface facilities that may have an effect on permafrost. • The Project will make full use of existing surface infrastructure to avoid additional loss and alteration of undisturbed aquatic and terrestrial land cover (i.e., habitat). • Existing facilities and those constructed for the Project will be insulated to minimize heat loss.	No Linkage
	• Direct loss and fragmentation of plant communities and wildlife habitat from the Project footprint	• Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use	• The Project will make full use of existing surface infrastructure to avoid additional loss and alteration of undisturbed aquatic and terrestrial land cover (i.e., habitat). • Existing trails will be stabilized as necessary to avoid encroachment problems and to protect adjacent habitat. • Banks and vegetated areas will be stabilized, if disturbed.	No Linkage
	• Soil erosion and sedimentation from construction activities may alter surface water quality in downstream waterbodies	• Water Quality • Aquatic Life Other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use	• The Project will make full use of existing surface infrastructure to avoid additional loss and alteration of undisturbed aquatic and terrestrial land cover (i.e., habitat). • Erosion and sediment control practices (e.g., silt fences, runoff management) applicable to northern environments and already in place at Ekati will be used during construction of new infrastructure and around disturbed areas, where appropriate. • Disturbed areas (e.g., access roads and banks) will be graded to a stable angle after work is completed, reclaimed, and revegetated.	No Linkage
	• Construction of the Project may cause disturbance or destruction of heritage resources	• Archaeology and Heritage Resources	• Archaeological surveys have been completed at the site and documentation is ongoing. • The Project will make full use of existing surface infrastructure to avoid additional loss and alteration of undisturbed aquatic and terrestrial land cover (i.e., habitat). • Management practices for the avoidance or preservation of archaeological and/or heritage materials discovered during mine activities are in place at the Ekati mine.	No Linkage
• Site Water Management o Annual Discharge from King Pond Settling Facility to 443 masl o Handling and storage of water from the Underground Mine o Water withdrawal for process and potable use	• Discharge from King Pond Settling Facility to Cujo Lake in the first year of the MUG Project may change hydrology in downstream waterbodies	• Surface Hydrology • Water Quality • Aquatic Life other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use	• A mine water management plan will be implemented for the Project, and will be based on previous experience at site. • A water management strategy will be developed for the initial efforts to reduce water levels in King Pond Settling Facility, which will include details related to the timing of Discharge, pumping rates, and volumes. • Initial efforts to reduce water levels of King Pond Settling Facility will occur after freshet, when constituent concentrations in King Pond Settling Facility are usually highest, but before the start of pumping of minewater from Misery Underground. • As a requirement of the existing Ekati mine Water Licence, water Discharged from King Pond Settling Facility to Cujo Lake will meet effluent quality criteria (EQC) in the Water Licence. • Water Discharged from King Pond Settling Facility to Cujo Lake is monitored as part of the overall minewater management (i.e., SNP) as well as in the Receiving Environment (i.e., AEMP), which provides input for adaptive management.	Secondary
	• Discharge from King Pond Settling Facility to Cujo Lake in the first year of the MUG Project may change water quality (e.g., suspended sediments, metals, nutrients) in receiving waterbodies	• Water Quality • Aquatic Life Other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use		Secondary

Table 6.5-1 MUG Project Activities, Potential Project Interactions, Mitigation and Environmental Design Features, and Interaction Classification

MUG Project Component/Activity	Potential Interaction	Valued Component	MUG Project Mitigation and Design Features	Interaction Classification
• Site Water Management o Annual Discharge from King Pond Settling Facility to 443 masl o Handling and storage of water from the Underground Mine o Water withdrawal for process and potable use (continued)	• Cessation of water Discharge during operations from King Pond Settling Facility to Cujo Lake may change hydrology and fish habitat in downstream waterbodies	• Surface Hydrology • Water Quality • Aquatic Life other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use	• A mine water management plan will be implemented for the Project, and will be based on previous experience at site. • Groundwater inflows to the underground mine will be stored on a temporary basis within King Pond Settling Facility and in the mined-out Lynx Pit to avoid Discharge of water to the environment that does not meet Water Licence EQC during Project operations.	Secondary
	• Cessation of water Discharge from King Pond Settling Facility to Cujo Lake during operations may change water quality (e.g., suspended sediments, metals, nutrients) in receiving waterbodies	• Water Quality • Aquatic Life Other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use		Secondary
	• Changes to local hydrology (surface water flows and water levels) from the water supply requirements (process water and potable water) for the Project	• Surface Hydrology • Water Quality • Aquatic Life other than Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Fish • Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use	• The existing potable water system at the Misery site will be used for the Project. • No increase in process water and potable water use is anticipated due to the Project. • Applicable Best Management Practices from Fisheries and Oceans Canada (DFO) are adhered to, including the DFO protocol for water withdrawals (DFO 2010). • Freshwater for Ekati mine operations is permitted to be drawn from Grizzly Lake, Little Lake, Thinner Lake (Misery Camp), Falcon Lake, and Lac de Gras. • Recycled water provided by the LLCF is used for operation of the processing plant. • Potable water is trucked from Ekati to Misery Camp as Misery Camp does not include any standalone site-specific water treatment facility. • The existing site water management system is designed to recycle water, where applicable, and reduce requirements for water withdrawal.	No Linkage
	• Groundwater inflow to the underground mine may cause changes to local or regional groundwater quantity and quality, which can affect surface water quantity and quality	• Groundwater • Water Quality • Aquatic Life other than Fish • Fish • Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use • Community Health and Well-being	• A mine water management plan will be implemented for the Project, and will be based on previous experience at site. This plan will be incorporated into Ekati mine WPKMP. • The AEMP implemented at the Ekati mine will encompass the MUG Project, and provides input for adaptive management.	Secondary
• General Construction and Operation Activities o Underground mining of the kimberlite pipe and operation of surface infrastructure and support facilities o Management of WRSA and other stockpiles o Processed kimberlite management o Storage of industrial, domestic, hazardous, and contaminated waste o Vehicle traffic along the haul and access roads	• Air and dust emissions and subsequent deposition may affect air, soil, aquatic substrates and water quality • Inhalation of air or ingestion of water, soil or vegetation that has been chemically altered by air and dust emissions	• Air Quality • Water Quality • Aquatic Life Other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use • Community Health and Well-being	• The AQEMMP implemented at the Ekati mine will encompass the MUG Project, and provides input for adaptive management • Equipment used on site is regularly maintained. • Use of existing surface facilities will limit the area disturbed at construction and limit the quantity of new air and dust emissions. • Dust suppression measures are applied, as appropriate, to haul roads, airstrip, and laydown areas. • Speed limits are established on all roads to reduce production of dust. • The majority of exhaust air from the underground mine will exit at a location within the existing Misery Pit. • Ultra-low-sulphur fuel is used at the Ekati mine. • Dust collectors are used in the ore development, drilling, and production areas.	Secondary

Table 6.5-1 MUG Project Activities, Potential Project Interactions, Mitigation and Environmental Design Features, and Interaction Classification

MUG Project Component/Activity	Potential Interaction	Valued Component	MUG Project Mitigation and Design Features	Interaction Classification
• General Construction and Operation Activities o Underground mining of the kimberlite pipe and operation of surface infrastructure and support facilities o Management of WRSA and other stockpiles o Processed kimberlite management o Storage of industrial, domestic, hazardous, and contaminated waste o Vehicle traffic along the haul and access roads (continued)	• Sensory disturbance effects from the presence of buildings, lights, smells, noise, blasting activity, and vehicles	• **C**aribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use	• The WEMP implemented at the Ekati mine will apply to the MUG Project, and provides input for adaptive management. • Use of existing surface facilities will limit the area disturbed at construction and limit the quantity of new sensory disturbances. • The current, effective practices and mitigations for safety of wildlife on roads, the airstrip, and other areas of the mine will be continued and expanded as necessary to include the Project. These practices include reporting of wildlife sightings by all employees, and control of encounters by Environment staff. • A minimum flying altitude of 600 m above ground level (except during takeoff and landing, and during field work) will be maintained for cargo, passenger aircraft, and helicopters outside of the Project site. • Environmental training will be provided for personnel. • Wildlife always have the right-of-way. • Vehicles encountering wildlife on roads will communicate the presence of wildlife on the roads to the Environment Department and others in the area. • Modified traffic patterns and road closures will be used as necessary to protect caribou and people. • Equipment used on site is regularly maintained.	Secondary
	• Seepage from waste rock piles and kimberlite stockpiles can cause changes in groundwater and surface water quality • Ingestion of soil, vegetation, or water that has been chemically altered by seepage from waste rock piles and kimberlite stockpiles	• Groundwater • Water Quality • Aquatic Life other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation)Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use • Community Health and Well-being	• Waste rock generated from the underground mine will be stored within the existing WRSA at the Misery site. There are no groundwater inflows into the existing WRSA. • The rock mined from the Misery Underground will be primarily granite (i.e., non-acid generating and non-metal leaching) rock. • Metasediment rock mined from the underground mine will be encapsulated within a thermally protective cover layer of granite such that metasediment is frozen into permafrost; this continues the approach successfully established at the Ekati mine for the Misery WRSA. • Monitoring programs and the WROMP are implemented at the Ekati mine. The Ekati mine WROMP will be amended to incorporate the MUG Project, and provides input for adaptive management. • Seepage is monitored and managed, if necessary, as described in the WROMP. • Seepage from the WRSA is monitored annually through the annual Seepage Monitoring Program.	No Linkage
	• Processed kimberlite management for the Project can alter surface water quality in downstream waterbodies	• Water Quality • Aquatic Life other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use • Community Health and Well-being	• Storage of PK for the MUG Project will be in approved facilities. • Water Discharged from the LLCF is monitored as part of the overall minewater management (i.e., SNP) as well as in the Receiving Environment (i.e., AEMP), and provides input for adaptive management. • Excess minewater in the Panda and Koala pits will be pumped to the LLCF (during operations) where it will be managed through the existing monitoring and Discharge programs as per EQC in the Water Licence.	Secondary
	• Physical hazards from the Project (e.g., animals becoming trapped in exposed sediments) may increase risk of injury or mortality to individual animals	• Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use	• The WEMP implemented at the Ekati mine will apply to the MUG Project, and provides input for adaptive management. • Explosives are stored in designated buildings. • Hazards are isolated to prevent wildlife interaction. • Caribou ramps and crossings have been constructed at strategic locations along the Misery Road. • Measures are in place to minimize human-wildlife interactions, including providing awareness training. • Pit infrastructure is monitored and mitigation is applied, as required. • Final reclamation will be completed so that the landscape is safe for wildlife use.	Secondary

Table 6.5-1 MUG Project Activities, Potential Project Interactions, Mitigation and Environmental Design Features, and Interaction Classification

MUG Project Component/Activity	Potential Interaction	Valued Component	MUG Project Mitigation and Design Features	Interaction Classification
• General Construction and Operation Activities o Underground mining of the kimberlite pipe and operation of surface infrastructure and support facilities o Management of WRSA and other stockpiles o Processed kimberlite management o Storage of industrial, domestic, hazardous, and contaminated waste o Vehicle traffic along the haul and access roads (continued)	• Attraction to the Project (e.g., food waste, oil products) may increase human-wildlife interactions and mortality risk to individual animals or may increase predator numbers and predation risk, which can affect prey population size	• Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use	• The WEMP implemented at the Ekati mine will apply to the MUG Project, and provides input for adaptive management. • No additional sources of attractants will be developed as part of the Project. • Waste Management practices are in place for the Ekati mine. • Hydrocarbon-contaminated soil is treated at the landfarm. • Hydrocarbon-contaminated snow and ice are taken to the Contaminated Snow Containment Facility, which is a lined containment facility. • Food wastes are managed appropriately to limit attraction or effect to wildlife. • Littering and feeding of wildlife is prohibited. • Deterrent measures are implemented, as needed. • Recyclables and waste hazardous materials are stored in appropriate containers to prevent exposure to wildlife until shipped off-site to an approved facility. • Education and reinforcement of proper waste management practices is provided to all personnel and visitors to the site. • The sanitary sewage treatment plant used at the Ekati mine site is enclosed and treats all domestic wastewater using primary and secondary levels of treatment. • Sewage generated at remote washroom facilities (e.g., Misery site) is trucked to the main camp waste water treatment facility. • The incinerator used at the Ekati mine site is enclosed and waste is frequently incinerated. • Juice boxes are no longer used. • Employee education on waste management practices and issues surrounding habituation is provided. • Inspections of landfill sites and waste storage areas are completed.	Secondary
	• Traffic along the site access and haul roads (e.g., Misery road) may result in wildlife-vehicle collisions	• Caribou, Carnivores, and Breeding Birds	• No new roads are required for the Project and vehicle traffic is not expected to increase • Drivers have standard safety training and are provided with awareness training • Speed limits are established on all roads to reduce or prevent wildlife-vehicle collisions. • Radio communication among drivers and main camp staff is maintained to alert drivers to caribou sightings on or near the road. • Caribou ramps and crossings have been constructed at strategic locations along the Misery road. • Appropriate signage is in place to identify caribou crossings and areas of high wildlife use. • Road closures are implemented during caribou migration throughout the Ekati mine site (i.e., Caribou Road Mitigation Plan).	Secondary
• General Construction and Operation Activities o Underground Mining of the kimberlite pipe and operation of surface infrastructure and support facilities	• Workforce requirements for the Project will maintain current employment stability and related income for the Misery workforce	• Employment and Economy	• The Project continues employment for the existing Misery workforce	Secondary
	• Project contract, service, equipment, and supply requirements will maintain the stability of the level of business activity in northern communities.	• Employment and Economy	• The Project continues demand for existing contractor services, and for underground mining-specialized contractors	Secondary
	• Workforce requirements for the Project may increase uptake of education and training opportunities by job seekers	• Employment and Economy	• The Project does not require a new labour force, and will employ a specialized contractor with an experienced workforce already trained in underground mining. • Potential for enhanced uptake of training opportunities is expected to be primarily from on-the-job training, as required	Secondary
	• Continued resource development contributes to the maintenance of community contributions and IBA payments	• Employment and Economy	• Current and future contributions and IBA payments will be continued by the MUG Project	Secondary

Table 6.5-1 MUG Project Activities, Potential Project Interactions, Mitigation and Environmental Design Features, and Interaction Classification

MUG Project Component/Activity	Potential Interaction	Valued Component	MUG Project Mitigation and Design Features	Interaction Classification
• General Construction and Operation Activities o Underground Mining of the kimberlite pipe and operation of surface infrastructure and support facilities (continued)	• Workforce requirements for the Project could generate migration between communities and associated pressure on infrastructure and services	• Community Health and Well-being	• The Project will continue employment for the existing Misery workforce and for contractors specialized in underground mining • Migration and population change is not expected to be significant, if occurring at all • Fly-in Fly-out arrangements with communities will be continued • The non-local workforce will be flown to site and housed in camp accommodation • On-site medical and emergency response services will be maintained • Out of area workers are expected to maintain relationships with healthcare providers in their communities of origin	Secondary
	• Project rotational employment and incomes can contribute to income disparity and social maladies (e.g., substance abuse and addictions, communicable diseases, domestic violence, crime)	• Community Health and Well-being	• The Project will continue employment and associated incomes for the existing Misery workforce, and for contractors • The non-local workforce will be flown to site and housed in camp accommodations • A worker Code of Conduct, and zero tolerance policy regarding substance abuse will be maintained while on rotation • An Employee and Family Assistance Program will be provided that includes access to counselling and addiction treatment	Secondary
• General Closure and Decommissioning Activities of the Misery Underground o Removal of project infrastructure	• Removal of Project infrastructure at closure may change hydrology in downstream waterbodies	• Surface Hydrology • Water Quality • Aquatic Life Other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use	• The underground workings of the Misery Pit will be cleared of mining equipment and other infrastructure. • Disturbed areas will be reclaimed and the surface stabilized. • Natural drainage patterns will be re-established. • Erosion and sediment control measures will be implemented where appropriate	Secondary
• MUG Project Closure and Jay Construction and Operations o Back-flooding of the mined-out Misery Pit in association with the Jay Project	• Pumping of minewater from Lynx Pit and King Pond Settling Facility to the mined-out Misery Pit at MUG Project closure may affect the water quality in Lac du Sauvage during Jay Project operations	• Water Quality • Aquatic Life Other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use	• As a requirement of the existing Ekati mine Water Licence, water Discharged from the Misery Pit during Jay Project operations will meet EQC in the Water Licence. • Water Discharged from the Misery Pit will be monitored as part of the overall minewater management (i.e., SNP) as well as in the Receiving Environment (i.e., AEMP), and provides input for adaptive management.	Primary
• Post-closure Following Jay Project Closure o Reconnection of the Misery Pit to the local hydrological system after closure of the Jay Project	• Closure of the MUG Project may affect water quality in the Misery pit lake at post-closure	• Water Quality • Aquatic Life Other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use	• An optimization study will be conducted to determine the optimal depth of the freshwater cap that will be placed in Misery Pit at Jay Project closure using water quality monitoring results obtained during Jay Project operations. • A Misery Pit back-flooding plan will be developed for the Final Closure and Reclamation Plan and will be based on site-specific monitoring and industry experience. • Water quality will be monitored during back-flooding of the Misery Pit to confirm formation of meromixis prior to release of water to the Lac de Gras Receiving Environment.	Primary
• Spills of Fuel and Hazardous Materials	• Spills (i.e., fuels, petroleum products, reagents) on site may cause changes to water and soil quality	• Water Quality • Physical/Terrestrial (Soils and Vegetation) Environment • Aquatic Life other than Fish • Fish • Physical/Terrestrial Environment (Soils and Vegetation) • Caribou, Carnivores, and Breeding Birds • Land Use and Traditional Land Use • Community Health and Well-being	• A Spill Contingency Plan is in place for the Ekati mine and will incorporate the MUG Project. • Regular equipment maintenance is conducted (e.g., regular checks for leaks). • Drip trays and/or absorbent pads are used during servicing and refuelling. • All hazardous substances are stored and handled on site in accordance with applicable regulations. • Fuel is stored at central bulk fuel farms and fuel tanks are housed within bermed areas. • The Project will follow standard policies used at the Ekati mine in the event of a spill; spill response training is provided and updated. • Hydrocarbon-impacted material will continue to be handled in accordance with the approved management plan.	No Linkage

AEMP = Aquatic Effects Monitoring Program; AQEMMP = Air Quality and Emissions Monitoring and Management Program; DFO = Fisheries and Oceans Canada; EQC = effluent quality criteria; IBA = Impact Benefit Agreement; LLCF = Long Lake Containment Facility; MUG = Misery Underground; PK = processed kimberlite; SNP = surveillance network program; WEMP = Wildlife Effects Monitoring Program; WPKMP = Wastewater and Processed Kimberlite Management Plan; WROMP = Waste Rock and Ore Storage Management Plan; WRSA = waste rock storage area; masl = metres above sea level.

6.5.2 Interactions with No Linkage to Effects

Changes to local hydrology (surface water flows and drainage patterns) from the Project footprint and possible effects to water quality

Changes to local hydrology from the Project footprint can affect water quality, and thus aquatic life other than fish, soils, vegetation, caribou, carnivores, breeding birds, and land use and traditional land use. New infrastructure for the MUG Project will be constructed in locations that have been previously disturbed. There will be no disturbance of new areas located outside of previous or current mining activities, and no alterations to existing drainage patterns. In addition, runoff and seepage from the Project facilities will be managed, as appropriate, to avoid adverse environmental effects in downstream waterbodies.

Mitigation and environmental design features to reduce the probability of potential effects to hydrology or water quality include:

- Management of runoff and seepage from Project facilities, as appropriate, to avoid adverse environmental effects in downstream waterbodies.
- Use of erosion and sediment control practices (e.g., silt fences, runoff management) applicable to northern environments and already in place at Ekati during construction of new infrastructure and around disturbed areas, where appropriate.
- Construction will be timed, where appropriate, to take place during dry or frozen conditions to minimize disturbance to soils and vegetation, and runoff to local waterbodies.

By implementing mitigation practices, no measurable changes to hydrology or water quality from the Project footprint are anticipated in downstream waterbodies relative to baseline conditions. Therefore, this interaction was determined to have no linkage to effects on water quality, aquatic life other than fish, soils, vegetation, caribou, carnivores, breeding birds, and land use and traditional land use.

Changes to permafrost conditions from the Project footprint

Loss and alteration of permafrost from the Project footprint has the potential to affect groundwater, surface hydrology, soils, vegetation, and land use and traditional land use. Freeze-induced displacement of soil (i.e., frost jacking) and thaw-induced displacement of soil (i.e., subsidence) are the main issues related to permafrost degradation (i.e., loss or alteration). Changes to thaw penetration and thickness of the active layer can influence surface stability through thaw settlement, frost heave, and bearing capacity, as well as slope stability (Tarnoicai et al. 2004). Changes can also affect hydrology, soil moisture, and nutrient availability, thereby influencing the ecology of an area by affecting vegetation.

Numerous factors affect the magnitude of change to permafrost areas and influence recovery of an area following disturbance: type of construction activities, site infrastructure, vegetation, soil type, soil texture, density, water content, and snow depth (Lawson 1986; Nolte et al. 1998; Jorgenson et al. 2010). Thaw settlement caused by disturbance and subsequent melting of permafrost can initially lead to water impoundment, decreased albedo, and an increase in heat flux, which in turn causes more thaw settlement (Jorgenson et al. 2010). This can result in a change in surface hydrology that shifts recovery patterns towards new plant communities, further influencing permafrost. The depth of the active layer may continue to increase as a result of disturbance (Burgess and Harry 1990; Burn and Smith 1993; Hayhoe and Tarnocai 1993).

The 1995 EIS predicted that local disturbance of the permafrost layer would occur due to mine activities such as the digging of open pits, storage of waste rock, and construction of roads and the LLCF; the disturbances were predicted to be local in nature and restricted to the mine footprint. The low relief of the claim block and the implementation of appropriate engineering design and construction practices specific to arctic areas typically mitigate most of the mine effects on permafrost.

Mitigation and environmental design features to reduce the potential for permafrost melting include:

- Design of the MUG Project minimizes the construction of new infrastructure that might have an effect on permafrost; and,
- New infrastructure will be constructed in locations that have been previously disturbed. There will be no additional alteration to undisturbed areas of aquatic and terrestrial land cover

By implementing mitigation practices, no changes to permafrost from the Project are anticipated. Therefore, this interaction was determined to have no linkage to effects on groundwater, surface hydrology, soils, vegetation, and land use and traditional land use.

Direct loss and fragmentation of plant communities and wildlife habitat from the Project footprint

The physical development at the Ekati mine encompasses 3,525 ha, or approximately 1.4% of the 2,607 km^2 claim block. The MUG Project will not alter undisturbed aquatic or terrestrial land cover. All infrastructure for the Project will be developed on existing disturbed areas; there is no predicted change in the direct loss and fragmentation of plant communities and wildlife habitat from the Project relative to existing (baseline) conditions. This includes the powerline that will be laid out on pipe supports on the ground surface along an existing road. A previous analysis for the Jay Project indicated that powerlines have smaller effects on caribou movement and distribution than roads and traffic (DDEC 2014). In contrast to the Jay Project, the powerline for the MUG Project does not intersect existing undisturbed habitat or caribou migration paths. Therefore, the powerline is predicted to not change the movement and behaviour of wildlife, or the migration and population connectivity of caribou. The Project is anticipated to have no interaction between direct loss and fragmentation of plant communities and wildlife habitat.

Soil erosion and sedimentation from construction activities may alter surface water quality in downstream waterbodies

Soil erosion and sedimentation from construction of new and/or upgraded infrastructure required for the Project may cause changes to water quality in nearby waterbodies. Project construction activities that may increase the potential for soil erosion and associated sedimentation of waterbodies include the planned upgrades to the King Pond Settling Facility Saddle Dam structure, expansion of the Misery camp, construction of a new fresh air raise, and installation of the powerline and dewatering and compressed air pipelines. Increased sediment runoff as a result of site clearing, contouring, and excavation associated with these activities may result in increased total suspended solids (TSS) and turbidity in receiving and downstream waterbodies, which can affect aquatic life other than fish, fish, soils, vegetation, caribou, carnivores, breeding birds, and land use and traditional land use.

Mitigation practices will be implemented to reduce potential effects to nearby waterbodies. The Project will make full use of existing Ekati mine facilities to avoid loss or alteration of undisturbed aquatic and terrestrial land cover. Erosion and sediment control practices will be implemented for the Project based on Ekati and industry standard Best Management Practices. Standard erosion and/or sedimentation control measures (e.g., silt fences, runoff management) will be implemented during construction around disturbed areas, as necessary, to prevent soil erosion and sediment from entering nearby watercourses. A sediment and erosion control plan will be implemented during construction of the proposed upgrades to the King Pond Settling Facility Saddle Dam water control structure. Runoff from construction associated with the Saddle Dam upgrades will be collected and managed, as required, within King Pond Settling Facility, which is used as a minewater management facility at the Misery site.

With the implementation of the mitigation described above, it is anticipated that the changes to surface water quality from soil erosion will be temporary and not detectable relative to baseline conditions. Therefore, this interaction is expected to have no linkage to effects on surface water quality, aquatic life other than fish, fish, soils, vegetation, caribou, carnivores, and breeding birds, and land use and traditional land use.

Construction of the Project may cause disturbance or destruction of heritage resources

The Archaeological Monitoring Program was initiated as part of the Ekati mine's commitment to protect archaeological and heritage resources. Archaeological surveys have been completed at the site and documentation is ongoing. Archaeological assessments or investigations were completed annually at Ekati from 1994 through 2007, and again from 2013 through to 2015 in conjunction with ongoing mine development and exploration. Archaeological investigations have typically involved a combination of aerial examination using a helicopter and ground reconnaissance. Areas with moderate to high archaeological potential are searched on foot and exposures and bedrock outcrops within the development areas are closely examined. Areas with low archaeological potential are generally eliminated during the helicopter reconnaissance survey.

An archaeological investigation of the Misery site area was completed in 1995 as part of the original assessment of the Misery mine site and access roads, and in 2013 as part of the proposed expansion of the existing waste rock storage area (Section 3.2.2). No archaeological sites have been recorded within 1 km of the Misery Pit, and no new land disturbance will be part of the proposed Project. As a result, no further archaeological surveys are necessary for the MUG Project. Mitigation practices are in place to avoid or preserve heritage resources that may be identified during mine operations. Therefore, this interaction was determined to have no linkage to effects on archaeology and heritage resources.

Changes to local hydrology (surface water flows and water levels) from the water supply requirements (process water and potable water) for the Project

Changes to local hydrology (surface water flows and water levels) from the water supply requirements (mining and potable) for the Project can affect water quality, aquatic life other than fish, fish, soils, vegetation, caribou, carnivores, breeding birds, and land use and traditional land-use. Freshwater is supplied to the Ekati mine operations primarily from Grizzly Lake. Other licensed freshwater sources include Little Lake, Thinner Lake, Falcon Lake, and Lac de Gras. The LLCF is the source of recycle water for processing plant operations. An increase in the maximum allowable annual extraction of potable water from Grizzly Lake from 150,000 m^3/year to 200,000 m^3/year was initiated between 2006 and 2008 (as per the Water Licence). Freshwater extraction from Grizzly Lake for the purpose of potable water has not increased since the inception of the new maximum.

It is anticipated that water demand will not increase for the MUG Project; therefore, the existing potable water system at site will be used. Appropriate protocols for water withdrawals (DFO 2010) will continue to be followed. The site water management system is designed to recycle water, where applicable, and reduce requirements for water withdrawal. For example, raw water required for operations will be taken from the LLCF. Since an increase in water demand is not expected and the current site water management system will continue to be used, no changes in local hydrology from water supply requirements are expected. This interaction was determined to have no linkage to effects to hydrology, water quality, aquatic life other than fish, fish, soils, vegetation, caribou, carnivores, breeding birds, and land use and traditional land use.

Seepage from waste rock piles and kimberlite stockpiles can cause changes in groundwater and surface water quality

Ingestion of soil, vegetation, or water that has been chemically altered by seepage from waste rock piles and kimberlite stockpiles

Seepage from the waste rock disposal areas and kimberlite stockpiles can cause changes in groundwater and surface water quality, which can affect soil and vegetation. Elevated concentrations of residual nitrogen (i.e., ammonia and/or nitrate) sourced from stored waste rock excavated using explosives could enter the natural Receiving Environment and cause effects to fish and other aquatic organisms. Ingestion of water, soil, or vegetation that has been chemically altered by seepage can cause effects to caribou, carnivores, breeding birds, land use and traditional land use, and community health and well-being.

The waste rock excavated from the MUG Project will be granite, which has been demonstrated, and accepted, as non-acid generating and non-metal leaching at the Ekati mine. Waste rock will be stored at the existing WRSA at the Misery site. This approach avoids the introduction of a new area of seepage and monitoring. There are no groundwater inflows into the existing WRSA. Additionally, as a condition of the Ekati mine Water Licence (July 2017), annual monitoring and reporting of WRSA seepage quality and ongoing validation of waste rock geochemical characterization are required. Findings of these monitoring programs are reported annually to the WLWB. The Waste Rock and WRSA Seepage Monitoring Programs are being expanded to incorporate the Sable and Jay Projects as part of the Water Licence amendment process. No further amendments to these programs are expected as a result of the MUG Project, due to the small quantities of waste rock that will be produced and the fact that it will be placed at an existing facility.

Changes to groundwater and surface water quality are not expected with the continued use of mitigation and monitoring programs currently in place for the Ekati mine specific to the waste rock disposal areas and kimberlite stockpiles. Therefore, these interactions were determined to have no linkage to effects to fish, soil, vegetation, caribou, carnivores, breeding birds, land use and traditional land use, and community health and well-being.

6.5.3 Interactions with Secondary Linkages

Discharge from King Pond Settling Facility to Cujo Lake in the first year of the MUG Project may change hydrology in downstream waterbodies

During the first year of the MUG Project (2018), there will be an annual Discharge from King Pond Settling Facility to lower the water level to 443 metres above sea level (masl) after freshet but before the start of pumping of minewater from Misery underground developments (Section 4.5.10; Golder 2017a). Discharge of this water to Cujo Lake may potentially affect hydrology in the Receiving Environment (Cujo Lake) and in downstream waterbodies (i.e., Christine Lake and Lac du Sauvage). Changes to hydrology have the potential to affect water quality, aquatic life other than fish, soils, vegetation, caribou, carnivores, breeding birds, and land use and traditional land use. Changes to hydrology from the Discharge from King Pond Settling Facility have the potential to affect fish movement and use of habitat within the downstream lakes and streams.

Currently, King Pond Settling Facility is a managed facility with a pumped Discharge to Cujo Lake in the King-Cujo Watershed. Discharge from King Pond Settling Facility under the Project will be managed to existing pumping limits and will continue to apply all currently regulated mitigations. Based on DDEC pumping records, King Pond Settling Facility Discharges annually to Lac du Sauvage through Cujo and Christine lakes (mean annual Discharge of approximately 270,000 m^3, typically over an approximately two to three-month period within July to October). Water levels within King Pond Settling Facility have historically been held between an elevation of 443.3 and 445.5 masl. The water management plan for the MUG Project includes the use of existing pumping infrastructure, with pumping expected to commence on August 1, 2018, at a rate of 1,000 m^3/hr. Pumping will occur until the operating level of 443 masl is reached, then stop, but would be recommenced if new inflows increase water levels prior to use of King Pond Settling Facility for storage of MUG Project minewater. The proposed pumping duration (approximately 20 days of Discharge from the King Pond Settling Facility) is based on expected initial water levels and inflows due to direct precipitation and runoff, and may be reduced or extended based on actual weather conditions during pumping.

The existing Discharges into Cujo Lake from King Pond Settling Facility are controlled and managed under existing and approved operations. Cujo Lake is near the headwaters of the watershed and, prior to mine development, would have received natural inflows that are now intercepted and stored within King Pond Settling Facility. Releases from King Pond Settling Facility to Cujo Lake vary seasonally and annually; however, the maximum pumping rates are limited to the existing pump and pipe infrastructure, which is expected to be used during the Discharge from the King Pond Settling Facility in the first year of the MUG Project. The expected pumping rates from King Pond Settling Facility for the pumping duration (approximately 20 days) are within the historical range of pumping rates from King Pond Settling Facility and are expected to occur during the period when existing pumping has generally historically occurred (i.e., outside the freshet period, when natural peak flows occur).

Cujo Lake

On a seasonal basis, inflow and outflow volumes to Cujo Lake are predicted to increase from existing conditions for one open-water season, as King Pond Settling Facility is pumped down to 443 masl. During the Discharge period, the magnitude of peak flows is not expected to increase above existing peak flows, as the Discharge period is outside of the freshet period when natural peak flows occur and the pumping rate is limited by the existing infrastructure. Therefore, no erosion or changes in channel morphology are expected; this is supported by assessments of Cujo Stream, Stream B2, and Stream B3 on July 22, 2017 during a pumping rate of 840 m^3/hr from the King Pond Settling Facility, where no erosion or elevated suspended sediment were observed. Expected changes to hydrology include an increase in the duration of high flows during the late summer season in Cujo Lake and Stream, and downstream streams B2 and B3 (streams upstream of Christine Lake); however, based on the historical pumping record and monitoring results (DDEC 2017d; ERM 2015a, 2016a), these conditions have occurred under existing operations. The Project effects are expected to be temporary for one open-water season.

Christine Lake

On a seasonal basis, inflow and outflow volumes to Christine Lake are predicted to increase from existing conditions for one open-water season during the Discharge from King Pond Settling Facility in the first year of the MUG Project. The magnitude of changes to hydrology in Christine Lake will be reduced in comparison to those in upstream waterbodies (i.e., Cujo Lake), as the natural drainage area and inflows

increase relative to the pumped volumes. During the Discharge period, the magnitude of peak flows is not expected to increase above existing peak flows, as the Discharge period is outside of the freshet period when natural peak flows occur and the pumping rate is limited by the existing infrastructure. Expected changes to hydrology include the increased duration of high flows during the late summer season in Christine Lake and Stream. The Project effects are expected to be temporary for one open-water season.

Lac du Sauvage

Predicted Project effects at the Lac du Sauvage outlet during the period of Discharge from the King Pond Settling Facility are estimated to be negligible and within natural variability. No measureable effects to the water levels or flows in the Lac du Sauvage outlet are expected due to the MUG Project.

Summary

The waterbody where the greatest temporary changes to flows and water levels are expected to occur is Cujo Lake, which is directly downstream of King Pond Settling Facility and has a small contributing drainage area. The magnitude of changes to water levels and flows decreases in downstream waterbodies, and are negligible in Lac du Sauvage, due to increases in contributing drainage areas and magnitudes of natural flows. The Discharge from King Pond Settling Facility in the first year of the MUG Project is expected to result in a temporary, local, and minor increase in the duration of higher flows and water levels in Cujo Lake and downstream waterbodies upstream of Lac du Sauvage compared to the existing conditions, with no expected increases in the magnitude of peak flows or erosion. Thus, it is expected that fish would be able to remain in the lakes and streams throughout the Discharge period, and move within the streams, and to overwintering habitat, prior to freeze up. As such, this interaction is considered secondary, and to have a negligible effect on water quality and aquatic life other than fish, fish, soils, vegetation, caribou, carnivores, breeding birds, and land use and traditional land use.

Discharge from the King Pond Settling Facility to Cujo Lake in the first year of the MUG Project may change water quality (e.g., suspended sediments, metals, nutrients) in receiving waterbodies

During the first year of the MUG Project (2018), there will be an annual Discharge from King Pond Settling Facility to lower the water level to 443 masl after freshet but before the start of pumping of minewater from Misery underground developments. Discharge to Cujo Lake may potentially affect water quality in the Receiving Environment and in downstream waterbodies (i.e., Christine Lake and Lac du Sauvage). Changes to water quality have the potential to affect aquatic life other than fish, fish, soils, vegetation, caribou, carnivores, breeding birds, and land use and traditional land use.

Currently, King Pond Settling Facility Discharges annually to Lac du Sauvage through Cujo and Christine lakes (mean annual Discharge of approximately 270,000 m^3, typically over an approximately two to three month period within July to October). These Discharges are regulated through effluent quality criteria (EQC) set out in the existing Ekati mine Water Licence.

As a requirement of the Ekati mine Water Licence, any water released to the Receiving Environment from King Pond Settling Facility will meet established EQC for Discharge to Cujo Lake; this will be applicable to the Discharge from the King Pond Settling Facility for the MUG Project. EQC for the mine site were set by the WLWB and are intended to ensure that water quality in the Receiving Environment is maintained at a level that allows for current and future uses (WLWB 2011). Water to be Discharged is regularly monitored

and sampled as part of the Ekati mine's SNP, which is established at the mine site to ensure compliance with the Water Licence. Monitored locations at waterbodies on site associated with the MUG Project will remain consistent with those in place for the Ekati mine, which include the King Pond Settling Facility Discharge location (SNP Station 1616-43) and Cujo Lake water hardness monitoring location (SNP Station 1616-42). The downstream Receiving Environment is also monitored as part of the Ekati mine AEMP, which evaluates the physical, chemical, and biological components of the aquatic ecosystem. Monitored locations include Cujo Lake, Cujo Outflow Stream, Christine–Lac du Sauvage Stream and the western bay of Lac du Sauvage near the inflow from Christine Lake. This monitoring will continue during the MUG Project.

The Discharge from King Pond Settling Facility to Cujo Lake is expected to occur well in advance of the start of pumping groundwater from Misery Underground. As such, the water quality of Discharges from King Pond Settling Facility to Cujo Lake during the Discharge period are expected to be similar to those encountered during Misery Pit open pit mining. The frequency and intensity of SNP monitoring, that is ongoing at King Pond Settling Facility and in the Receiving Environment, provides confidence in the ability to track and maintain Discharges below EQC. If constituent concentrations in King Pond Settling Facility at the SNP Discharge monitoring location begin to rise during the period of Discharge, lead time will be available to allow for adaptive management, including discontinuing pumping activities. Water from King Pond Settling Facility will only be Discharged to the environment if it meets the EQC.

As water from King Pond Settling Facility will only be Discharged to the Receiving Environment if it meets EQC, and Discharge will occur in advance of the start of pumping groundwater from Misery Underground, potential changes to water quality in the downstream Receiving Environment are predicted to be minor and localized (i.e., limited in downstream spatial extent, consistent with current conditions). These changes should be well within the tolerance limits of resident biota, and monitoring programs are already in place. As such, this interaction is considered secondary, and is expected to have a negligible residual effect to water quality, aquatic life other than fish, fish, soils, vegetation, caribou, carnivores, breeding birds, and land use and traditional land use.

Cessation of water Discharge during operations from King Pond Settling Facility to Cujo Lake may change hydrology and fish habitat in downstream waterbodies

The chemistry of groundwater produced from the Misery Underground is expected to not meet EQC in the Water Licence for direct Discharge from King Pond Settling Facility to the Cujo Lake Receiving Environment. It is therefore not anticipated that water in King Pond Settling Facility will be suitable for Discharge to the environment after mixing with minewater from underground developments. As such, the water management plan is centred on the containment of minewater throughout the MUG Project construction and operations phase. However, if the King Pond Settlement Facility does meet Water Licence EQC, operations of the facility would continue as per current minewater management strategies. The following, however, assesses the scenario where no Discharge occurs during the MUG Project.

Following the annual Discharge of King Pond Settling Facility in the first year of the MUG Project, Discharge from King Pond Settling Facility is expected to be suspended during MUG Project operations; minewater pumped from the underground will be initially stored within King Pond Settling Facility. Suspension of water Discharge is expected to occur over the period extending from early development of the MUG Project through to the end of the operations phase of the Project. During this period, King Pond

Settling Facility will be used as a holding facility for minewater and other project-affected water. However, Discharge of minewater from King Pond Settling Facility to Cujo Lake may occur during operation of the Project if the water meets existing EQC. Beginning in Year 2 of the Project and once the Lynx Pit is available, minewater from the Misery underground developments will be pumped to the mined-out Lynx Pit, as well as the excess minewater stored within the King Pond Settling Facility.

Discharges into Cujo Lake are controlled and managed from the King Pond Settling Facility under existing and approved operations. Cujo Lake is near the headwaters of the watershed and, prior to mine development, would have received inflows that are now intercepted and stored within the King Pond Settling Facility. Releases from the King Pond Settling Facility to Cujo Lake vary seasonally and annually, as summarized in Table 6.5-2. In recent years of operations, most flow releases from King Pond Settling Facility have occurred later in the open-water season when flows would naturally be low. Pumping during the typical period of spring freshet (i.e., June) has occurred infrequently or with relatively small volumes during recent operations, with no June pumping happening in consecutive years between 2010 and 2011 and again from 2015 through 2017 (Table 6.5-2).

Table 6.5-2 Monthly Volumes Pumped from King Pond Settling Facility to Cujo Lake (m^3)

	May	June	July	August	September	October	Total
2001	0	0	0	39,519	236,797	123,004	399,320
2002	0	12,344	32,858	12,506	270,250	0	315,614
2008	0	29,082	0	0	70,398	50,449	149,929
2009	0	9,331	49,872	0	64,702	105,056	228,961
2010	0	0	60,816	194,338	113,776	0	368,930
2011	0	0	0	29,030	206,433	0	235,463
2012	0	302,294	142,079	0	0	0	302,294
2013	0	0	66,323	0	0	0	66,323
2014	720	13,600	4,560	9,920	1,680	80	26,160
2015	0	0	238,458	0	0	437,818	676,276
2016	0	0	0	0	154,404	0	154,404
2017[(a)]	0	0	n/a [(a)]	n/a	n/a	n/a	n/a

a) pumping in 2017 was initiated on July 15, 2017, monthly pumping volumes after initiation of pumping are not available (n/a)
m^3 = cubic metres.

Cujo Lake

On an annual basis, inflow and outflow from Cujo Lake is predicted to decrease from existing conditions for the duration of operations as King Pond Settling Facility will not contribute to flows downstream. Cujo Lake is 10 m deep (DDEC 2014, Annex XIV), and small changes in water levels that might occur with the cessation of pumping are not expected to result in a measurable change to the physical conditions within Cujo Lake.

Seasonally, many months will have little or no change from current operations with the cessation of flows. A majority of Discharge into Cujo Lake from King Pond Settling Facility has occurred in the late summer

and fall (Table 6.5-2). Flows during spring freshet in the watershed downstream of Cujo Lake under current operations rely on local watershed inputs and not on releases from the King Settling Pond Facility in most years. The cessation of pumping would not alter conditions from current operation during spring freshet in most years.

The majority of existing releases to Cujo Lake occur later in the season between August and October, although the timing and magnitude of flow releases from King Pond Settling Facility have been variable from year to year. Discharges during current operations later in the open-water season would represent an increase in flows relative to pre-development conditions (i.e., prior to Ekati mine development). Cessation of pumping would generally result in decreased flows compared to current operations, but this would result in conditions that would more closely resemble pre-development conditions. Under current operations, there are also consecutive years with no late summer or fall pumping as well (e.g., 2012 through 2013). Due to the variability in current operations from year to year, there are periods under current operations where the cessation of pumping will be similar to existing conditions as many months currently operate with no Discharge to Cujo Lake.

Christine Lake

Christine Lake has a larger watershed area that contributes to water levels and flow that is not affected by the King Pond Settling Facility, and as a result, the operation of the King Pond Settling Facility has less influence on the variability of water levels and outlet discharges from Christine Lake. Christine Lake has a maximum depth of 14.6 m (DDEC 2014, Annex XIV), and small changes to water levels under both current operations and with the cessation of pumping are expected to be within the natural range of variability and will not result in a measurable change to the physical conditions within Christine Lake. The change in operations of the King Pond Settling Facility under the Project will not alter the flow contributions from the remainder of the Christine Lake watershed, which is expected to continue to attenuate the effect on water level and outlet discharge from Christine Lake. The Christine Lake outlet stream (i.e., Christine-Lac du Sauvage) is expected to freeze as occurs under current operations and have no outflow from November to the end of May.

Lac du Sauvage

Predicted MUG Project effects at the Lac du Sauvage outlet during operations are estimated to be negligible and within natural variability. No measureable effects to the water levels or flows at the Lac du Sauvage outlet are expected due to the Project.

Effects on Fish and Fish Habitat

Cujo Lake and the streams between Cujo Lake and Christine Lake provide suitable fish habitat and support a fish population that is being sustained under the current flow management operations (DDEC 2014, Annex XIV, 2015a; ERM 2015a). Changes in water levels and flows from the cessation of water Discharge from King Pond Settling Facility could affect habitat for fish and other aquatic life in downstream waterbodies; however, conditions are not expected to differ measurably from current operations. Most of the pumping releases have occurred in the late summer and fall when fish in the Arctic typically begin to move out of stream habitats to lake habitats for summer and fall feeding and in advance of winter conditions where streams typically freeze to the substrate.

Fisheries inventories completed in Cujo and Christine Lakes and in their respective outflow streams from 2007 to 2013 indicate that Round Whitefish are the most abundant species in Cujo Lake, followed by Lake Trout, Slimy Sculpin, and Arctic Grayling (DDEC 2014, Annex XIV). In Christine Lake, Lake Chub was the most abundant fish species present, followed by Slimy Sculpin and Lake Trout. The least abundant species were Arctic Grayling and Burbot. The outlet streams were dominated by Arctic Grayling, followed by Slimy Sculpin and Burbot. Round Whitefish were also present in the Christine Lake outlet stream (DDEC 2014, Annex XIV). Arctic Grayling will utilize stream habitats during freshet for spawning, but then typically return to lake habitats for summer feeding and to overwinter (Richardson et al. 2001).

Spawning surveys conducted in 2014 found evidence of Arctic Grayling spawning in Streams B2 and B3, located downstream of Cujo Lake (DDEC 2015a). The primary fish species using stream habitats are Arctic Grayling, which use stream habitats seasonally for spawning during the spring freshet. Successful spawning was confirmed in 2014; this followed a period where three out of the previous four years had no spring freshet pumping. Flow conditions in 2014 had very minimal pumping into Cujo Lake that would not have provided any measureable improvement to access or spawning conditions relative to a non-pumping condition. Discharge from King Pond Settling Facility was equivalent to a flow augmentation of 0.005 m^3/s or 5 L/s averaged across the month (Table 6.5-2), whereas the freshet flow in 2014 was at 0.06 m^3/s (ERM 2015a) or an order of magnitude greater than the pumping rate.

During incidental observations of fish use of stream habitats in July 2017 (Golder, unpublished data), Arctic Grayling were well distributed throughout the streams downstream of Cujo Lake in a year where no pumping occurred during the spring freshet (Table 6.5-2). Observational data have confirmed fish access and spawning occurs without supplemental spring flows from the King Pond Settling Facility to Cujo Lake under current operations. It is not expected that the cessation of pumping will prevent access to habitat during spring freshet. No changes to stream habitat availability or access during spring is predicted relative to existing conditions.

The fish species found in the watershed would use habitats in Cujo Lake and Christine Lake for summer feeding and overwintering. Maximum water depths within Cujo and Christine Lakes are 10 m and 14.6 m, respectively. Given the small magnitude of the water level reductions that can be expected relative to the overall depths of the lakes, the cessation of Discharge from King Pond Settling Facility is not expected to alter fish habitat use of Cujo and Christine Lakes, including use of overwintering habitats. The change in water levels in Lac du Sauvage and at the outlet of Lac du Sauvage are expected to remain within the natural range of variability, and are therefore not expected to measurably affect fish habitat quality.

Summary

The waterbody where the greatest changes to flows and water levels could occur is Cujo Lake, which is located directly downstream of King Pond Settling Facility, and the connecting streams between Cujo Lake and Christine Lake. The magnitude of changes to water levels and flows decreases in downstream waterbodies, and is expected to be negligible in Christine Lake and Lac du Sauvage due to increases in contributing drainage areas and magnitudes of natural flows. The cessation of Discharge from King Pond Settling Facility to Cujo Lake during operation of the Project is expected to result in a temporary, local, reduction in flows and water levels in Cujo Lake and downstream watercourses. The reduction of flows is temporary, as Discharges from King Pond Settling Facility to Cujo Lake will be

re-established at closure of the MUG Project, or as soon as EQC can be met. It is expected that fish would be able to remain in the lakes and streams throughout the period of operations, and move within the streams to spawning habitats during spring freshet, and to overwintering habitat prior to freeze up. As such, this interaction is considered secondary, and to have a minor effect on water quality and aquatic life other than fish, soils, vegetation, caribou, carnivores, breeding birds, and land use and traditional land use.

Cessation of water Discharge from King Pond Settling Facility to Cujo Lake during operations may change water quality (e.g., suspended sediments, metals, nutrients) in receiving waterbodies

During the operations phase of the Project, it is expected that the release of minewater from King Pond Settling Facility will be discontinued, as the water in King Pond Settling Facility will likely not be suitable for Discharge to the environment after mixing with minewater from the underground development. Discharge from the King Pond Settling Facility to Cujo Lake, however, may occur if the water meets Water Licence EQC.

Under existing conditions, Discharge from King Pond Settling Facility to Cujo Lake typically occurs on an annual but variable basis over an approximate two to three month period from July to October (see Table 6.5-2). Cessation of Discharge of this water to Cujo Lake during operation of the Project may alter water quality in the Receiving Environment and in downstream waterbodies (i.e., Christine Lake and Lac du Sauvage), which can affect aquatic life other than fish, fish, soils, vegetation, caribou, carnivores, breeding birds, and land use and traditional land use.

The chemistry of groundwater produced from the Misery underground developments is generally not expected to meet EQC in the Water Licence for Discharge from King Pond Settling Facility to the Cujo Lake Receiving Environment. Following the Discharge from King Pond Settling Facility into Cujo Lake in the first year of the MUG Project, Discharge from the facility is expected to be suspended. Minewater pumped from the underground will be stored on a temporary basis within King Pond Settling Facility. Beginning in Year 2 of the Project, once Lynx Pit is available, the water stored within the facility will be pumped to the mined-out Lynx Pit, which will provide additional storage of groundwater from the MUG Project. Suspension of water Discharge is expected to occur over the period extending from early development of the Misery Underground through to the end of the operations phase of the MUG Project. Discharge from the King Pond Settling Facility to Cujo Lake, however, may occur if the water meets Discharge criteria (i.e., existing EQC).

The cessation of Discharge from King Pond Settling Facility to Cujo Lake during operation of the Project is expected to result in an overall improvement in water quality in the Cujo Lake Receiving Environment and in downstream waterbodies. Concentrations of TSS, TDS, nutrients (nitrogen and phosphorus) and metals, which are released to Cujo Lake in minewater Discharged from King Pond Settling Facility are expected to decrease over time as the loading of these constituents to the environment is temporarily discontinued. This is expected to result in an overall positive change in aquatic habitat quality during the period that the Discharge is discontinued or limited. Once EQC for King Pond Settling Facility are met, annual Discharge similar to pumping schedules over the past few years would be re-instated, and the downstream Receiving Environment would return to current conditions. As such, this interaction is

considered secondary, and is expected to have a negligible effect on water quality and aquatic life other than fish, fish, soils, vegetation, caribou, carnivores, breeding birds, and land use and traditional land use.

Groundwater inflow to the underground mine may cause changes to local or regional groundwater quantity and quality, which can affect surface water quantity and quality

Groundwater inflow to the Misery underground developments may alter local or regional groundwater quality, which can affect surface hydrology and water quality. Changes to these VCs can affect aquatic life other than fish, fish, caribou, carnivores, breeding birds, land use and traditional land use, and community health and well-being. An open talik occurs below Lac de Gras and open taliks are expected to occur below Mist Lake, which is located approximately 300 m to the east of the Misery Pit, and the Misery Pit (formerly the site of Misery Lake). During mining, the lakes with open taliks below them may provide a source of recharge to the subsurface with water movement along structural discontinuities. A survey of lineaments in the area indicates that such discontinuities may exist and, if permeable and continuous, could connect Lac de Gras and Mist Lake with the Misery Underground and thus act as a source of seepage.

Mining of the underground portion of the Misery kimberlite pipe will induce groundwater to flow toward the underground operation. Groundwater inflow to Misery Underground will originate from deep bedrock and from surface water. This inflow will consist of high TDS groundwater from deep bedrock and low TDS groundwater from surface water sources. A mine water management plan (Golder 2017a) has been developed for the Project according to practices established in the WPKMP (Section 4.5.10). During mining, sumps, the water conveyance system, and pumping will be employed to manage water entering the underground workings. Groundwater inflows collected in the Misery Underground will be pumped out via a pipeline and managed in the King Pond Settling Facility and Lynx Pit during Misery underground operations.

No measurable reduced water levels in the surrounding lakes are anticipated in response to Misery Underground dewatering based on operating experience and data gained at the Ekati mine over the past 18 years of mine operations. An analysis of projected groundwater inflow rates and associated TDS mass loading rates to the Misery Underground has been completed for the Project as part of the water balance studies (Golder 2017a,b). Thus, this interaction is predicted to have negligible residual effects to groundwater and water quality.

Air and dust emissions and subsequent deposition may affect air, soil, aquatic substrates and water quality

Air and dust emissions and subsequent deposition can cause chemical changes to water and soil quality, and cover aquatic substrates and plants, which can influence aquatic life other than fish, fish, vegetation, wildlife, land use and traditional land use, and community health and well-being. Stationary and mobile combustion exhausts are generally the primary sources of sulphur dioxide (SO_2) and NO_X emissions. Roads, rock crushing, wind erosion, and the airstrip are the main sources of fugitive dust emissions at the Ekati mine. Polycyclic aromatic hydrocarbon and volatile organic compound emissions are predominantly from combustion exhausts; emissions of trace metals are associated with all sources but to varying degrees. Fugitive dust deposition from MUG Project operations may increase the potential for incremental concentrations of TSS, nutrients, and metals in nearby waterbodies. In addition, blasting activities could result in fugitive air emissions that add residual nitrogen (e.g., nitrates and ammonia) to runoff collected in

the underground mine or in watersheds immediately surrounding the MUG Project, which may affect surface water quality in nearby waterbodies.

Dust deposition may alter soil quality and vegetation chemistry, cover terrestrial plant communities, and affect wildlife. Dust covering vegetation may have a physical or physiological effect on plants. Larger dust particles can cause visible injuries and abrasions (Farmer 1993; Grantz et al. 2003), while smaller dust particles landing on leaves can affect photosynthesis by blocking sunlight and reduce respiration and transpiration by clogging stomata (Farmer 1993; Grantz et al. 2003). Dust on vegetation can also result in a reduction of plant growth and biomass, and may alter species composition (Grantz et al. 2003). Walker and Everett (1987) and Everett (1980) reported that few vascular plant species showed physiological effects from dust, except where vegetation was subject to very high dust loading.

Mitigation to control dust at the Ekati mine has included watering and applying dust suppressant to the roads, and monitoring is completed through the air quality monitoring program (ERM 2015b). Further studies on the rate and spatial extent of dust deposition, triggers for adaptive management, and the effectiveness of mitigation methods to limit dust generation are included in the AQEMMP for the Jay Project (DDEC 2017b). The site-wide air quality monitoring program and the AQEMMP are currently being integrated. The amalgamated version of this plan will be circulated for review and comment.

Recent research on the distribution of dust at the Ekati mine indicates that the spatial extent of dust deposition is within 1 km (Chen et al. 2017). In addition, emissions of particulate matter and other compounds (e.g., SO_2 and NO_X) at the Ekati mine site have typically been low and are consistently within applicable guideline values (ERM 2015b). DDEC is currently completing a pilot test application of an alternative dust suppressant, to determine its effectiveness, given the Ekati mine's unique northern climate and associated challenges. DDEC has begun a comprehensive trial on the Misery Road with the objective to determine whether this product reduces fugitive dust from roads better than current dust suppression practices (Section 3.4.1 of the AQEMMP). The existing AQEMMP will include the MUG Project.

No additional vehicle traffic is expected for the Project. The MUG Project will not alter undisturbed aquatic or terrestrial land cover. All infrastructure for the Project will be developed on existing disturbed areas, which will keep dust generation to the existing Ekati footprint and adjacent landscape. The majority of exhaust air will exit at a location within the existing Misery Pit, which will reduce the overall dust loading above ground. Ultra-low-sulphur fuel will be used underground, and dust collectors will be used in the ore development, drilling, and production areas. In addition, runoff collected in in the underground mine will be handled according to the water management plan (Golder 2017a), which will further reduce the potential for interaction between dustfall from the underground mine and water quality in the downstream environment.

The results of the Ekati AEMP Annual Reports indicate that, in general, constituent concentrations calculated from dustfall are at least three orders of magnitude smaller than the average observed stream concentrations. The low potential of dust deposition to change water quality is further confirmed by the results of recent AEMPs (Rescan 2012; ERM 2016b), which indicate that dust deposition from the mine site has a negligible potential to affect the concentrations of TSS, nutrients, or metals in nearby waterbodies. Subsequently, the dust from Project is predicted to have no adverse effects on water quality.

Dust deposition from the MUG Project is not expected to cover aquatic substrates (i.e., streambed and lakebed habitat). The results of ongoing monitoring at Ekati have indicated that dustfall from the Ekati mine has a minimal effect on water and sediment quality, including concentrations of suspended sediment in local waterbodies. Therefore, no change in deposition rates to lake bottom substrates are anticipated due to the Project. In general, fine sediments have the same chemical composition as the dust (they share the same source material), so aquatic life in the lake will have minimal exposure to dust-derived sediment with different chemistry. In addition, the wave action and associated currents that often characterize high-quality shoals for spawning (e.g., reviewed in Lane et al. 1996; Richardson et al. 2001) likely maintains shoals relatively free of sediment accumulation. No adverse changes to aquatic life and fish habitat quality are expected from the Project.

Dust deposition from the MUG Project is not predicted to affect vegetation in areas outside of the immediate vicinity of the footprint. Metals concentrations in lichens indicate that dust from the Ekati mine that contains metals is confined to a relatively small area, and declines with distance from the mine (ERM 2015b). Long-term monitoring at the Diavik Mine has also shown that adverse effects from dust on plant species abundance and richness, and metals concentrations in lichens are limited in magnitude and spatial extent (Golder 2017c).

Overall, air and dust emissions and subsequent deposition are expected to result in minor and localized changes to soil, aquatic substrate, and water quality. This interaction is predicted to have negligible residual effects on vegetation, wildlife, aquatic life other than fish, fish, and traditional and non-traditional land use.

Inhalation of air and/or ingestion of soil, vegetation and water that has been chemically altered by air and dust emissions

Inhalation of air and/or ingestion of soil, vegetation, and water that has been chemically altered by air and dust emissions can affect the health of wildlife and people. Results from the air quality monitoring program indicate that environmental design features and mitigation implemented at Ekati mine are effective at mitigating the effects of the mine on air quality. A Human and Wildlife Health Risk Assessment was conducted to assess significance of incremental and cumulative chemical emissions from the Jay Project and other developments on human and wildlife health; effects were determined to be not significant (DDEC 2015b). Air and dust emissions and subsequent deposition are expected to result in minor changes to surface water, sediment, soil, and vegetation chemistry (see above). Therefore, this interaction was determined to have negligible residual effects to the health of wildlife and people.

Sensory disturbance effects from the presence of buildings, lights, smells, noise, blasting activity, and vehicles

Sensory disturbance from the MUG Project can cause changes to the habitat use, movement, and behaviour of wildlife, and subsequently influence land use and traditional land use. Project development may generate sensory disturbances including increased noise levels and visual disturbances from moving vehicles and humans during construction and operations. The area surrounding human activities where sensory disturbances may affect animal behaviour and movement is referred to as the zone of influence (ZOI). Animals may respond to sensory disturbances by reducing their occupancy and use of habitats within the ZOI, which can lead to local changes in abundance and distribution (Tyler 1991; Fortin and Andruskiw 2003; Bayne et al. 2008; Benítez-López et al. 2010). Effects can vary and responses appear

to be species-specific (Dickson and Beier 2002; Habib et al. 2007; Bayne et al. 2008; Fahrig and Rytwinski 2009; Benítez-López et al. 2010). Factors that appear to influence the magnitude of effects include the type of disturbance, the frequency and intensity of the disturbance, and the level of habituation to disturbance (Fortin and Andruskiw 2003; Bayne et al. 2008; Fahrig and Rytwinksi 2009).

Various types of caribou monitoring completed near the Ekati and Diavik mines have detected effects to caribou movements at fine scales (ERM Rescan 2014) and feeding decisions by cows with calves at intermediate scales (Golder 2011). The ZOI for reduced feeding by cows with calves was estimated to be from 5 to 7 km (Golder 2011). In addition to altering behavioural activities, analysis of radio-collar and aerial survey data have detected an avoidance of caribou from 11 to 14 km from the Ekati and Diavik mines (Boulanger et al. 2012). Thus, sensory disturbance may alter where animals position themselves in space but also may influence their foraging and resting activities. However, the mechanism underlying the ZOI is still unclear. Also, numerous (in many years, thousands) of Bathurst caribou have been observed to pass through the Ekati mine area every year during the northern migration and post-calving to autumn period. For example, a group of over 3,000 animals passed through the mine site on October 4, 2010 and over 5,000 animals passed through the mine site on October 12, 2010.

Roads may act as a potential deterrence or attractant for wildlife (Forman and Alexander 1998; Trombulak and Frissell 2000). Road avoidance or attractant behaviour vary between species and within species such that certain populations, age groups, genders, or individuals react either positively or negatively to roads. In some cases, movement patterns change as a result of wildlife avoiding roads (Klein 1991), while in other cases, wildlife use roads as travel corridors, refuge habitat, or food sources (Forman and Alexander 1998). Mitigation and monitoring have been adopted at Ekati to avoid and minimize effects from roads on caribou and other wildlife through the WEMP and CRMP (DDEC 2017a).

Results of the WEMP indicate that wildlife have continued to use the area around the Ekati mine and, in the vicinity of the Ekati mine, may be habituated to current levels of activity. No additional vehicle traffic is expected for the Project. The Project will not alter undisturbed aquatic or terrestrial land cover. All infrastructure for the Project will be developed on existing disturbed areas, which should result in no to little change in the spatial extent of the ZOI. The magnitude of the ZOI should also change little relative to existing conditions as the Project is an underground operation. Therefore, this interaction is predicted to have negligible residual effects to caribou and other wildlife, and land use and traditional land use.

Processed kimberlite management for the Project can alter surface water quality in downstream waterbodies

Storage of PK generated from the MUG Project in watersheds that drain to, or are ultimately Discharged to, downstream receiving waterbodies may cause changes in surface water quality in these waterbodies, which may lead to effects to aquatic life other than fish, fish, caribou, carnivores, breeding birds, traditional land use, and community health and well-being.

As required by the Water Licence (WLWB 2017), storage and processing of PK generated from the MUG Project will be managed under the Ekati mine WPKMP and the WROMP. The WPKMP describes the processes, plans, and monitoring for the management of wastewater and FPK at the Ekati mine. Management of CPK will continue to be handled according to the WROMP. These plans will be updated to include the minor amendments needed to incorporate the MUG Project.

Storage of FPK and CPK for the MUG Project will therefore be accommodated in approved facilities. At the onset of the Project, the management of CPK resulting from the MUG Project will be consistent with the current deposition plan for the Ekati mine as per the WPKMP, which is using the LLCF and Beartooth Pit for storage. As per the WROMP, CPK will continue to be stored in the Coarse Kimberlite Storage Area. However, as per the recently approved Water Licence amendment to include the Jay Project (WLWB 2017), the Panda and Koala pits have been approved as Processed Kimberlite Containment Areas. A Panda and Koala Deposition Study for PK will be provided to the WLWB for approval prior to use of the pits for PK deposition. For the MUG Project, PK will initially be deposited into the currently used facilities at the Ekati mine (i.e., LLCF and Coarse Kimberlite Storage Area), but may be deposited into the Koala and Panda pits once the Deposition Study has been provided to, and approved by, the WLWB. Once available, the Panda and Koala open pits would then become the primary deposition locations for PK resulting from the Project.

The Koala watershed is the area surrounding the main Ekati mine site and the watershed that receives the majority of the mine Discharge. The LLCF, which is located in this watershed, stores mine-affected water and FPK generated at the Ekati mine site, including the minewater Discharge originating from water management associated with the Beartooth, Panda, and Koala Pits, and WRSAs. Water released from the LLCF flows through a series of small lakes in the lower portion of the Koala watershed before entering Lac de Gras. As a condition of the Ekati mine Water Licence, the LLCF Discharge will meet established EQC for Discharge from Cell E to Leslie Lake. The SNP will continue to provide ongoing collection and monthly reporting of water quality information at the LLCF effluent Discharge location, and will ensure continued compliance with EQC as per the Water Licence.

Monitoring of Receiving Environment water quality will continue under the Ekati mine's site-wide AEMP, which examines the Receiving Environment downstream of the LLCF, including the LLCF Discharge (SNP Station 1616-30), Leslie Lake, Leslie–Moose Stream, Moose Lake, Moose–Nero Stream, Nema Lake, Nema–Martine Stream, Slipper Lake, and Slipper–Lac de Gras Stream. The northern bay of Lac de Gras near the inflow from Slipper Lake is also monitored.

As water will only be Discharged to the Receiving Environment if it meets EQC, potential effects to the water quality and to other receptor VCs in the downstream Receiving Environments are not expected to change from current conditions; that is, any changes are expected to be minor and well within the tolerance limits of resident biota. This interaction is expected to have a negligible residual effect on water quality and aquatic life other than fish, fish, soil, vegetation, caribou, carnivores, breeding birds, land use and traditional land use, and community health and well-being.

Physical hazards from the Project (e.g., animals becoming trapped in exposed sediments) may increase risk of injury or mortality to individual animals

The presence of physical hazards on-site may result in an increased frequency of injury or mortality to wildlife. However, the implementation of environmental design features (Table 6.5-1) and the WEMP are expected to decrease the risk to wildlife from physical hazards on-site (e.g., giving wildlife the right of way). Wildlife deterrent actions will be also implemented by knowledgeable and trained personnel. The goal of these deterrents is to respond to wildlife situations using humane management methods in ways that will keep both humans and animals safe.

The frequency of accidental mine-related wildlife mortalities has been extremely low at operating mine sites. For example, the six occasions where carnivore species were accidentally destroyed at a mine, and where the cause of death was clearly attributable to the mine, were a result of vehicle collisions (DDEC 2014; Section 13). From 1996 to 2013, there was a total of 12 mine-related caribou mortalities at the Diavik, Ekati, and Snap Lake mines (DDEC 2014; Section 12). Two animals were intentionally destroyed, seven had been entangled in fences, and three died after becoming stuck in exposed lakebed sediments. As a consequence of the fence-related mortalities, the fence around the Ekati airstrip was replaced in August 2010 with a construction and safety barrier fence to avoid further fence-related caribou mortalities at the airstrip. No reported injuries or mortalities have been associated with open pits, fly rock, or waste rock piles. A number of different bird species have been accidentally killed at mine sites from vehicles, electrocution from powerlines, striking buildings and power lines, getting caught in nets during fish-outs, and unknown causes.

For the MUG Project, the water level in King Pond Settling Facility will be initially lowered to provide increased storage capacity to receive water from the underground operations. Although exposed lakebed sediments could potentially trap and cause injury or mortality to caribou and other wildlife as a result of the draw down, this interaction is not expected at the Project because animals are unlikely to enter the King Pond Settling Facility area. The area is largely enclosed by site infrastructure, which is anticipated to physically deflect wildlife movement, and the high amount of human activity in the Misery area is likely to result in avoidance of the area by wildlife. Additionally, it is expected that King Pond Settling Facility will be lowered to the operating level of 443 masl, and not lower, which is expected to further reduce the potential for impacts to caribou safety. The duration of the time that pond sediments will be exposed is also expected to be short (i.e., one year). In addition to these environmental design features and mitigation, wildlife deterrent actions will be implemented by knowledgeable and trained personnel; the goal of these deterrents is to manage wildlife encounters in ways that will keep both humans and animals safe.

Although there is a potential for mortality or injury to occur, the implementation of proven successful mitigation and environmental design features, applied with the principles of adaptive management through the WEMP, are anticipated to reduce the risk to wildlife mortality from physical hazards on-site. Changes in mortality are predicted to be minor relative to existing conditions. As such, mortality from physical hazards on-site is expected to have a negligible residual effect on wildlife, and land use and traditional land use.

Attraction to the Project (e.g., food waste, oil products) may increase human-wildlife interactions and mortality risk to individual animals or may increase predator numbers and predation risk, which can affect prey population size

Food smells and other aromatic compounds such as petroleum-based chemicals, grey water, and sewage can attract carnivores to human developments (Benn and Herrero 2002; Peirce and Van Daele 2006; Canadian Wildlife Service 2007; Beckmann and Lackey 2008). In addition, infrastructure may also attract carnivores as it can serve as a temporary refuge to escape extreme heat or cold (Canadian Wildlife Service 2007). Attraction of carnivores and predatory birds (e.g., ravens and gulls) to the Project can increase predation pressure on prey species (e.g., caribou, passerines, and waterfowl), and may cause declines in local abundance in these prey species (Monda et al. 1994; Canadian Wildlife Service 2007; Liebezeit et al. 2009).

The attraction of wildlife to the Project has the potential to increase human-wildlife interactions, which may result in the removal of individuals by mortality or relocation. Wildlife species have been intentionally destroyed at the Ekati, Diavik, Snap Lake, and Jericho mines, either by government biologists or with government permission (DDEC 2014; Section 13). Intentional destruction of individual animals generally followed habituation of the animal to operating mines over an extended period of time, and after multiple deterrent attempts failed with the same individual. Lessons learned from these mines have shown that diligent waste management practices and staff education can substantially decrease the frequency of attractants and the number of carnivore incidents (DDEC 2014; Section 13). These waste management practices are in effect at the Ekati mine, and will be, by association, incorporated into the MUG Project.

Environmental design features and mitigation strategies have been established to reduce the numbers of carnivores attracted to the Project (Table 6.5-3). These strategies are outlined in the WEMP, and are similar to management practices and policies implemented at other diamond mines in the NWT and Nunavut:

- Education and reinforcement of proper waste management practices to all workers and visitors to the site will be provided.
- People will be educated on the risks associated with feeding wildlife and careless disposal of food garbage.
- Separate bins will be located throughout facilities on-site for immediate sorting of domestic waste.
- Food waste will transported directly to the incinerator storage area for incineration.
- Incinerator ash from combustion of kitchen and office waste will be transported to the landfill.
- Ongoing review of the efficiency of the waste management program will continue including improvement through adaptive management.

DDEC also practices successive levels of deterrents, starting with avoidance (e.g., removing crews from the area), visual monitoring, truck deterrence (including horn), bear bangers, rubber bullets, and helicopters. Dispatching of an animal is only applied after successive levels of deterrence do not deter an animal from site and following consultation and approval from the GNWT Environment and Natural Resources.

The Project will not result in additional sources of attractants, and waste management practices and adaptive management used at operating mines in the NWT have shown to be successful at minimizing attraction of wildlife. The environmental design features and mitigation implemented for the Project are anticipated to result in minor changes in problem wildlife and predator-prey relationships relative to existing conditions. Subsequently, the interactions are expected to have a negligible residual effect on wildlife populations, and land use and traditional land use.

Traffic along the site access and haul roads (i.e., Misery road) may result in wildlife-vehicle collisions

No new roads are required for the MUG Project and there is no expected increase in vehicle traffic associated with construction and operation. The WEMP and CRMP will be applied to the Project, and is not expected to increase the risk of mortality to wildlife from collisions with vehicles. Mitigation in the WEMP has shown to be effective at minimizing the risk of wildlife-vehicle collisions. No caribou have been killed or injured by vehicles at the Ekati mine. One wolf pup died from being struck by a vehicle. Birds are most affected by vehicle collisions (DDEC 2014; Section 13). Subsequently, the MUG Project and the Ekati mine are anticipated to result in a minor influence on wildlife mortality, and a negligible effect on population abundance.

Workforce requirements of the Project will maintain current employment stability and related income for the Misery workforce

The MUG Project will draw upon the existing Misery open pit workforce and the Panda/Koala underground workforce, and on contractors specialized in underground mining when meeting its workforce requirements. Table 6.5-3 provides a breakdown of Project employment requirements by skill level, year, and employer. In any given year, some positions will be required for limited periods (e.g., several months at a time) associated with specific construction and operational activities.

Given that the workforce will be a combination of existing DDEC employees, and contractors with experienced (i.e., already employed), skilled personnel, the Project does not represent substantial new employment opportunities. The additional workforce requirements beyond the existing Misery workforce (approximately 80 positions at peak construction and operation) are expected to be met largely by contractors. Incidental employment associated with attrition would be low given the relatively small size of the Project workforce (Table 6.5-3). The MUG Project does not prevent the unemployment of the existing Misery open pit workforce, as it is assumed that, with the short period between existing and planned Ekati mine operations and the Jay Project, employees would be reallocated to other tasks at the mine. In consideration of the above, the Project's positive effect on employment is assessed as negligible, and to be a secondary pathway.

Table 6.5-3 MUG Project Workforce Requirements (Positions)

Fiscal Year[a]	Employer	Employment by Classification					Total Employment (Average Annual)	Peak Workforce Requirements	
		Management	Professional	Skilled	Semi-Skilled	Entry Level			
2018	DDEC	1.8	2.4	1.2	1.2	0.0	6.6	Nov/Dec	11.0
	Contractor	0.0	0.0	0.0	0.0	4.0	4.0		16.0
	Total	1.8	2.4	1.2	1.2	4.0	*10.6*		*27.0*
2019	DDEC	3.0	5.2	31.8	2.0	0.0	42.0	Nov/Dec	47.0
	Contractor	0.9	3.6	51.7	17.6	31.7	105.5		128.0
	Total	3.9	8.8	83.5	19.6	31.7	*147.5*		*175.0*
2020	DDEC	2.3	6.6	18.6	0.6	0.0	28.1	May	33.0
	Contractor	1.0	4.0	65.7	33.0	32.0	135.7		139.0
	Total	3.3	10.6	84.3	33.6	32.0	*163.8*		*172.0*
2021	DDEC	4.0	6.0	18.0	0.0	0.0	28.0	Feb	28.0
	Contractor	1.0	4.0	56.3	46.0	17.0	124.3		143.0
	Total	5.0	10.0	74.3	46.0	17.0	*152.3*		*171.0*
2022	DDEC	2.0	6.0	18.0	0.0	0.0	26.0	All Year	26.0
	Contractor	1.0	4.0	60.0	46.0	16.0	127.0		127.0
	Total	3.0	10.0	78.0	46.0	16.0	*153.0*		*153.0*
2023	DDEC	0.8	2.4	7.6	0.0	0.0	10.8	May/Jun	26.0
	Contractor	0.4	1.6	24.1	17.3	10.7	54.1		139.0
	Total	1.2	4.0	31.7	17.3	10.7	*64.9*		*165.0*

a) Workforce planning requirements are available from the pre-feasibility study (DDEC 2017e) by fiscal year, which corresponds to the period beginning in February of a year, ending in January of the following year.

Project contract, service, equipment, and supply requirements will maintain the stability of the level of business activity in northern communities

The Project continues demand for existing contractor services, and for contractors specialized in underground mining. Without the MUG Project, it is expected that the demand for these contractors would reduce during the period between existing and planned Ekati mine operations, and the Jay Project. This period would be short, and the number of contracting opportunities temporarily removed would be negligible relative to the value of other opportunities with the Ekati mine and other mineral developments in the NWT. The incremental impact of the MUG Project on contracting opportunities in the NWT is, therefore, assessed as negligible, and to be a secondary pathway.

Workforce requirements for the Project may increase uptake of education and training opportunities by job seekers

The Project does not require a new labour force, and will employ specialized contractors with experienced workforces already trained in underground mining. Potential for enhanced uptake of training opportunities is expected to be primarily from on-the-job training, as required. Given the limited requirement for and associated uptake of training opportunities by the workforce, the Project's effect on education and training is assessed as negligible, and to be a secondary pathway.

Continued resource development contributes to the maintenance of community contributions and IBA payments

Current and future community contributions (e.g., scholarships, financial and in-kind support for community initiatives) and IBA payments would be continued by the MUG Project. This applies to community contributions that are attached to funding reserves that represent a percentage of total revenues or profits from the Ekati mine, and to royalties associated with DDEC's IBAs. Given the size of the MUG Project relative to existing and planned operations at the Ekati mine, and in consideration of other contributions made to communities by other operators in the region, the Project's effect on community contributions and IBA payments is assessed as negligible, and to be a secondary pathway.

Workforce requirements for the Project could generate migration between communities and associated pressure on infrastructure and services

The MUG Project will continue employment for the some of the existing Misery workforce and for contractor services specialized in underground mining. This workforce is expected to be experienced, and already employed by DDEC or contractors (i.e., no new labour). Fly-in fly-out arrangements with communities will continue and employees/contractors (including those from the south) will be housed in camp accommodations while on rotation. The Project is, therefore, not expected to generate new direct employment opportunities for the Northern labour force that would require prospective workers to move between communities.

There is the potential that some people may choose to relocate to fly-in, fly-out communities based on the speculation that they may be able to access employment associated with the MUG Project. While DDEC cannot control or predict with accuracy potential migration, efforts such as clear communication of employment requirements to community representatives and Economic Development Officers, and of recruitment practices could potentially dissuade individuals who are considering relocation in the hopes of employment. On-site medical services will be available in the event of emergencies, and the southern workforce is expected is expected to maintain their relationships with healthcare providers in their community of origin, and to not relocate with families. Assuming the effectiveness of these communication efforts, and in recognition of the size and scope of the Project, this pathway has been assessed as secondary.

Project rotational employment and incomes can contribute to income disparity and social maladies (e.g., substance abuse and addictions, communicable diseases, domestic violence, crime)

The MUG Project will continue employment and associated incomes for the existing Misery workforce, and for contractors. These income benefits do not extend to those unable to take up employment and contracting opportunities with the Project or other employers. They also, however, are not anticipated to drive additional consumer spending beyond current conditions, or to influence inflation in communities. Existing social disparity in communities is not expected to be changed by continuation of incomes for those currently employed, but will persist. The Project's ability to change social disparity in communities is, therefore, assessed as negligible.

Continuation of employment is not anticipated to lead to a change in the behaviour of the existing workforce, or to alleviate or exacerbate current social maladies faced by communities. Social maladies

would not disappear in a scenario where the Project does not move forward, as many are systemic and, without treatment or remedy, long lasting.

The non-local workforce will be flown to site and housed in camp accommodations, and is expected to have limited interaction with the local population in Yellowknife or other communities, excluding periods of transit to and from the south. DDEC will enforce a worker Code of Conduct for all employees, and will maintain a zero-tolerance policy for substance abuse while on rotation. All employees and their families will have access to an Employee and Family Assistance Program that includes counselling and addiction treatment.

Given the above, the Project's potential to effect income disparity and social maladies beyond current conditions is assessed as negligible, and to be a secondary pathway.

Removal of Project infrastructure at closure may change hydrology in downstream waterbodies

Following completion of mining of the Misery Underground, the removal of Project infrastructure will occur, which may alter surface hydrology in downstream waterbodies and adversely affect water quality, aquatic life other than fish, fish, soils, vegetation, caribou, carnivores, breeding birds, and land use and traditional land use. Closure of mine infrastructure that serves the overall Ekati mine, including the Project, will be reclaimed according to the procedures described in the existing, approved Ekati mine ICRP. This includes closure and reclamation of the open pits, underground mine workings, WRSAs, PK containment areas, water management facilities, buildings, and roads and pads that will be used for the Project.

It is anticipated that both the MUG Project and the Jay Project will introduce necessary changes to the existing ICRP. As per the Water Licence amendment to include the Jay Project (amendment #4, see Part K condition 6), an update to the ICRP will be prepared and submitted to the WLWB for approval. Closure and reclamation of new infrastructure associated with the MUG Project will be similar to reclamation planned for other underground facilities at the Ekati mine and will include removal of equipment from the underground workings, as well as decommissioning of new and/or upgraded surface facilities that are required for the Project (e.g., the expanded Misery camp, fresh air raise, power transmission line, and water pipeline).

Closure and reclamation of surface infrastructure associated with the MUG Project will follow the procedures outlined in the existing ICRP for the overall Ekati mine site. Drainage patterns will be re-established as close to pre-development conditions as possible, with drainage ditches contoured or backfilled as appropriate to remove any hazards to wildlife. Erosion and sediment control measures will be implemented where appropriate. Where feasible, long-term sediment control will be achieved by revegetation. As a result, the removal of the Project facilities is not anticipated to have a measurable influence on surface hydrology and bank/channel integrity within the downstream watershed. Drainage through the reclaimed areas of the Project is not expected to result in measurable changes to water and sediment quality in downstream waterbodies; however, monitoring will be conducted with adaptive management as necessary.

With implementation of the Project design and mitigation discussed above, it is anticipated that residual effects to surface hydrology from reclamation of project infrastructure at closure, will be minor. As such,

this interaction is considered to be secondary, and expected to have minor residual effects on water quality, aquatic life other than fish, fish, soils, vegetation, caribou, carnivores, breeding birds, and land use and traditional land use.

6.5.4 Spills of Fuel and Other Hazardous Materials

Spills of fuel and other hazardous materials occurring on-site have the potential to cause effects to VCs. The potential for spills was identified as having a potential interaction to water quality, aquatic life other than fish, fish, vegetation, caribou, carnivores, breeding birds, land use and traditional land use, and community health and well-being:

Spills (i.e., fuels, petroleum products, reagents) on site may cause changes to water and soil quality

Spills during construction, operations, or decommissioning and reclamation activities of the MUG Project have the potential to change water and soil chemistry, which can adversely affect vegetation, water quality, aquatic life other than fish, fish, caribou, carnivores, breeding birds, land use and traditional land use, and community health and well-being. Mitigation identified in the Ekati mine Spill Contingency Plan (DDEC 2016f) and environmental design features will be in place to limit the frequency and minimize the extent of spills that have potential to occur during Project activities (Table 6.5-1). Hazardous materials and fuel are stored according to regulatory requirements to protect the environment and workers. Fuel tanks are located in lined and bermed containment areas and existing fuel storage facilities built as part of the existing Ekati mine (main fuel storage tank, fuel transfer tank, dispensing and offloading stations) will be extended to encompass the life of the Project. No additional fuel storage will be needed as part of the Project. Individuals working on site and handling hazardous materials are trained in spill response and the Ekati mine's standard policies will be followed.

The implementation of the Ekati mine Spill Contingency Plan and environmental design features are anticipated to reduce the likelihood and extent of the release or spills of hazardous materials occurring on-site. No detectable changes to surface water and soil quality are expected. Therefore, this interaction was determined to have no linkage to effects on vegetation, water quality, aquatic life other than fish, fish, caribou, carnivores, breeding birds, land use and traditional land use, and community health and well-being.

6.5.5 Primary Interactions

The following interactions were determined to be primary and therefore are carried forward to the assessment of primary interactions and residual risks (Section 6.6):

- Pumping of minewater from Lynx Pit and King Pond Settling Facility to the mined-out Misery Pit at MUG Project closure may affect the water quality in Lac du Sauvage during Jay Project operations.
- Closure of the MUG Project may affect water quality in the Misery pit lake at post-closure

6.6 Assessment of Primary Interactions and Residual Risks

The intent of this section is to identify interactions associated with the Project that may lead to residual effects, after implementing mitigation and environmental design features. The assessment of primary interactions and residual risks considered the primary Project interactions that have the potential to result in measureable environmental changes and effects to VCs after implementing environmental design features and mitigation (Section 6.5.5). The primary interactions identified for the MUG Project include potential effects associated with the storage of minewater generated from the Misery underground developments within Misery Pit on the water quality of Lac du Sauvage during Jay Project operations, and in the Misery Pit Lake and downstream environment (i.e., Lac de Gras) during the post-closure phase.

6.6.1 Pumping of minewater from Lynx Pit and King Pond Settling Facility to the mined-out Misery Pit at Closure may affect the water quality in Lac du Sauvage during Jay Project operations

At closure of the MUG Project, minewater stored in the Lynx Pit and in King Pond Settling Facility during operation of the MUG Project will be pumped to the bottom of the mined-out Misery Pit for long-term storage (Section 4.9.5.4). Misery Pit will then become the primary minewater management facility for the Jay Project (see Golder 2017a and Golder 2016b for additional details on MUG and Jay Project water management plans, respectively). In early operations of the Jay Project, Misery Pit will be used to store minewater pumped from the Jay Project (surface minewater and groundwater inflows from the Jay Pit), but there will be no Discharge from the pit. In later operations, Misery Pit will approach the maximum operational water level and as a consequence, water will be pumped from the top of Misery Pit to Lac du Sauvage (operational Discharge) to allow continued pumping of minewater from the Jay Project for management in the Misery Pit.

Storage of MUG Project water in Misery Pit is expected to affect the quality of water Discharged from Misery Pit to Lac de Sauvage during Jay Project operations, as well as the timing of initiation of Discharge, resulting in an overall increase in the total volume of water Discharged. This could alter water quality in Lac du Sauvage and downstream in Lac de Gras, and thereby affect aquatic life other than fish, fish, soils, vegetation, caribou, carnivores, breeding birds, land use, and traditional land use. A site-water quality model was developed as part of the Developer's Assessment Report (DAR) for the Jay Project (DDEC 2014) to predict the quality of Discharge water released from Misery Pit to Lac du Sauvage; this model was subsequently updated to support the Ekati mine Type A Water Licence amendment application to include the Jay Project (Golder 2016c). Based on the model update, DDEC proposed EQC as part of the Water Licence submission, which were subsequently reviewed, adjusted, and ultimately approved by the Minister of the GNWT in July 2017. As the proposed water management plan for the MUG Project includes use of the mined-out Misery Pit and underground workings to store water produced during underground mining, the water quality model developed for the Jay Project Water Licence application was again updated to include the MUG Project. A description of the updated model inputs and assumptions used to generate updated Discharge water quality predictions is provided in Golder (2017b) in Appendix F of the Water Licence and Land Use Permit Application.

Development of the MUG Project will result in minewater from the MUG Project being stored in Misery Pit at the commencement of Jay Project Dewatering and operations, which will reduce the Misery Pit storage capacity available for Jay Project minewater. The water balance and water quality models included in the

Jay Project Water Licence amendment application (Golder 2016b,c) indicate that Discharge from Misery Pit to Lac du Sauvage during Jay Project operations would occur in Operations Year 7 of the Jay Project. Updated water balance model predictions for the MUG Project (Golder 2017a) that include the storage of MUG Project minewater in Misery Pit prior to the Jay Project operations indicate that discharge from Misery Pit to Lac du Sauvage would be expected to begin in Operations Year 6 of the Jay Project (Golder 2017a).

Water quality predictions evaluating the influence of the MUG Project on discharge water quality from Misery Pit to Lac du Sauvage during Jay Project operations are presented in Golder (2017b). Projected Misery Pit discharge constituent concentrations were similar to the Jay Project Water Licence amendment application projections (Golder 2016c); however, maximum concentrations of certain parameters are projected to increase due to inclusion of the MUG Project (e.g., TDS, chloride, and total phosphorus). Smaller changes are expected to occur in parameters whose constituent concentrations decreased as mining in Jay Pit advances (e.g., chromium and cobalt).

To determine if mining of the MUG Project would result in a compliant Discharge water quality, projected Misery Pit discharge constituent concentrations were compared to the approved EQC. The mean modelled water quality data projections indicate that concentrations of water quality parameters with EQC in the Water Licence will remain below these Discharge limits throughout the entire period of Discharge from Misery Pit to Lac de Sauvage during Jay Project operations, and that EQC are therefore still achievable and appropriate for the Misery Pit Discharge.

To remain protective of Lac du Sauvage, DDEC will maintain Misery Pit Discharge below the established EQC as stipulated in the amended Ekati mine Water Licence (July 2017). As part of the Jay Project Water Licence application process (Golder 2016c), DDEC established safeguards to provide confidence that non-compliant water will not be Discharged, including monitoring of water stored in Misery Pit to validate water quality projections prior to discharging, and implementing mitigation strategies, should constituent concentrations be observed to be greater than predicted.

Water quality in the Lac du Sauvage Receiving Environment was modelled in the DAR for the Jay Project (DDEC 2014) and updated for the Jay Project Water Licence amendment application (Golder 2016c). The predicted changes in concentrations in the previously mentioned constituents (e.g., TDS, chloride, total phosphorus, chromium, and cobalt) due to inclusion of the MUG Project are not expected to appreciably alter water quality projections established for Lac du Sauvage in the DAR or the Water Licence amendment application. Therefore, the conclusions of the DAR remain valid for the updated water quality model predictions.

The DAR predicted that residual effects to water quality would occur from the Jay Project, particularly when minewater is pumped from the Misery Pit to Lac du Sauvage. Predicted changes to water quality included increases in each of the constituent groups (i.e., TDS, major ions, nutrients, metals), with peak concentrations timed to occur in the final year of Jay Project operations, which then decrease through closure. A concentration gradient from the point of Discharge near the diked area to the outlet of Lac du Sauvage was also expected. Although Discharge of minewater from Misery Pit was predicted to change water quality in Lac du Sauvage, concentrations throughout all Jay Project phases were not predicted to increase above site-specific objectives, protection of aquatic life and drinking water

guidelines, or chronic benchmarks at any assessment location. As a result, effects to the health of aquatic biota or as a drinking water source were considered negligible.

The conclusion of the DAR for the Jay Project, and the Jay Project Water Licence application, that mining of the Jay Pit will not result in significant adverse effects to downstream receptors remains valid for the updated water quality predictions that include the MUG Project. As such, this interaction is expected to have minor residual effects on water quality, aquatic life other than fish, fish, soils, vegetation, caribou, carnivores, breeding birds, land use, and traditional land use.

6.6.2 Closure of the MUG Project may affect water quality in the Misery pit lake at post-closure

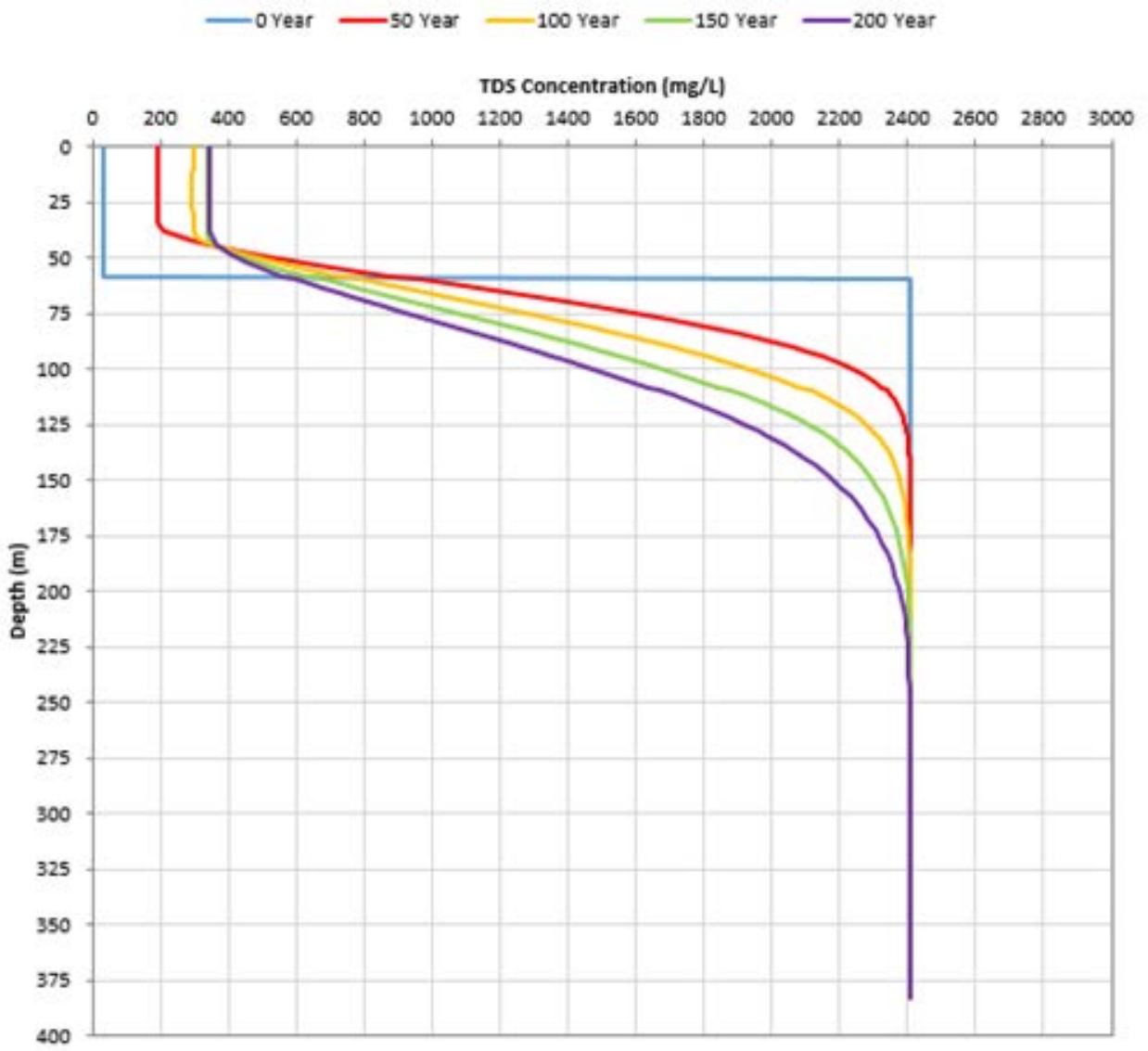
Development of the MUG Project will result in minewater generated from the underground mining operation being stored in the Misery Pit along with water originating from mining of the Jay Project (Golder 2017a, Section 4.9.5.4). At closure of the Jay Project, minewater stored in Misery Pit will be isolated at the bottom of the pit through the development of long-term meromixis. “Meromixis” occurs when water below a certain depth does not undergo physical mixing with the upper layer, due to its high density relative to the density of the upper layer. The high density, bottom layer is referred to as the “monimolimnion” and the low density, upper layer is referred to as the “mixolimnion”. To establish meromixis in Misery Pit in closure, a portion of the minewater in the Misery Pit will be pumped to the bottom of the Jay Pit to allow for a 60 m low density freshwater cap sourced from Lac du Sauvage, and surface catchment runoff, to be placed over the high density minewater. Following back-flooding, and after Misery Pit reaches its full supply level, freshwater in the surface of the mixolimnion would then seasonally overflow to Lac de Gras. Storage of minewater generated from the MUG Project within Misery Pit may affect the quality of the surface water of Misery Pit and in downstream waterbodies (i.e., Lac de Gras) during post-closure. Changes to the water quality VC could affect aquatic life other than fish, fish, soils, vegetation, caribou, carnivores, breeding birds, land use and traditional land use.

A key objective of the site water management plan for the MUG Project and the Jay Project is to establish meromictic conditions in the Misery Pit to preclude minewater from mixing with the overlying freshwater cap, and thereby potentially affecting the pit’s closure condition objective; that is, the surface water quality of Misery Pit is safe for use by fish, wildlife, and people. In the Jay Project DAR (DDEC 2014) and Water Licence amendment application (Golder 2016c), the stability of meromixis in Misery Pit was evaluated in two ways: hydrodynamic modelling of the first 200 years after back-flooding, and mass balance calculations over 5,000 years using a vertical mass-balance slice spreadsheet model. The hydrodynamic and vertical slice spreadsheet models were updated to include the MUG Project to determine if its inclusion affected the stability of meromixis of the Misery Pit as evaluated in the Water Licence amendment application (Golder 2016c). Additional details on the hydrodynamic and vertical slice spreadsheet models are provided Appendix 8G of the DAR (DDEC 2014) and in Golder 2017b.

Hydrodynamic and vertical slice spreadsheet model results for the Misery Pit at post-closure with the inclusion of the MUG Project are presented in Golder (2017b). Consistent with previous modelling evaluations (DDEC 2014; Golder 2016c), Misery Pit, with the inclusion of the MUG Project, is predicted to establish meromictic conditions following back-flooding with water pumped from Lac du Sauvage, and to remain stable into post-closure (i.e., 200 years). Model results indicate that following back-flooding, TDS and other water quality constituents will slowly increase in the mixolimnion, reaching steady-state

conditions as a result of gradual upward diffusion from the monimolimnion to the mixolimnion over time (Figure 6.6-1).

Figure 6.6-1 Misery Pit – Simulated Mixolimnion Total Dissolved Solids Concentrations Following MUG and Jay Projects (Average MUG Project Groundwater Scenario)



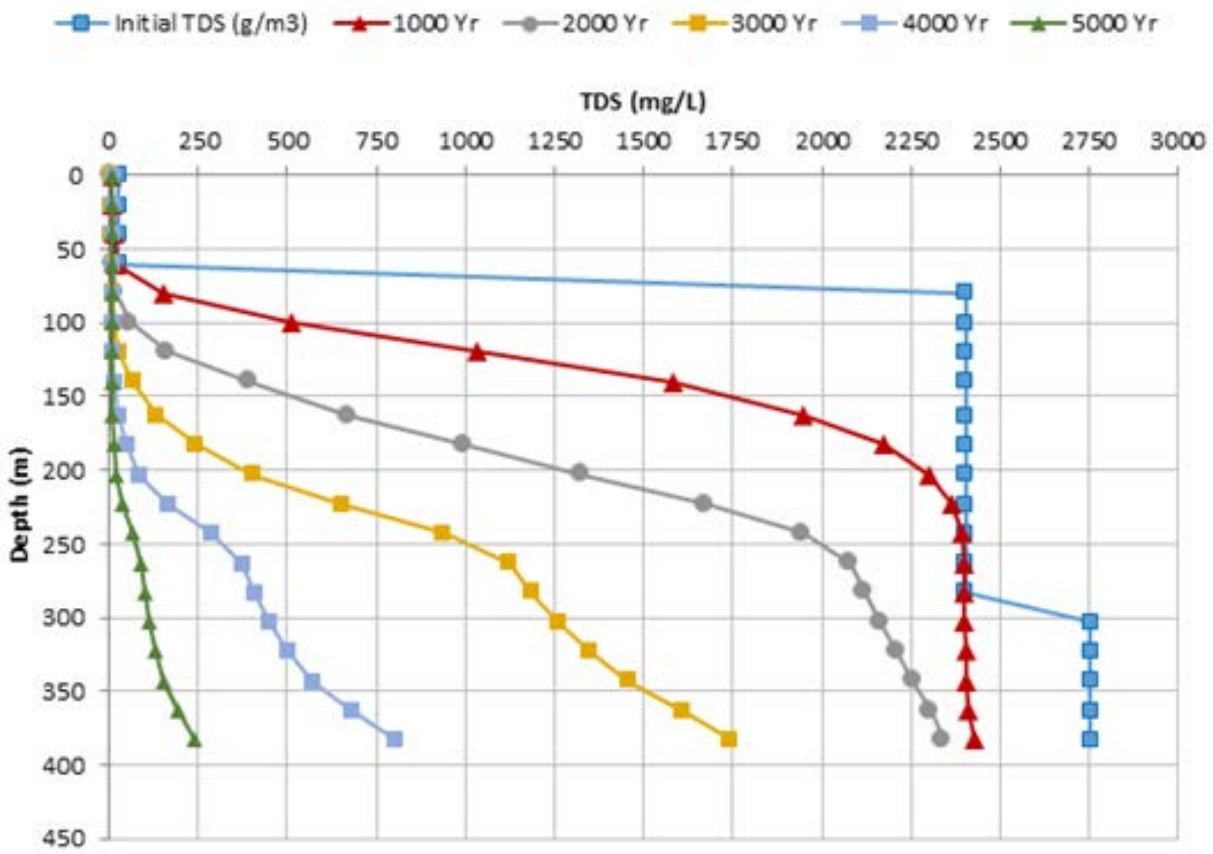
MUG = Misery Underground; TDS = total dissolved solids; mg/L = milligrams per litre; m = metre.

These projected water quality conditions in the mixolimnion over the 200-year model period during open-water conditions provide an estimate of potential water quality of the seasonal pit overflow that would flow toward Lac de Gras. These projections are similar to the modelling results presented in the DAR (DDEC 2014) and Water Licence amendment application (Golder 2016c); maximum projected constituent

concentrations in the Misery pit mixolimnion are similar to the Water Licence amendment application predictions for the majority of the constituents, with some constituents (e.g., copper) showing slight increases, and TDS and other groundwater-correlated constituents show minor decreases (e.g., hardness and chloride) (see Table 9 of Golder [2017b]). Although some constituents show slight increases, operational monitoring and adaptive management strategies required under the Water Licence (e.g., freshwater cap optimization studies) provide added confidence that Misery Pit will satisfy closure goals and objectives, and not pose an environmental risk.

In terms of a longer term projection (5,000 years), results of the vertical slice spreadsheet model indicate that Misery Pit, with the inclusion of the MUG Project, will eventually become a freshwater system in its entirety. Over time, the pit will become comprised completely of low TDS water due to the gradual groundwater outflow migration from the bottom of Misery Pit to Lac de Gras and the replacement of this outflow by lower TDS water from the mixolimnion, which is replenished by surface groundwater inflows from the surrounding lake environs (Figure 6.6-2).

Figure 6.6-2 Misery Pit Vertical Slice Spreadsheet Model Results (MUG and Jay Projects)



MUG = Misery Underground; TDS = total dissolved solids; g/m^3 = grams per cubic metre; Yr = year; mg/L = milligrams per litre; m = metre.

One of the key influences on the closure surface water quality condition of Misery Pit will be the Misery Pit back-flooding plan, which will be developed for the Final Closure and Reclamation Plan based on site-specific operational monitoring of Misery Pit during operations and industry experience. Based on the operational monitoring data, DDEC will conduct a freshwater cap optimization study (a requirement under the amended Water Licence; WLWB 2017) to evaluate the optimal depth of the Misery Pit freshwater cap required to establish and maintain meromictic conditions in the pit and to meet closure water quality criteria. The closure objectives for pit lakes at the Ekati mine are provided in Section 5.2.7 of the Ekati mine ICRP (BHP Billiton 2011), which has been approved by the WLWB, and includes the objective that water in pits at the Ekati mine meets closure water quality criteria. An update to the ICRP is currently in progress, which will incorporate components related to the Jay Project, including the Misery Pit. During back-flooding, water quality in the pit will be monitored to confirm the progression and formation of meromictic conditions before releasing water to the Receiving Environment. In the highly unlikely event that meromixis does not establish in Misery Pit, and if water quality in the discharge water from the Misery pit lake is not acceptable for release by the time the lake is nearing discharge elevation, adaptive management will be implemented.

Post-closure water quality in the Lac de Gras Receiving Environment was modelled for the DAR for the Jay Project (DDEC 2014) and updated for the Water Licence amendment application (Golder 2016c), which includes the small, intermittent inflow from Misery Pit in closure/post-closure conditions. With the inclusion of the storage of MUG Project water in the Misery Pit and underground workings at closure, the same conclusions are applicable. As shown in Golder (2017b), and consistent with the Water Licence amendment application (Golder 2016c), projected concentrations of key constituents in the Misery Pit Discharge were lower or equal in comparison to the DAR projections (DDEC 2014), which were assessed to not result in significant adverse effects in Lac de Gras. The DAR predicted that there will be long-term Project-related influences on Lac de Gras through the overflow from the Misery Pit, as well as inflows from the Koala watershed that will be influenced by the back-flooded Panda and Koala pits, and the LLCF. However, concentrations of water quality constituents in Lac de Gras are predicted to continue decreasing in post-closure towards a long-term steady state condition. Although changes in water quality are predicted in Lac de Gras, they remain less than guidelines and objectives that are protective of aquatic life and drinking water.

The hydrodynamic modelling completed for the DAR and Water Licence amendment application, and the effects assessment in the DAR, concluded that no significant adverse effects to water quality and receptor VCs would result from the overflow of from the Misery pit lake to Lac de Gras. These conclusions remain valid for the updated water quality predictions that include the MUG Project. As such, this interaction is expected to have minor residual effects on water quality, aquatic life other than fish, fish, soils, vegetation, caribou, carnivores, breeding birds, land use and traditional land use.

6.7 Risk and Mitigation Conclusion

On the basis of the detailed Project information and assessment of effects provided in this Project Description, DDEC believes that the Project can be operated in a manner that, taking into account proven environmental design features, mitigation and administrative controls, is not likely to cause significant adverse effects to the biophysical or socio-economic environments. New infrastructure that will be required for the MUG Project is minimal and will be placed within already disturbed areas. There are no environmental risks that cannot be mitigated or regulated through a Water Licence amendment and a

land use permit. Authorizations from agencies such as Fisheries and Oceans Canada and Transport Canada are not required. Furthermore, the Project will have a positive effect in terms of contracting opportunities and workforce.

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