Ekati Diamond Mine

Environmental Agreement and Water Licence Annual Report 2019

Dominion Diamond Mines

July 2, 2020

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Re: Ekati Diamond Mine – Environmental Agreement and Water Licence Annual Report 2019

Dominion Diamond Mines ULC (Dominion) is pleased to submit the attached *Environmental Agreement and Water Licence Annual Report 2019.* This report was prepared in accordance with the annual reporting requirements of Part B Condition 10 and Schedule 1 Condition 1 of Water Licence W2012L2-0001 and Article 5 of the Environmental Agreement. Reviewer comments from the *Environmental Agreement and Water Licence Annual Report 2018* were considered in the preparation of this year's report.

Dominion trusts that you will find this report to be clear and informative. Please contact Claudine Lee, Head of Environment at claudine.lee@ddcorp.ca or 867-446-3719 should you have any questions.

Sincerely,

Claudine Lee, M.Sc., P.Geol.
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Abbreviations and Acronyms

AQMP	Air Quality Monitoring Program
AEMP	Aquatic Effects Monitoring Program
ARD	Acid Rock Drainage
Board (the)	Wek’èezhìi Land and Water Board (WLWB)
CAEAL	Canadian Association for Environmental Analytical Laboratories
CIRNAC	Crown-Indigenous Relations and Northern Affairs (formerly INAC)
CKRSA	Coarse Kimberlite Reject Storage Area
CPUE	Catch per Unit Effort
CRP	Coarse Rejects Pile
CSCF	Contaminated Snow Containment Facility
DFO	Fisheries and Oceans Canada
Dominion	Dominion Diamond Mines ULC
ECCC	Environment and Climate Change Canada
ENR	Environment and Natural Resources
EQC	Effluent Quality Criteria
ERT	Emergency Response Team
FAR	Fresh Air Raise
GNWT	Government of the Northwest Territories
ha	Hectare
HADD	Harmful Alteration, Disruption or Destruction
HQ	Hazard quotient
HSE	Health, Safety and Environment
IBA	Impact Benefit Agreement
ICRP	Interim Closure and Reclamation Plan
IEMA	Independent Environmental Monitoring Agency
ISO	International Organization for Standardization

ITI	Department of Industry, Tourism and Investment
KIA	Kitikmeot Inuit Association
KPSF	King Pond Settling Facility
LKDFN	Lutsel K'e Dene First Nation
LLCF	Long Lake Containment Facility
m^3	Cubic metres
masl	Metres above sea level
MVRMA	*Mackenzie Valley Resource Management Act*
NFPA	National Fire Protection Association
NP	Neutralization Potential
NTKP	Naonaiyaotit Traditional Knowledge Project
PAG	Potentially acid generating
PDC	Panda Diversion Channel
PK	Processed kimberlite
PSD	Pigeon Stream Diversion
QA/QC	Quality Assurance / Quality Control
SNP	Surveillance Network Program
SWE	Snow water equivalent
TK	Traditional Knowledge
TKEG	Traditional Knowledge Elders Group
TRV	Toxicity reference value
TSM	Towards Sustainable Mining
TSP	Total Suspended Particulate
TSS	Total Suspended Solids
VEC	Valued Ecosystem Component
WAMP	Watershed Adaptive Management Plan
Water Licence	Type A Water Licence W2012L2-0001
WEMP	Wildlife Effects Monitoring Program

WLWB	Wek’èezhìi Land and Water Board (the Board)
wmt	Wet metric tonnes
WRSA	Waste Rock Storage Area
WPKMP	Wastewater and Processed Kimberlite Management Plan
WROMP	Waste Rock and Ore Storage Management Plan
WRP	Waste Rock Pile
YKDFN	Yellowknives Dene First Nation
ZOI	Zone of Influence

1. Introduction

Dominion Diamond Mines ULC (Dominion) is a Canadian diamond mining company with ownership interests in two major producing diamond mines in Canada's Northwest Territories (NWT). Dominion operates the Ekati Diamond Mine (in which it owns a controlling interest), and also owns 40% of the Diavik Diamond Mine. It supplies premium rough diamond assortments to the global market through its sorting and selling operations in Canada, Belgium, and India.

The 2019 Annual Report for the Ekati Diamond Mine has been prepared to meet the annual reporting obligations outlined in the following regulatory documents:

- Type A Water Licence W2012L2-0001 (Water Licence) was issued prior to devolution under the federal *NWT Waters Act* and the *Mackenzie Valley Resource Management Act* (MVRMA), as currently administered by the Wek'èezhìi Land and Water Board (the Board). Post devolution, the Water Licence was amended and issued under the *Waters Act*, a territorial legislation.
- The Environmental Agreement between the Queen in Right of Canada (represented by the Minister of Crown-Indigenous Relations and Northern Affairs, formerly Indigenous and Northern Affairs Canada [INAC]), the Government of the Northwest Territories (GNWT; represented by the Minister of Resources, Wildlife and Economic Development, presently Environment and Natural Resources [ENR]), and BHP Billiton, executed January 1997. Dominion has assumed the rights and responsibilities of BHP Billiton under the Environmental Agreement.

The following report summarizes activities conducted by Dominion during the 2019 calendar year to meet the requirements of the Water Licence and Environmental Agreement. Dominion is pleased to submit this report and welcomes comments from reviewers and recipients.

Graphical summaries of water and liquid Waste management at the Ekati Diamond Mine during the 2019 reporting year are provided in Figure 1, and a graphical summary of solid Waste management is provided in Figure 2.

Figure 1 2019 Ekati Diamond Mine Water and Liquid Waste Summary

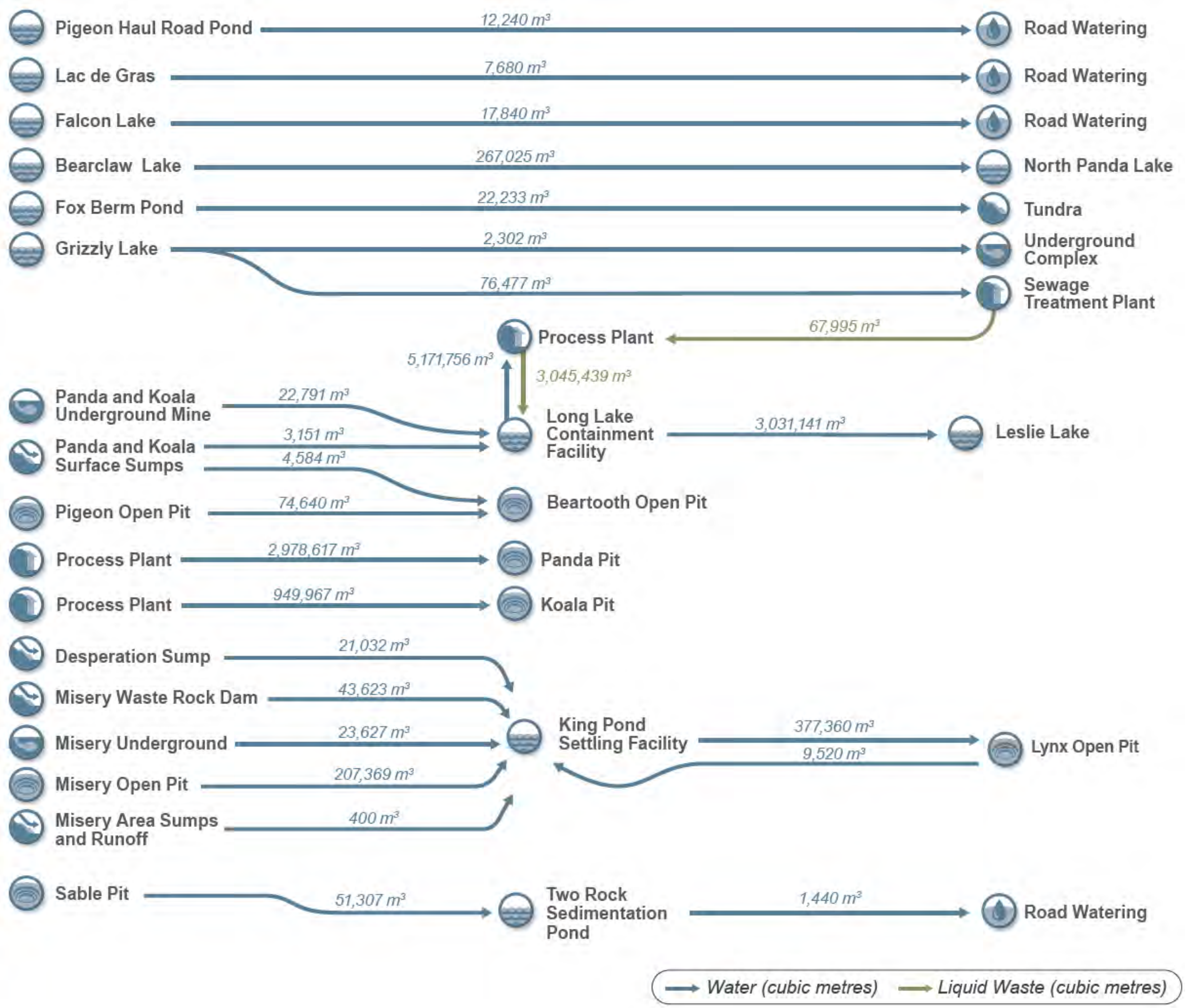
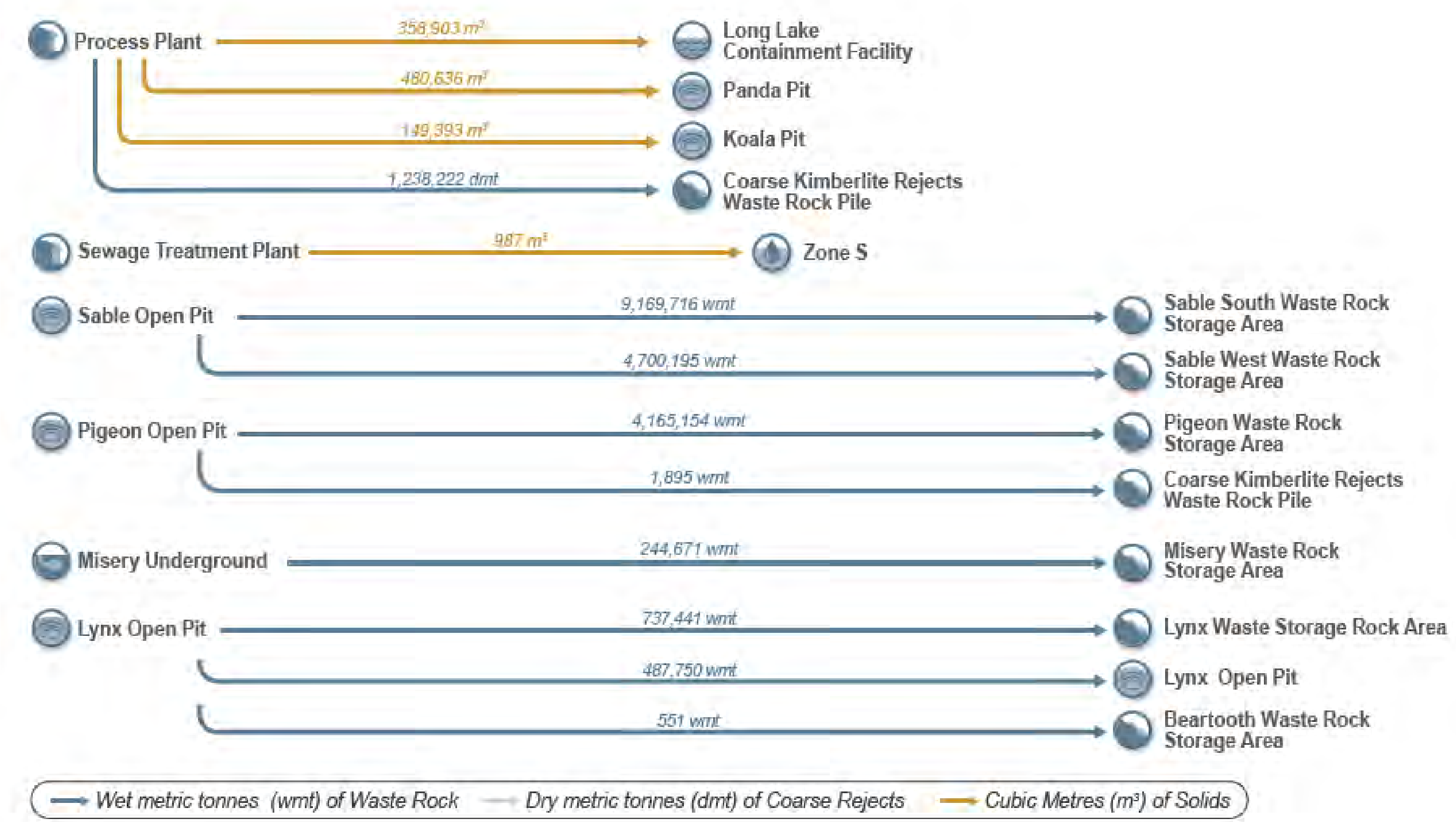


Figure 2 2019 Ekati Diamond Mine Solid Waste Summary



2. Project Overview

2.1 Location

The Ekati Diamond Mine is located approximately 200 km south of the Arctic Circle and 310 km northeast of Yellowknife, NWT, Canada (Figure 3). The mine is situated within the Lac de Gras watershed at the headwaters of the Coppermine River drainage basin, which flows north to the Arctic Ocean. Located 100 km north of the tree line on the Arctic tundra, the local terrain is characterized by boulder fields, tundra, wetlands, and numerous lakes with interconnecting streams. There are more than 8,000 lakes within the claim block. It is an area of continuous permafrost with a shallow active layer (less than 2 metres thick), which thaws during the brief summer.

2.1.1 Sustainable Development Policy

Dominion's Sustainable Development Policy (Figure 4) was created as part of the mine's Integrated Health, Safety, and Environment (HSE) Management System to reflect Dominion's commitment to sustainability and continuous improvement. The HSE Management System provides a framework to complete tasks consistently, correctly, and effectively that will drive continual improvement in health, safety, and environmental performance.

Internal audits of six HSE Management System standards were conducted in 2019. The internal audits demonstrated that Dominion continues to operate the Ekati Diamond Mine in compliance with the standards set out in the HSE Management System. The company continues to make improvements to the HSE Management System and continues to effectively address minor non-conformances identified during the auditing process. The opportunities for improvement related to environmental management have been documented in the Ekati Diamond Mine First Priority Enterprise (FPe) software and will be tracked through to completion.

Towards Sustainable Mining (TSM) is an initiative of the Mining Association of Canada and is designed to improve the performance of the mining industry through continual improvement and alignment with guiding principles. The Ekati Diamond Mine participates in this initiative, subscribes to the guiding principles of TSM, and annually reports key performance indicators that demonstrate alignment and commitment with the guiding principles. These indicators are designed to identify the industry's current performance in key areas, point to improvement, and must be routinely confirmed by independent auditing agencies. Areas for which performance indicators have been developed include Tailings Management, Energy and Greenhouse Gas Emissions Management, Indigenous and Community Relationships, Crisis Management, Safety and Health, Biodiversity Conservation Management, and Preventing Child and Forced Labour.

Figure 3 Ekati Diamond Mine Location

Figure 4 Sustainable Development Policy

Dominion Diamond Mines

Sustainable Development Policy

Dominion Diamond Mines ULC is committed to promoting a sustainable and successful future through a safe and healthy workplace, protecting the environment, developing local communities and delivering a high quality product. By following the principles of accountability, teamwork, respect and stakeholder involvement, we strive to set industry standards for sustainable development. That means meeting stakeholders' needs now and in the future.

Core Values

Our core values show how we will achieve sustainable development by demonstrating the courage to care; being bold, entrepreneurial, and trusted; and modelling positive behaviours.

Zero Harm

Our goal: To build a legacy of commitment, trust and respect.
Our approach: To actively protect our people, the environment and the local communities.

Safety

Our goal: To work with our people to reduce and eliminate workplace injuries.
Our approach: To provide a safe and injury free workplace through committed leadership and working together.

Health

Our goal: To enhance the health and well-being of our people.
Our approach: To engage our people to promote personal health and wellness and eliminate occupational illnesses.

Environmental Protection

Our goal: To protect the environment.
Our approach: To promote a culture of environmental stewardship and respect for the natural environment within our workforce and the communities.

Risk Management

Our goal: To identify and effectively manage risk.
Our approach: To follow a strong process of assessment, critical control development and monitoring.

Community Engagement

Our goal: To build relationships of trust with our stakeholders and build capacity in the communities.
Our approach: To communicate openly and honestly, support local programs, and make real contributions in the communities.

Compliance

Our goal: To become an industry leader in compliance.
Our approach: To comply with all community commitments, standards, regulations and laws by promoting sharing and collaboration with our partners and stakeholders.

Creating Value

Our goal: To create profit and opportunities for the benefit of our stakeholders.
Our approach: To set and achieve business objectives through continuous improvement.

Continual Improvement

Our goal: To identify and implement opportunities and best practices for continuous improvement to the health, safety and environment culture.
Our approach: To set objectives and targets for continuous improvement in areas that include occupational health and safety, prevention of pollution, waste generation, processed kimberlite disposal management, progressive reclamation, biodiversity conservation, energy use and greenhouse gas emissions, and water use.

Record #: HSE RCD STA 04.01
Document Owner: Chief Executive Officer
Version: 4 Date: Feb 27, 2019

A TSM internal self-assessment of 2019 performance will be conducted in 2020. Results of the most recent self-assessment in early 2019 demonstrated continued strong performance across the six protocols, as well as one new protocol, Child and Forced Labour. The Ekati Diamond Mine continues to maintain an "A" level or better for all indicators of each protocol.

The Mining Association of Canada selected Dominion as finalists for both the 2019 Environmental Excellence Award and the 2019 Community Engagement Award. Dominion's submission for the Environmental Excellence Award was for the LLCF Pilot Study, which works toward closure optimization for processed kimberlite. Dominion's submission for the Community Engagement Excellence Award was for the Corporate Social Responsibility Project in India. In partnership with an NGO in India, Dominion has focused on three key areas: clean water, sanitation, and sustainable farming. Roughly 2,000 families in 8-10 hamlets in India have directly benefitted from these programs.

Further information on TSM can be found on www.mining.ca.

2.2 Regulatory Instruments and Contractual Agreements

The Ekati Diamond Mine is regulated through licences, permits, and authorizations. These regulatory documents are governed by many parties including federal and territorial agencies and resource management boards. In addition to complying with government regulations, the Ekati Diamond Mine has an Environmental Agreement, which is a contractual obligation between the Government of Canada, the GNWT, and Dominion.

On April 1, 2014 the GNWT became responsible for managing public land, water, and resources in the NWT. Devolution was the last major transfer of powers from the federal government to the territorial government. The Department of Industry, Tourism and Investment (ITI) became responsible for administration of mineral exploration activities (mineral tenure, royalties) under the modernized Mining Regulations. Mine operation activities (e.g., water and land use) will continue to be regulated under the *Mackenzie Valley Resource Management Act* (MVRMA). The MVRMA remains federal legislation, however, devolution gave the GNWT significant delegated authorities.

ITI will continue to have responsibility for the negotiation and administration of socio-economic agreements and facilitating and enabling employment and business development associated with mineral exploration and mine development and operations.

2.2.1 Type A Water Licence W2012L2-0001

Ekati Diamond Mine's Water Licence (W2012L2-0001) was issued by the Board and went into effect on July 30, 2013. The Licence will expire on August 18, 2021 and is an amendment to Licence MV2009L2-0001 and replaces the latter's terms and conditions. The term of Water Licence W2012L2-0001 has not been changed and the expiry date of the amended Water Licence remains August 18, 2021.

2.2.2 Environmental Agreement

The Environmental Agreement (originally signed in 1997) is signed by Her Majesty the Queen in Right of Canada (represented by Crown-Indigenous Relations and Northern Affairs), the Government of the

Northwest Territories (represented by the Minister of ENR) and Dominion. The Environmental Agreement continues in effect until full final reclamation of the Project site is completed.

2.2.3 Authorizations for Works or Undertakings Affecting Fish Habitat

The Ekati mine has five applicable Fish Act Authorizations (FAAs). Three of the five FAAs have been closed in 2018 and 2019 (SC99037, 15-HCAA-00266, and SCA96021) with offsetting commitments extending beyond the valid authorization period. Two FAAs (i.e., SC01111 and SC00028) remain active and provide approval to conduct work that results in the harmful alteration, disruption, or destruction (HADD) of fish habitat. These FAAs are summarized in Section 4.1.3 of this report.

In fulfilment of the requirements for the Lynx Lake Dewatering and fish salvage FAA (15-HCAA-00266), the following work was completed in 2019:

- Year 1 of monitoring at Pike Creek was planned to be conducted in 2019; however, the spawning migration and the young of year (YOY) outmigration monitoring programs were ceased due to a community tragedy of the sudden loss of three travelers announced on May 17, 2019. As a result, the crew was unable to collect data on the fish migration because freshet (open-water) conditions had not started by the time the program was discontinued. Future fisheries and hydrological monitoring will supplement the work completed in 2019. The initial year of monitoring will be completed once field work in the community of Lutsel K'e is possible.

In fulfilment of requirements for the Jay Project set out by Fisheries and Oceans Canada (DFO), the following work was undertaken in 2019:

- Daily monitoring of the Ac35 fish ladder by the Dominion Environment Department was completed throughout freshet (June 21 to July 28, 2019). A memo was provided to DFO on February 21, 2020 providing a summary on the 2019 Fish Ladder Monitoring Program. The memo included details on stream crossing Ac35 as recommended by DFO in December 2018.

3. Type A Water Licence W2012L2-0001 Ekati Mine Site

Effective date: July 30, 2013
Amendment date: August 24, 2018
Expiry date: August 18, 2021

Part B: General Conditions

Condition 10 states that the Licencee shall file an Annual Report with the Board not later than April 30 of the year following the calendar year reported. The Annual report shall contain the following information (see Section 3.1 to 3.5 headings below).

3.1 Measuring and Reporting Water and Waste

a) The monthly and annual quantities in cubic metres of water obtained from any sources for the uses listed in Part D, Condition 2 and 3, where appropriate this is to differentiate between water diverted and water that has been otherwise used

A summary of freshwater use is presented in Table 1. Sable Lake and Pigeon Pond have been removed from Table 1 because both have been dewatered and developed into active pits. Two Rock Lake has been removed from Table 1 because it is now Two Rock Sedimentation Pond (TRSP). No water was obtained from Little Lake, Thinner Lake, or Lac du Sauvage in 2019. Water obtained from Falcon Lake and Lac de Gras was used for road watering, and Grizzly Lake serves as the primary source of fresh water for the Ekati Main Accommodations and the surrounding outbuildings.

Table 1 Fresh Water Use (m^3)

Month	Grizzly Lake	Little Lake	Thinner Lake	Falcon Lake	Lac de Gras	Lac du Sauvage
January	7,598	0	0	0	0	0
February	7,113	0	0	0	0	0
March	7,319	0	0	0	1,110	0
April	7,311	0	0	0	110	0
May	6,702	0	0	0	0	0
June	6,374	0	0	0	7,680	0
July	5,943	0	0	12,160	0	0
August	6,202	0	0	2,640	0	0
September	5,942	0	0	3.040	0	0
October	6,338	0	0	0	0	0
November	6,093	0	0	0	0	0
December	5,844	0	0	0	0	0
Annual total	**78,779**	**0**	**0**	**17,840**	**8,900**	**0**
Maximum limit as per Water Licence	**200,000**	**400,000**	**15,000**	**100,000**	**100,000**	**500,000**

b) The monthly elevations of water during the open-water season for Grizzly Lake, Little Lake, Thinner Lake, Upper Panda Lake, Cell E of the Long Lake Containment Facility, the King Pond Settling Facility, the Two Rock Sedimentation Pond, Misery Pit during its use as the Misery Pit Minewater Facility, and Lynx pit during its use for Misery Underground Development and Jay Minewater management

Lake levels are assessed on a monthly basis during open water by staff gauge readings and and/or surveyed elevations. The open-water season is typically from June through September. Monthly lake levels are summarized in Table 2. Misery Pit is not currently being used as the Misery Pit Minewater Facility and Lynx Pit is not currently being used for Jay Minewater Management.

Table 2 Lake Level Elevations (masl)

Month	Lac du Sauvage	Grizzly Lake	Little Lake	Falcon Lake	Thinner Lake	TRSP	Upper Panda Lake	Cell E LLCF	King Pond Settling Facility
January	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	447.74[1]	Frozen
February	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	447.58[1]	Frozen
March	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	447.75[1]	Frozen
April	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	447.74[1]	Frozen
May	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	447.89	Frozen
June	415.76	468.05	449.53	469.68	451.78	486.00	460.84	447.95	444.13
July	416.15	468.13	449.58	469.89	451.75	486.20	460.63	448.44	444.45
August	416.70	468.11	449.52	469.81	451.74	486.39	461.03	448.17	444.71
September	416.08	468.03	449.36	469.78	451.74	486.36	460.57	448.24	444.69
October	Frozen	Frozen	Frozen	Frozen	Frozen	486.48	Frozen	449.01[1]	444.14
November	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	448.96[1]	444.08
December	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	Frozen	448.85[1]	444.07

Notes:
ND = No Data
[1] Surveyed through the ice

c) The monthly and total quantities in cubic metres of water Dewatered from Sable, Pigeon, Two Rock Lake, and Lac du Sauvage

Table 3 shows that no water was dewatered from Lac du Sauvage in 2019. Sable Lake and Pigeon Pond have been removed from Table 3 because both have been dewatered and developed into active pits. Two Rock Lake has been removed from Table 3 because it is now the TRSP.

Table 3 Dewatering from Lac du Sauvage

Month	Lac du Sauvage
January	0
February	0
March	0
April	0
May	0
June	0
July	0
August	0
September	0
October	0
November	0
December	0
Annual Total	0

d) The monthly and annual quantities in cubic metres of each Waste deposited into the Long Lake Containment Facility, King Pond Settling Facility, Phase 1 Tailings Containment Area, the Two Rock Sedimentation Pond, the Misery Pit Minewater Facility, and Lynx Pit during its use for Misery Underground Development and Jay Minewater management

Minewater Discharged into the containment facilities is expected to fluctuate seasonally with larger volumes being pumped during the spring freshet. Additionally, after significant rain events, water collects in the camp sumps and needs to be pumped out. After freeze-up, the volumes pumped decrease, with the main contributors being the indoor sumps such as the Truckshop and Washbay sumps. The Phase 1 Containment Area has been reclaimed and no longer receives Waste and Misery Pit is not currently being used as the Misery Pit Minewater Facility. A summary of monthly quantities of solid and liquid Waste to the facilities is presented in Table 4.

e) The monthly and annual quantities in cubic metres of any Discharges of water or Waste by location and nature of the Discharge

A summary of the monthly quantities of water or Waste Discharged by location and nature of Discharge are presented in Table 5. Authorizations for these Discharges, which can all be found on the Board Registry, are outlined below:

- Authorization to Discharge water from the Fox Berm Pond to the Receiving Environment was granted by the Inspector on July 8, 2019.
- Authorization to use water from TRSP for road watering was granted by the Inspector on July 16, 2019, however no water from TRSP was used.
- Authorization to Discharge water from Cell E of the LLCF to Leslie Lake was granted by the Inspector on July 19, 2019.
- Authorization to use water from the Pigeon Haul Road Pond for road watering was granted by the Inspector on June 14, 2019. After an EQC exceedance temporarily halted the use of Pigeon Haul

Road Pond water for road watering, authorization to recommence use for road watering was granted by the Inspector on July 25, 2019.

Table 4 Waste Discharged to Containment Facility (m^3)

Month	Long Lake Containment Facility				Beartooth		TRSP	King Pond Settling Facility		Panda Pit		Koala Pit		Lynx Pit[3]
	Process Plant Solids	Process Plant Liquids	Minewater[1]	Other Waste[2]	Minewater[1]	Other Waste[2]	Minewater[1]	Minewater[1]	Other Waste[2]	Process Plant Solids	Process Plant Liquids	Process Plant Solids	Process Plant Liquids	Minewater[1]
January	69,477	547,550	6,866	0	0	0	0	0	0	0	0	0	0	0
February	46,896	523,073	15,925	257	0	0	0	0	0	0	0	0	0	0
March	60,090	580,188	0	20	0	0	0	0	0	0	0	0	0	0
April	45,099	548,486	0	30	0	0	0	0	0	0	0	0	0	0
May	15,462	125,669	0	1,181	2,960	4,560	0	7,768	0	48,844	396,979	0	0	0
June	15,331	96,628	0	186	11,200	0	16,080	50,437	400	74,960	472,452	0	0	0
July	24,951	145,870	0	142	16,880	0	21,600	32,602	0	87,347	510,653	0	0	0
August	27,623	148,299	0	495	36,160	24	3,539	76,483	0	90,233	519,155	0	0	0
September	18,701	114,826	0	760	4,320	0	8	64,290	0	76,395	469,078	0	0	157,615
October	18,915	111,144	0	15	3,120	0	10,000	7,748	0	86,349	507,377	0	0	219,745
November	8,771	54,683	0	6	0	0	80	946	0	16,475	102,707	67,378	420,046	0
December	7,587	49,024	0	59	0	0	0	243	0	33	215	82,015	529,921	0
Annual Total	**358,903**	**3,045,439**	**22,791**	**3,151**	**74,640**	**4,584**	**51,307**	**240,516**	**400**	**480,636**	**2,978,617**	**149,393**	**949,967**	**377,360**

Notes:

[1] Minewater and Process Plant Total Liquids have been separated in Table 4 to improve clarity in reporting. More specific minewater information can be found in Table 6.

[2] "Other Waste" refers to the liquids removed from sumps within the Truck Shop and surface sumps which are not tied into the dewatering system.

[3] Minewater from MUG was pumped directly to King Pond Settling Facility and water from King Pond Settling Facility was pumped to Lynx Pit

Table 5 Discharge of Waste or water by location and nature of Discharge (m^3)

Month	Cell E to Leslie Lake	Fox Berm Pond to Tundra	TRSP to Road Watering	Pigeon Haul Road Pond for Road Watering	Lac de Gras for Road Watering	Falcon Lake for Road Watering
January	0	0	0	0	0	0
February	0	0	0	0	0	0
March	0	0	0	0	0	0
April	0	0	0	0	0	0
May	0	0	0	0	0	0
June	0	0	0	10,800	7,680	0
July	1,909,798	21,759	1,440	1,440	0	12,160
August	1,121,343	454	0	0	0	2,640
September	0	0	0	0	0	3,040
October	0	0	0	0	0	0
November	0	0	0	0	0	0
December	0	0	0	0	0	0
Annual total	**3,031,141**	**22,233**	**1,440**	**12,240**	**7,680**	**17,840**

f) The monthly and annual quantities in cubic metres of Minewater pumped from each open pit and underground mine and its deposit location

The monthly and annual quantities of minewater pumped from each pit and underground mine are summarized in Table 6. No minewater was pumped from Fox Pit in 2019. In October 2012 the Ekati Diamond Mine began reporting underground minewater from Panda and Koala as a single volume in the monthly SNP report.

Table 6 Minewater Pumped from Each Open Pit and Underground Mine (m^3)

Month	Koala and Panda Underground to LLCF	Pigeon Pit to Beartooth	Misery Pit to King Pond Settling Facility	MUG to King Pond Settling Facility	Lynx Pit to King Pond Settling Facility	Sable Pit to TRSP
January	6,866	0	0	0	0	0
February	15,925	0	0	0	0	0
March	0	0	0	0	0	0
April	0	0	0	0	0	0
May	0	2,960	7,768	0	0	0
June	0	11,200	40,917	0	9,520	16,080
July	0	16,880	32,602	0	0	21,600
August	0	36,160	76,483	0	0	3,539
September	0	4,320	49,600	14,690	0	8
October	0	3,120	0	7,748	0	10,000
November	0	0	0	946	0	80
December	0	0	0	243	0	0
Annual Total	**22,791**	**74,640**	**207,369**	**23,627**	**9,520**	**51,307**

g) The monthly and annual quantities in cubic metres of treated Sewage effluent Discharged from the Sewage Treatment Facilities

All sewage went through primary and secondary treatment in the central facility at the main Ekati Diamond Mine camp in 2019. Sewage from the underground facilities, Misery Camp, Pigeon office trailer, and Sable Camp was trucked to the central facility. Treated effluent water was piped with the Fine Processed Kimberlite (FPK) slurry to the LLCF, Panda Pit, or Koala Pit. Solids were deposited into Zone S in the Panda/Koala Waste Rock Storage Area. A total of 67,995 m^3 of liquid sewage effluent was deposited into containment facilities through the Process Plant. Table 7 provides quantities of both treated sewage effluents and sludge Discharged from the sewage treatment facility.

Table 7 Sewage Effluent (m^3)

Month	Effluent to LLCF	Sewage Solids to Zone S[1]
January	6,432	227
February	5,540	230
March	5,111	200
April	5,978	130
May	4,937	120
June	6,138	0
July	5,724	50
August	5,878	0
September	5,674	20
October	5,773	0
November	5,580	0
December	5,230	10
Annual total	**67,995**	**987**

Note:
[1] Values estimated based on the capacity of the trucks hauling the sewage sludge.

h) The monthly and annual quantities in cubic metres of Sewage solids removed from the Sewage Treatment Facilities

There was 987 m^3 of sewage solids removed from the sewage treatment plant in 2019. Sewage solids were deposited into Zone S on the Panda/Koala Waste Rock Storage Area. Quantities of sewage effluent and solids removed from the Sewage Treatment Facilities are summarized in Table 7.

i) The monthly and annual quantities in cubic metres of recycled water, identifying both source and use

There was 5,171,756 m^3 of recycled water drawn from Cell D of the LLCF and used in the Process Plant as process water in 2019. No water was withdrawn from Phase 1 Containment Facility for use in processing in 2019; this facility was decommissioned in 2002 and is now reclaimed. Process Plant water use is summarized in Table 8.

Table 8 Recycled Water Used (m^3)

Month	Long Lake Containment Facility	Month	Long Lake Containment Facility
January	407,531	August	486,530
February	361,550	September	447,910
March	449,199	October	434,778
April	421,859	November	434,856
May	378,389	December	436,626
June	419,803	**Annual Total**	**5,171,756**
July	492,725		

j) Tabular summaries of all data and information generated under the *Surveillance Network Program* and graphical summaries of parameters in the effluent quality criteria under Part H at the points of compliance (SNP stations 1616-30, 1616-43, 1616-47, 0008-Sa3, Jay-0005a/b) in an electronic format acceptable to the Board

Surveillance Network Program (SNP) data for 2019 has been submitted to the Board on a monthly basis. SNP sampling locations are identified in Figure 5. SNP Monthly Reports are publicly available on the Board registry (http://www.mvlwb.ca/Registry.aspx?a=W2012L2-0001). The frequency, summary of sampling, sample parameters, and Discharge criteria for the SNP are provided in Appendix A. SNP stations Jay-0005a and Jay-0005b were not active, as there is no pumping from Misery Pit to Lac du Sauvage, and the stations were not monitored in 2019.

k) The monthly and annual quantities of overburden removed from diked area

No overburden was removed from the diked area in 2019.

3.2 Management Plans and Activities

l) A summary of Dewatering and Drawdown activities in accordance with part E, Conditions 1-3 of this Licence

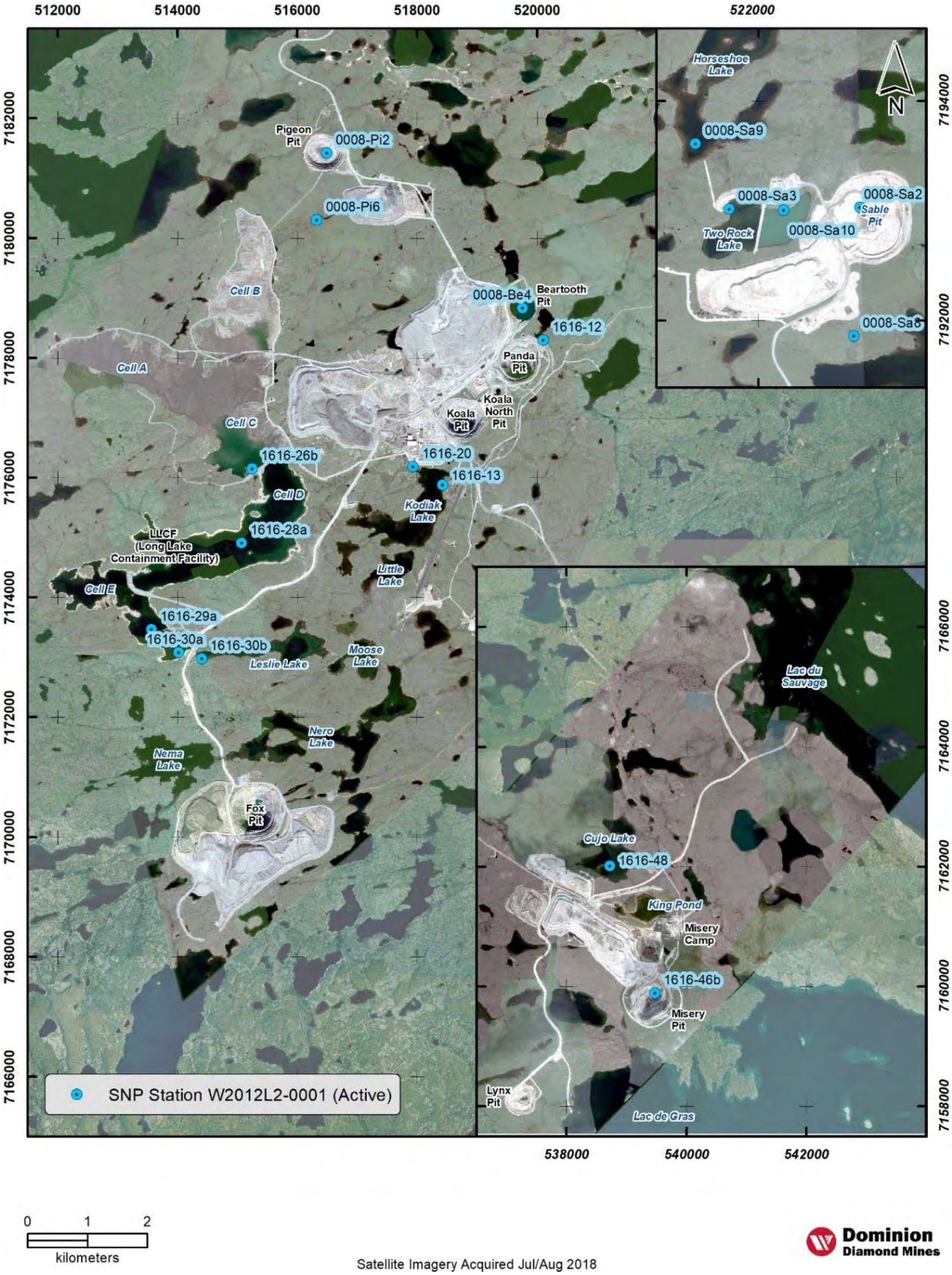
From July 31 to October 10 a total of 267,025 m^3 of water was pumped from Bearclaw Lake to North Panda in 2019. From July 20 to August 29 a total of 3,031,141 m^3 was pumped from Cell E of the LLCF to Leslie Lake. A total of 22,233 m^3 was pumped from Fox Berm Pond to South Fox Lake 2 from July 15 to August 2. All daily inspections during pumping indicated a clear Discharge, there was no erosion of the lake shore for either drawdown location, and maximum pumping rates were not exceeded.

The following pumping summaries were submitted to the Board for the 2019 pumping season:

- 2019 Bearclaw Pumping Summary
- 2019 Cell E Pumping Summary
- 2019 Fox Berm Pond Pumping Summary

All water movement activities for 2019 are provided in Figure 1 (Ekati Diamond Mine Water and Liquid Waste Summary).

Figure 5 Ekati Diamond Mine SNP Sampling Locations



m) A summary of Construction Activities and an Updated Mine Plan

Various operational construction activities were conducted in 2019.

Misery Underground (MUG) Infrastructure

- Successful dewatering of Misery pit prior to kimberlite development underground (Q2 and Q3)
- 4m diameter, 280m deep raise-bored Fresh Air Raise (FAR) completed (Q2 to Q4)
- Line power delivered to underground workings through the main FAR (Q3 to Q4)
- Construction activities started for main underground power distribution centre, underground compressors, main underground de-sliming and dewatering stations (Q3 to present)
- Production activities commenced with MUG kimberlite being delivered to the Ekati mine Process Plant (Q3)
- Broke through to the upper portal which will be used for mine access in the future (Q4)

LLCF Reclamation Research

Field-scale reclamation research in Cell B of the LLCF continued in 2019. Programs included:

- Excavating and stabilizing two separate channels through Cell B
- Use of mounding as an erosion control measure
- Implementation of wildlife fences
- Expanded mine generated organic material trials and mycorrhizae trials

Results of these studies will be included as part of the 2019 Reclamation Research Report.

Life of Mine Plan

The Life of Mine Plan is presented in Figure 6. This plan is subject to change as Dominion continues to evaluate future projects.

n) A summary of all work carried out over the last year under the approved Management Plans referred to in Part H, Conditions 1 through 3 of this Licence including:

I. The quantity of Kimberlite processed through the process plant in 2019

Production in 2019 was 4,102,545 tonnes of kimberlite ore (Table 9).

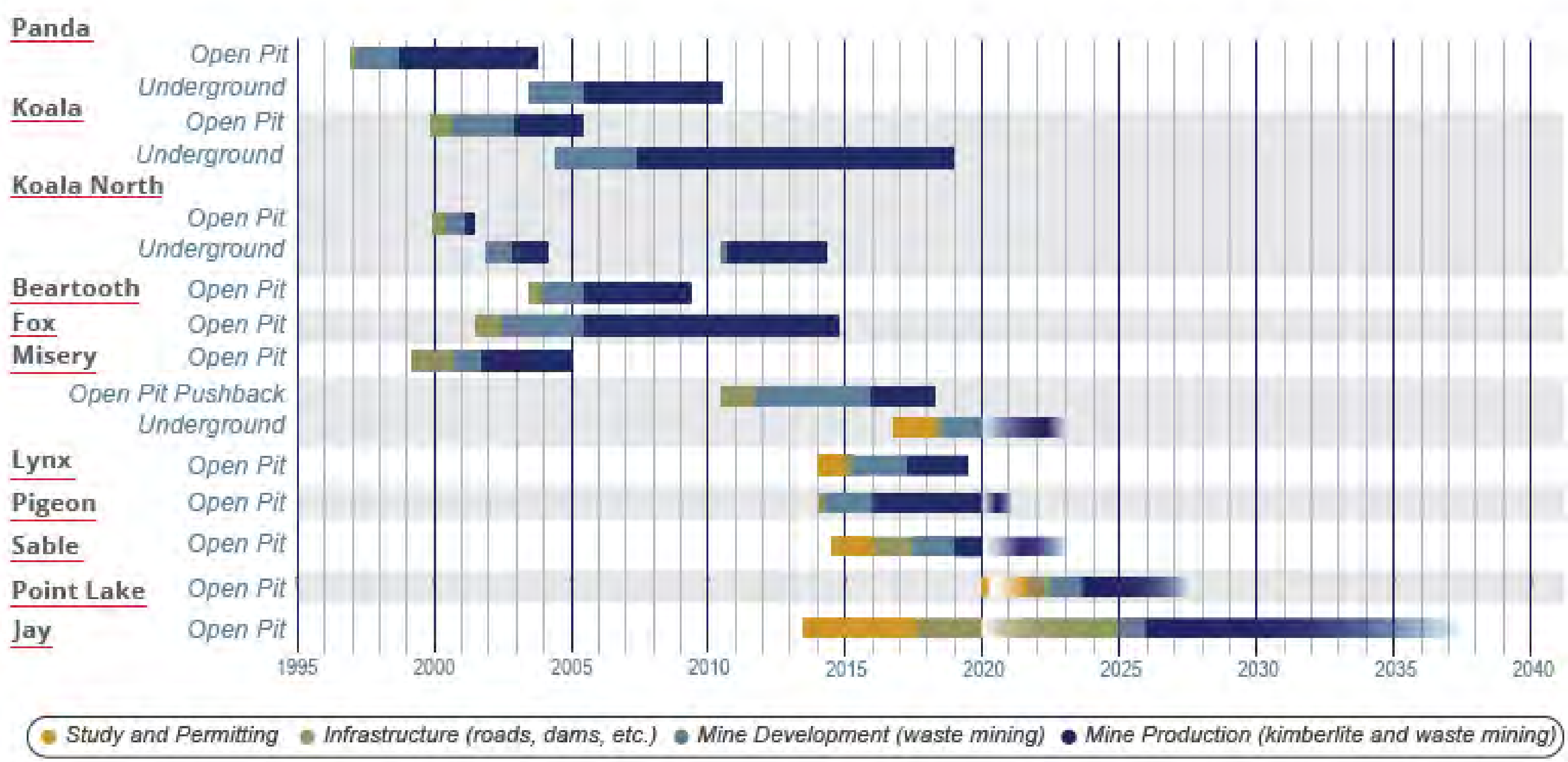
Table 9 Tonnes of Kimberlite Ore Processed

Month	Volume of Ore Processed (tonnes)	Month	Volume of Ore Processed (tonnes)
January	286,444	August	395,486
February	283,540	September	362,467
March	313,640	October	387,409
April	339,606	November	322,512
May	338,847	December	316,478
June	362,442	**Annual Total**	**4,102,545**
July	393,674		

II. The quantity of Waste Rock by type from each open pit and underground mine deposited in each of the Waste Rock Storage Areas and a description of construction compared to the Board-approved design for each Waste Rock Storage Area

There was 19,507,195 wet metric tonnes (wmt) of Waste Rock deposited in the various Waste Rock piles in 2019. The 2019 quantities of Waste Rock produced and deposited is provided in Table 10.

Figure 6 Life of Mine Plan



Note:
[1]Point Lake is currently in the pre-feasibility stage and is not currently permitted.

Table 10 Quantity of Waste Rock Produced

Waste Rock Produced	Waste Rock Deposited	Mass (wmt)
Misery Underground	Misery Waste Rock Storage Area	244,671
Pigeon Pit	Pigeon Waste Rock Storage Area	4,165,154
Pigeon Pit	Coarse Kimberlite Rejects WRP	1,895
Lynx Pit	Lynx Waste Rock Storage Area	737,441
Lynx Pit	Lynx Pit[1]	487,750
Lynx Pit	Beartooth Waste Rock Storage Area[2]	551
Sable Pit	Sable South Waste Rock Storage Area	9,169,716
Sable Pit	Sable West Waste Rock Storage Area	4,700,195
Total		**19,507,195**

Notes:
WRP = Waste Rock Pile
wmt = wet metric tonnes
[1] A portion of Waste Rock from the bottom of Lynx Pit was relocated to the upper benches
[2] This Waste Rock was sorted from Lynx ore at the Primary area near the Process Plant, and then disposed of at the nearby Beartooth WRSA

All Waste Rock Storage Areas (WRSA) have been constructed based on approved designs by the Board. More detail on WRSAs can be found in the Dominion Waste Rock and Ore Storage Management Plan published on the Board public registry.

III. The quantity of Coarse Processed Kimberlite deposited in each deposition location

A total of 1,238,222 tonnes of Coarse Kimberlite Reject Material from the Process Plant was placed in the Coarse Kimberlite Rejects Storage Area (CKRSA) located in the Panda/Koala/Beartooth WRSA in 2019.

IV. The quantity of Fine Processed Kimberlite deposited in each deposition location

Table 4 indicates the monthly volumes of Process Plant Solids – the FPK – deposited in the LLCF, Panda Pit, and Koala Pit.

V. A summary of the results of Seepage surveys conducted in accordance with Part H, Condition 5 of this Licence

In 2019, routine monitoring of Waste Rock seepage during freshet and fall, and rainfall events in July and August was continued following established protocols. The toes of each Waste Rock pile were checked on foot along the tundra in all areas where drainage flowed away from the Waste Rock.

During the 2019 surveys, 14 new seepage stations were identified and sampled. The large number of new seepage stations established was due to significant ice melt occurring during the freshet survey. Some of the new stations (SEEP-377A, SEEP-519A) were established downstream of an existing monitoring station to study the evolution of seepage water chemistry. Most of the new stations established during freshet were not flowing in the fall.

The screening method applied in 2018 to identify Seeps of Potential Concern was based on an 'interim' Board approval, which also directed Dominion to develop a more consistent and transparent procedure.

In response to those Directives, Dominion is developing a Seepage Response Framework that provides an improved procedure for identifying where and when adaptive management responses may be necessary. The Seepage Response Framework will replace the previous method of identifying Seeps of Potential Concern and will be submitted to the Board. Due to the pending submission of the requested updated adaptive management approach to WRSA seepage, the previous ‘interim’ method for identifying Seeps of Potential Concern is no longer considered relevant and was not repeated for the 2019 Seepage Report.

All existing seeps were checked for flow and samples were collected from all seeps that had measurable flow. Seeps with standing water were not sampled.

- Fifty (50) seeps were sampled during freshet and 17 seeps were sampled during the fall survey.
- Eight (8) seeps were sampled following rainfall events in July and August.

Reference Areas

Overall, REF-005, which is located upstream of Bearclaw Lake, continues to show only minimal influence of mining activities, likely through the deposition of dust from the nearby haul road. However, concentrations were well below those of WRSA seeps for key parameters and continue to allow for comparison of long-term trends. REF-037, located upstream of Horseshow Lake in the Sable Area, showed no significant changes in chemistry to historical monitoring results and continues to be a suitable reference station.

Overall, differences in water chemistry between REF-005 and REF-037 have been evident since onset of monitoring and are likely a result of the different catchment areas of these two stations, as opposed to influence of mining activities at REF-005.

Panda/Koala/Beartooth WRSA

- Seepage from the Panda/Koala WRSA continued to show influence of Waste Rock leaching and flushing of explosive residues at stations SEEP-018B, SEEP-331, SEEP-019, and SEEP-357.
- Generally, there were no significant changes to trends in leaching in recent years.
- Results from SEEP-501 and SEEP-527 samples indicated minimal influence of Waste Rock leaching and likely influence of dilution by meltwater.
- Results from SEEP-006A indicated on-going influence of Waste Rock and kimberlite leaching, as well as flushing of explosive residues, with concentrations of major elements that were higher than the median WRSA concentrations. Trace element concentrations were similar to those for median WRSA seepage. Seepage from this station flows towards the Koala Pit.

Coarse Kimberlite Reject Storage Area

All seepage from the CKRSA drains into the Long Lake Containment Facility. Seeps that showed the highest influence of weathering and leaching of coarse kimberlite rejects (CKR) included:

- Seeps at the toe of the WRSA berm: SEEP-368, SEEP-393, SEEP-371, SEEP-387

- Seeps downstream of the WRSA berm: SEEP-333, SEEP-012

Other seeps indicated kimberlite leaching that was diluted by meltwater or highly attenuated through contact with the tundra:

- Seeps at the toe of the WRSA berm: SEEP-343, SEEP-355, SEEP-515, SEEP-516, SEEP-392
- Seeps downstream of the WRSA berm: SEEP-383, SEEP-384, SEEP-502, SEEP-526

Evidence of erosion and sediment transport was also noted at several seeps (e.g. SEEP-355). Petroleum hydrocarbons were only detected twice in CKRSA seepage between 2017 and 2019.

Fox WRSA

Seepage draining from the Fox WRSA that indicated more pronounced influence of sulphide oxidation and kimberlite leaching from the WRSA or kimberlite storage areas included:

- Seeps at the toe of the WRSA: SEEP-373, SEEP-377, SEEP-370, SEEP-529
- Seeps downstream of the WRSA: SEEP-373A

Seepage that indicated less pronounced sulphide oxidation and kimberlite leaching either due to dilution or interaction with the tundra included:

- Seeps at the toe of the WRSA: SEEP-510, SEEP-374, SEEP-512, SEEP-391, SEEP-513, SEEP-514, SEEP-521, SEEP-522, SEEP-378, SEEP-523, SEEP-524, SEEP-390, SEEP-326, SEEP-360, SEEP-362, SEEP-362A, and SEEP-388
- Seeps downstream of the WRSA: SEEP-377A, SEEP-382, SEEP-302

Seepage that indicated flushing of fine rock from the WRSA included:

- Seeps at the toe of the WRSA: SEEP-377, SEEP-390, SEEP-529, SEEP-362

Seepage that is similar to background and likely heavily influenced by meltwater during freshet or interaction with the tundra included:

- Seeps at the toe of the WRSA: SEEP-512
- Seeps downstream of the WRSA: SEEP-367, SEEP-508, SEEP-509, SEEP-507, SEEP-517, SEEP-518, SEEP-519, SEEP-519A, SEEP-304/304A

Misery WRSA

Seepage results downstream of the Waste Rock Dam can be summarized as follows:

- SEEP-057 and SEEP-059, downstream of the Waste Rock Dam, showed increasing trends of various parameter concentrations, indicating a greater, though still minimal, influence of Waste

Rock leaching in recent years. Higher trace element concentrations were observed in the upstream station SEEP-057, compared to downstream.

- Generally, results of the other upstream seeps SEEP-506 and SEEP-525 showed minimal influence of Waste Rock leaching.
- Comparison of pond water upstream of the Waste Rock Dam, runoff from the direction of the Misery camp and SEEP-057 results, indicate that seepage downstream of the Waste Rock Dam does in fact show signs of WRSA influence. However, it does not necessarily originate from the Waste Rock Dam pond. Results at REF-040 indicate that contact water may be flowing from the Misery Camp.

Seepage results from the south side of the Misery WRSA at SEEP-528 indicated minor influence of sulphide oxidation at this seep, with trace element concentrations that were between the median and 95th percentile WRSA values.

Seepage results from downstream of the Jay Crusher Pad at SEEP-081 indicated that concentrations of key parameters have mostly stabilized since the sharp increases from 2015 to 2016. Concentrations of several dissolved trace elements (Cd, Co, Cu, Pb, Mn, Ni, Se, Sr, Zn) were above the 95th percentile values for the catchment area in 2019. The results indicate a higher influence of sulphide oxidation in recent years, however not necessarily an increase of kimberlite leaching.

Pigeon WRSA

Most of the seeps monitored downstream of the Pigeon WRSA flow from the western edge of the WRSA, and most of the seeps flow into Little Reynolds Pond through SEEP-389A. Results indicate a decrease in Waste Rock leaching at SEEP-389, while all seeps on the west side of Pigeon (except SEEP-398) showed influence of sulphide oxidation. There is a lack of influence of kimberlite leaching at all seeps, and a lack of influence of Waste Rock leaching at SEEP-394 and SEEP-398.

Sable and Lynx WRSAs

No seepage was encountered during the freshet and fall surveys around the Sable or Lynx WRSAs.

VI. Updated results of ongoing Acid/Alkaline Rock Drainage and related geochemical test work

The Geochemical Characterization Management Plan (formerly Acid/Alkaline Rock Drainage) has been incorporated into the Waste Rock and Ore Storage Management Plan (WROMP). Data summaries are available in the following tables from the WROMP Version 10.1.

- Table 3.1: Summary of Panda Waste Rock Acid-Base Accounting Data
- Table 3.2: Summary of Elemental Concentrations in Panda Waste Rock
- Table 3.3: Summary of Koala Waste Rock Acid-Base Accounting Data
- Table 3.4: Summary of Elemental Concentrations in Koala Waste Rock
- Table 3.5: Summary of Beartooth Waste Rock Acid-Base Accounting Data
- Table 3.6: Summary of Elemental Concentrations in Beartooth Waste Rock

Over 90% of the Waste Rock stored at the Ekati Diamond Mine is granite. The remaining Waste Rock is either metasediment, diabase, or Waste kimberlite. The following is a summary of key results of geochemical characterization for the Ekati Diamond Mine:

- The majority of rock types mined at the Ekati mine are not potentially acid generating or have low potential to generate acidity.
- Metasediment rock at the Misery and Pigeon pits is classified as potentially acid generating (PAG).
- Misery metasediment generated acid under laboratory conditions over a time frame of several tens of weeks. It is estimated that this would translate to periods of several years under site conditions.
- The Misery WRSA is of sufficient age that the effects of acidification ought to be apparent if the schist were becoming acidic.
- The Misery WRSA seepage is currently not acidic (see Section 5).
- The draft Pigeon humidity cell results indicate that the diabase, diorite, granite, and mixed granite/metasediments are non-PAG, and not a risk of metal leaching, while the metasediments are PAG and a risk of metal leaching.
- Granite and diabase are classified as non-potential acid generating (non-PAG).

VII. *Tracking and documenting of Jay Waste Rock placement by rock type*

This requirement was not applicable for 2019.

VIII. Results of Waste Rock sampling within the Jay open pit to confirm geochemical characteristics and geological mapping of the benches sampled

This requirement was not applicable for 2019.

IX. Results of sampling and field inspection program to confirm Jay Waste Rock placement

This requirement was not applicable for 2019.

X. Results of Groundwater monitoring and reporting program for the open pits during operations for the Jay Development in accordance with the approved Wastewater and Processed Kimberlite Management Plan

This requirement was not applicable for 2019.

o) A summary of any Modifications carried out in accordance with Part G of this Licence and/or major maintenance work carried out on any water or Waste management facilities including but not limited to, Water Supply Facilities, Collection and Settling Ponds, Long Lake Containment Facility, King Pond Settling Facility, Sewage Treatment Facilities, Two Rock Sedimentation Pond, Pigeon Diversion Channel, Jay and North Dike, Sub-Basin B Diversion Channel, and associated structures

No modifications or major maintenance work, as defined in Part G of the Water Licence, were undertaken in 2019.

p) A summary of the results of the Aquatic Effects Monitoring Program in accordance with Part J of this Licence

A Report has been prepared to summarize results of the 2019 AEMP. Please refer to Appendix D for this detailed summary of the 2019 AEMP results.

q) A progress report on any studies requested by the Board that relate to Waste management, water use, or mine site Reclamation and a brief description of any future studies planned by the Licensee

No studies were requested by the Board during this reporting period. Reclamation research plans and reclamation engineering studies are described, carried out, and reported under the requirements of the Board-approved Interim Closure and Reclamation Plan.

r) A summary of any revisions to the approved:

I. Construction Plan for the Jay and North Dike referred to in Part F, Condition 3

The initial Construction Plan for the Jay and North Dike has not yet been submitted to the Board.

II. Waste Management Plan, Wastewater and Processed Kimberlite Management Plan and Waste Rock and Ore Storage Management Plan referred to in part H of this Licence

Version 6.0 of the Waste Management Plan was submitted to the Board on December 31, 2019 as part of an annual review. The Plan included administrative changes to the overarching Waste Management Plan and accompanying Plans. Version 6.0 updated roles and responsibilities, updated ash sampling procedures, and incorporated MUG into the Hydrocarbon Impacted Material Management Plan. Version 6.0 of the Waste Management Plan has been submitted to the Board for approval.

Wastewater and Processed Kimberlite Management Plan (WPKMP) Version 9.0 was submitted to the Board on March 22, 2019 and was approved on June 13, 2019. The primary changes to the WPKMP for Version 9.0 were incorporation of the MDMER and the closure and reclamation of the Panda, Koala, and Koala North Underground mine workings. Version 9.0 also updated containment area operational monitoring to the following:

- Once per 12-hour shift visual inspection of active FPK Discharge spigot locations at the LLCF, and the road-accessible perimeter of Cells A and C to active FPK spigot Discharge locations.
- Once per 12-hour shift visual inspection of the Beartooth and Panda/Koala FPK pipelines when active.

Waste Rock and Ore Storage Management Plan (WROMP) Version 10.1 was submitted on July 24, 2019. Following correspondence with the Board regarding conformity, an updated version was submitted on October 30, 2019 and was approved by the Board on March 30, 2020. Updated for Version 10.1 primarily focused on the use of diabase as a construction material, but also included the following minor updates:

- Incorporation of the Misery Underground Development
- Updated geochemical data for Beartooth, Misery, Pigeon, and Lynx Pipes
- Updated Seepage Report sampling locations and seepage sampling protocol
- Updated Waste tonnages mined and estimates of future Waste generation

III. Spill Contingency Plan and Hydrocarbon-Impacted Materials Management Plan referred to in part I of this Licence

Dominion submitted Version 13.0 of the Spill Contingency Plan to the Board on December 31, 2019. This version contained updates to the Fuel and Lubricants Bulk Storage Locations and Characteristics table and updates to the contact list. Version 13.0 also includes a new section on Product Transfer Areas as well as updated to emergency preparation procedures. This version of the Spill Contingency Plan has been submitted to the Board for approval.

Dominion submitted Version 6.0 of the Hydrocarbon-Impacted Materials Management Plan to the Board on December 31, 2019. This version incorporated the MUG Project and the use of King Pond Settling Facility for storing minewater. This version was also updated to reflect the closure of Koala Underground Operations. Version 6.0 of the Hydrocarbons-Impacted Materials Management Plan is currently under review by the Board.

s) A summary of the results of the monitoring carried out under the Hydrocarbon-Contaminated Materials Management Plan referred to in Part I, Condition 4 of this Licence

Hydrocarbon Impacted Materials Management Plan

Results of monitoring carried out under the Ekati Diamond Mine Hydrocarbon-Impacted Materials Management Plan are as follows:

Volume of treated soil removed from the landfarm each year:

Dominion conducted a Landfarm Bioremediation Pilot Project that included a trial run in partnership with Delta Remediation. In June 2018, the initial trial included 1,000 m^3 of hydrocarbon impacted materials being treated with a Biologix solution to attempt to meet CCME Agricultural Guidelines. Biologix is a consortium of naturally occurring microbes selected for their ability to degrade a wide range of organic chemicals, and specifically formulated for the remediation of petroleum and toxic organics. The overall benefit of bioaugmentation is the selective addition of beneficial microbes appropriate for the site conditions to reduce the risk and uncertainty that are associated with other stimulatory approaches to bioremediation.

Soil sampling was undertaken prior to and after the bioremediation process. By September 2019, the Biologix treatment had proved to reduce all petroleum hydrocarbon fractions. By September 2019 F1, F2, and F4 fractions were all able to meet CCME Agricultural Surface Soil Guidelines. F3 fractions were also proven to degrade with ranges of contamination ranging from 3120-8070 mg/kg before treatment and 1630-1880 mg/kg by September of 2019. In this timeframe, the microbes effectively degraded all fractions to the point that the entire trial windrow passed CCME Agricultural Subsoil Guidelines. This level of degradation meant that the entire trial windrow was able to be removed from the landfarm facility without the need to haul offsite.

Following the success of the Landfarm Bioremediation Pilot Project, 1,000 m^3 of previously hydrocarbon impacted soil has been removed from the landfarm facility and was utilized as material to cap landfill Waste below 1.5 m from the surface.

An additional 80 m^3 of material over 4cm in diameter was recovered from the landfarm using an industrial screener and taken to Zone S for disposal.

Volume of water Discharged from the Contaminated Snow Containment Facility (CSCF) to the Long Lake Containment Facility (LLCF):

- No water was Discharged from the CSCF to the LLCF in 2019. 112 m^3 of water was Discharged from the landfarm sump to the LLCF in 2019.

3.3 Spills and Unauthorized Discharges

t) A list and description, including volumes, of all Unauthorized Discharges and summaries of follow-up actions taken

A total of 23 spills were reported to the NWT Spill Line or the new ENR Online Spill Reporting Tool in 2019. Appendix E provides a summary of 2019 external spill reports. One spill from 2018 and two spills from 2019 remain open with the NWT Spill Line:

- **Spill 2019127:** A diesel spill of 111,000 L occurred in the Sable Fuel Farm on March 20, 2019. This spill was caused by a faulty High-Level switch in a generator day tank within the berm, which caused fuel to continue to transfer from the bulk tank to the day tank until it overflowed into the containment berm. Dominion has incorporated timers into the programmable logic controller (PLC) to ensure that the pumps can only transfer fuel from the bulk tanks to the smaller day tanks for a set amount of time before shutting off. Dominion provided an update to the Inspector in Spill Report 2019127 Follow-Up on October 31, 2019. Dominion continues to conduct daily and more intensive weekly inspections of the fuel system, and Dominion will continue to remove contaminated water from within the berm once freshet arrives in 2020.
- **Spill 2019429:** A 117 L diesel spill occurred outside of the Misery Light Duty Shop on October 17, 2019. Fuel was being transferred from a 4,500-L fuel tank to the 1,135-L day tank within the Misery Light Duty Shop. The day tank over-filled and the diesel travelled up and out of the vent line onto the ground outside of the shop. Dominion cleaned up the spill, however the Inspector was not able to visually confirm the clean-up before the area was covered in snow and ice. The spill will be inspected in spring 2020.
- **Spill 2019456:** A 450 L engine oil spill occurred within the Sable Maintenance Shelter onto the rig-matting flooring on November 6, 2019. While most of the spill was recovered, it is suspected that some of the oil may have leaked between the rig-matting flooring surface and onto the ground beneath the shop. This leaked oil is unlikely to infiltrate the heavily compacted ground beneath the rig-matting. As per the Inspector's direction, Dominion will address this spill when the Sable Maintenance Shelter is decommissioned and taken down.

Externally reported spills at the Ekati Diamond Mine can be found on the ENR database of hazardous material spills at https://www.enr.gov.nt.ca/en/spills.

u) An outline of any spill training and communications exercises carried out

The Ekati Diamond Mine Emergency Response Team (ERT) currently has 62 active members who respond to underground and surface emergencies, including environmental emergencies such as spills. Of those 62 ERT members, 37 are stationed at the Ekati Diamond Mine Main Camp and 25 are stationed at Misery Camp. ERT members must have a valid Standard First Aid certificate and NWT/Nunavut Territorial Surface and Underground Mine Rescue certificate. Practices are held regularly and are documented. Dominion's minimum requirement of training, per member, is 72 hours in the calendar year. The Worker's Safety and Compensation Commission minimum requirement of training, per member, is 55 hours in the calendar year.

The following is a list of spill response and communications exercises carried out at the Ekati Diamond Mine in 2019:

- **Mock Exercise**: On August 7, 2019 a full-scale Incident Management Team (IMT) mock scenario was conducted involving ERT members responding to a simulated 10,000,000 L diesel tank puncture (caused by and IT-28 Loader). The team was able to stop the leak and initiate cleanup.
- **ERT Practice:** On January 19, 2019 an ERT practice focused on the Spill Response Trailer contents, equipment, and deployment plans.
- **Spill Response Trailer Inventory Inspections**: The Ekati Diamond Mine Main Camp is outfitted with a Spill Response Trailer that is inspected on a quarterly basis.
- **Spill Training**: In 2019, Dominion delivered presentations for incoming contractor groups to ensure personnel were aware of spill response and spill reporting practices at the Ekati Diamond Mine. The presentations were delivered to members of the MUG construction team as well as exploration drilling teams.

3.4 Closure and Reclamation

v) A summary of the results of the Annual Closure and Reclamation Plan Progress Report referred to in Part K of this Licence

A summary of amendments to the Interim Closure and Reclamation Plan (ICRP) is presented in Appendix F – 2019 Closure and Reclamation Progress Report (Section 6: ICRP Updates).

A summary of reclamation work conducted in 2019 is presented in Appendix F – 2019 Closure and Reclamation Progress Report (Section 5: Reclamation Activities and Monitoring).

An updated estimate of the current mine reclamation liability is presented in Appendix F – 2019 Closure and Reclamation Progress Report (Section 7: Security and Relinquishment).

3.5 Other Reporting Requirements

w) Any other details on water use or Waste disposal requested by the Board by November 1st of the year being reported

There were no requests made by the Board regarding water use disposal under this clause by November 1, 2019.

In the Reasons for Decision for the WROMP v. 10.1 the Board directs Dominion to submit a map with all locations of Lynx diabase use in construction, and an estimate of the quantities used in this Annual Report (Decision # 3). To date, no Lynx diabase has been used in construction at the Ekati Diamond Mine.

In the future, the requested Lynx diabase map and estimates will be provided as part of the Waste Rock and Waste Rock Storage Area Seepage Survey Report submission.

x) A description of how Traditional Knowledge, including but not limited to that received from the Traditional Knowledge Elders Group, influence decision making

Dominion is committed to incorporating oral and recorded Traditional Knowledge into decision making at the Ekati Diamond Mine. With significant input from communities and the Traditional Knowledge Elder's Group (TKEG), Dominion developed a Traditional Knowledge Management Framework to outline how Dominion will collect, store, manage, and use Traditional Knowledge in a respectful way. The TK Framework was approved by the TKEG in January 2017 and will operate as a living document which can be amended at any time at the TKEG's discretion. A summary of the 2017 TKEG meetings can be found at the following link: Summary Reports and Posters for TKEG Meetings. As per Section 5 of the Framework, Dominion respects that Indigenous people own and control their TK, and Dominion will only use their TK with consent, and only as intended in the context of which it was shared. Dominion maintains that it is not appropriate to disclose TK that has been obtained in a public document not directly related to the aspect of which it was shared. Dominion has also developed an Engagement Plan which is consistent with the requirements of the *Engagement and Consultation Policy* released by the Land and Water Boards of the Mackenzie Valley in 2013.

Dominion approaches community engagement and the incorporation of Traditional Knowledge in a number of ways: through on-site monitoring programs, larger regional programs, workshops, meetings, and support of community-led TK programs. Please see Section 4.3.4 of this report for a full list of Traditional Knowledge Projects and TK Preservation Programs conducted in 2019.

y) Any changes to the Engineer of Record for the Jay Dike and North Dike

There were no changes to the Engineer of Record for the Jay Dike and North Dike in 2019.

4. Environmental Agreement Article V Reporting Requirements

The following section details the requirements of Section 5.1 of the Environmental Agreement that came into effect on January 6, 1997.

Section 5.1: Annual Report

a) Dominion shall prepare and submit a report (the "Annual Report") to the Minister, the GNWT, the Monitoring Agency and the Aboriginal Peoples commencing on April 30, 1998 and on each April 30 thereafter until full and final reclamation of the Project site has been completed in accordance with the requirements of all Regulatory Instruments and the terms of this Agreement. Each Annual Report shall be accompanied by a plain English summary prepared by Dominion and shall include the results of Dominion's ongoing compliance with this Agreement and applicable legislation, instruments and agreements for the preceding Reporting Year and providing the Minister, the GNWT, the Monitoring Agency and the Aboriginal Peoples with all supporting information and data from the environmental monitoring programs and all studies and research conducted in accordance with Articles X, XI, and XII of this Agreement. Each Annual Report shall contain, inter alia, the following (see Section 4.1 to 4.7 headings below).

4.1 Compliance Reports with Respect to the Water Licence, the Surface Leases, the Land Use Permits and Other Regulatory Instruments (Clause 5.1.a.i)

Section 3 of this report provides details on compliance with the Type A Water Licence W2012L2-0001 and DFO Authorizations that regulate the Ekati Diamond Mine. Surface Leases and Land Use Permits are inspected regularly by GNWT Department of Lands.

The GNWT Department of Lands Inspector performed Type A Water Licence W2012L2-0001 inspections at the Ekati Diamond Mine throughout 2019. During those inspections the following areas were visited:

- Fuel stations
- Fuel transfer areas
- Underground fresh air raises
- Underground operations
- Water and Waste facilities including the incinerator, composter, burn bin and landfill
- Contaminated Snow Containment Facility
- Misery Camp
- King Pond
- Grizzly Road and lake water intake
- Long Lake Containment Facility
- Pigeon Stream Diversion (PSD)

- Panda Diversion Channel (PDC)
- Sable/Pigeon Road
- Sable Development
- Lynx Haul Road
- Laydowns
- Dust suppressant storage area
- Fox Pit
- Misery Pit
- Pigeon Pit
- Beartooth Pit
- Lynx Pit
- Jay Access Road

The findings for the W2012L2-0001 inspections can be found on the Board Registry at the following links:

- January 30 - Feb 1, 2019 GNWT, Department of Lands Water Licence Inspection
- February 26 – 28, 2019 GNWT, Department of Lands Water Licence Inspection
- April 9 and May 21, 2019 GNWT, Department of Lands Water Licence Inspections

The Inspector also conducted Land Use Permit inspections in 2019. The Inspector verified the cleanup of spills reported to the NWT Spill Line and the ENR Online Spill Reporting Tool. Please see Section 3.3(s) above for further details on reported spills. The dates and findings of these inspections can be found at the following links:

- January 22, 2019 W2017D0004 Misery Underground Inspection Report
- January 31, 2019 W2018C0005 Exploration Inspection Report
- February 21, March 19, and April 9, 2019 W2018C0005 Exploration Inspection Report
- March 19, 2019 W2017D0004 Misery Underground Inspection Report
- April 9, 2019 W2016D0003 Sable Development Inspection Report
- April 30, 2019 W2017D0004 Misery Underground Inspection Report
- June 25, 2019 W2017D0004 Misery Underground Inspection Report
- August 21, 2019 W2018C0005 Exploration Inspection Report
- September 10, 2019 W2017D0004 Misery Underground Inspection Report
- December 10, 2019 W2017D0004 Misery Underground Inspection Report

Specific aspects of the operation were deemed “Unacceptable” during two of the inspections listed above:

- January 30 - February 1, 2019 Water Licence Inspection: Dominion received an unacceptable rating for the Landfill due to the discovery of two plastic pails of protein powder supplement. The incident was discussed with the Operational Management Team at a close-out meeting on February 1st and the incident was entered in First Priority Enterprise and was shared across site at Safe Shift Meetings on February 2, 2020. The pails are believed to have originated from an accommodations room that was cleaned out after an employee left site. Dominion has not had any unacceptable ratings at the landfill since this occurrence.

- March 19, 2019 W2017D0004 Misery Underground Inspection: Dominion received unacceptable ratings related to fuel handling and Waste management. As per the inspection report, the following concerns were identified by the Inspector:

    - *Land Use Permit must be displayed in an area(s) so that it is plainly visible and accessible by employees so they may understand the requirements of the operating conditions;*
    - *Spills must be cleaned up as they occur and the hydrocarbon impacted soils properly disposed of (Condition #38);*
    - *The use of proper secondary containment under parked equipment (Condition #37);*
    - *Containers with hydrocarbons must be properly staged and placed in secondary containment to prevent spills (Condition #33);*
    - *Secondary containment must be used during fuel transfers (Condition #32);*
    - *Waste is to be staged in properly labeled containers and disposed of at approved facilities (Condition #23); and*
    - *All batteries must be properly containerized and stored out of the weather elements to prevent the introduction of harmful chemicals to the local environment (Condition #16).*

    Dominion immediately rectified the compliance issues that were identified in the report and the Superintendent of the Misery Underground Project discussed the findings with all applicable personnel. The Inspector returned for a subsequent inspection on April 30, 2019 and noted that concerns raised during the March 19th inspection had been adequately addressed:

    - A copy of the Land Use Permit posted in the Misery Camp mud room;
    - Proper secondary containment placed beneath parked equipment;
    - Hydrocarbon containers properly staged;
    - Waste properly staged and labelled; and
    - Batteries placed out of the elements.

    Dominion continues to work closely with the Inspector to ensure ongoing compliance with all conditions of Land Use Permit W2017D0004.

Leases 76D/9-3-2, 76D/9-4-2, 76D/9-10-1, 76D/9-11-1, 76D/10-2-2, 76D/10-3-2, 76D/10-4-2, 76D/10-5-2, 76D/10-7-2, and 76D/15-4-2 were inspected on July 17th. The Inspectors noted no concerns with these lease areas. The lease inspection reports are not a matter of public record.

4.1.1 Surface Leases and Mining Leases

Dominion holds 282 mineral leases and 10 surface leases which were issued subject to the *Territorial Lands Act*. The surface leases are summarized in Table 11. As of April 1, 2014, the Ekati mine leases became subject to the *Northwest Territories Lands Act* and the *Northwest Territories Lands Regulations*.

Table 11 Surface Leases

Surface Lease	Size (ha)	Area
76D/9-3-2	1,121.2	Misery Pit, facilities and road
76D/9-4-2	12	Misery Facilities
76D/10-2-2	6,023	Koala, Panda and Fox Pits and facilities
76D/10-3-2	3,701	Long Lake Containment Facility
76D/10-4-2	110	Airstrip and facilities
76D/15-4-2	998	Sable Pit and facilities
76D/10-5-2	155	Main Camp
76D/10-7-2	324.6	Pigeon Pit and facilities
76D/9-10-1	186.4	Lynx Waste Rock Storage Area
76D/9-11-1	173.1	Lynx Pit and road
Total	**12,804.3**	

4.1.2 Land Use Permits

Dominion Diamond Mines ULC currently holds 11 Type A Land Use Permits with the Wek’èezhìi Land and Water Board related to activities at the Ekati Diamond Mine. These Land Use Permits are all listed in Table 12.

Table 12 Land Use Permits

Type A Land Use Permit #	Activity Covered	Issue Date	Expiry Date
W2018C0005	Mineral Exploration, Winter Road Construction, Camp, Fuel Storage, and Associated Activities	October 24, 2018	October 23, 2023
W2013D0006	Lynx Pit and Access Road	April 30, 2014	April 29, 2021
W2015D0005	Lynx Waste Rock Storage Area	June 5, 2015	June 4, 2022
W2014I0001	Misery Powerline	August 11, 2014	August 10, 2021
W2016D0003	Sable Pit and Associated Activities	May 12, 2016	May 11, 2021
W2016D0005	Pigeon Pit and Associated Activities	July 19, 2016	July 18, 2021
W2016F0006	Pigeon and Sable Haul Road	July 19, 2016	July 18, 2021
W2016F0007	Jay Development (Early Works)	July 19, 2016	July 18, 2021
W2013D0007	Jay Pit	May 29, 2017	May 28, 2022
W2017J0003	Jay Project Culture Camp	June 20, 2017	June 19, 2022
W2017D0004	Misery Underground Activities	July 12, 2018	July 11, 2023

On March 29, 2019 the Board extended Land Use Permit W2013D0006 for Lynx Pit and Access Road by two years to April 29, 2021. On July 16, 2019 the Board extended Land Use Permit W2014I0001 for the Misery Powerline by two years to August 10, 2021.

Throughout 2019, Dominion complied with the Land Use Permits and Surface Leases the Ekati Diamond Mine operates under. The GNWT Department of Lands Water Licence and Land Use Permit inspection reports are a matter of public record.

4.1.3 Fisheries Act Authorizations

Ekati Diamond Mine has five applicable Fisheries Act Authorizations (FAAs; Table 13). These Authorizations provide approval to conduct work that results in the harmful alteration, disruption or destruction of fish habitat. See Section 2.2.3 of this report for further details on these Authorizations. Three of the five FAAs have been closed in 2018 and 2019 (SC99037, 15-HCAA-00266, and SCA96021) with offsetting commitments extending beyond the valid authorization period for SC99037 and 15-HCAA-00266. Fisheries Act Authorization SCA96021 was closed in 2019 due to completion of works described in the Authorization and confirmation from Fisheries and Oceans Canada that conditions described in the FAA have been met (i.e., completion of the corresponding compensation work on Panda Diversion Channel). Two FAAs remain active or are in the process of closure (SC00028 and SC01111).

Fisheries Act Authorization #15-HCAA-00266 was closed-out in January 2019 as per Dominion's request following completion of works described in the Authorization, specifically, the dewatering of Lynx Lake. The remedial work in Pike Creek was completed in late summer 2018 and the monitoring of the habitat improvement of Pike Creek is the only outstanding requirement under the Authorization. Monitoring is scheduled for completion in years 1, 4, 8 and 10 and are due in 2021, 2022, 2026 and 2028, respectively. Year 1 post-construction monitoring at Pike Creek was originally scheduled for 2019 but was postponed to 2021 when it is expected that access to Pike Creek will be feasible again.

Fisheries Act Authorization #SC99037 was closed out in December 2018 as per Dominion's request following completion of works described in the Authorization, specifically the loss of reaches 3 and 4 of Pigeon Stream. Pigeon Stream Diversion (PSD) was designed and constructed as compensation for the habitat loss in Pigeon Stream. Years 1, 2, and 4 of monitoring were completed in 2014, 2015, and 2017 with year 7 scheduled for 2020. With the reduced workforce and Territorial Government restrictions on incoming travel to the Northwest Territories, year 7 monitoring will be postponed to 2021.

Table 13 Department of Fisheries and Oceans Fisheries Act Authorizations

DFO FAA #	Activity Covered
SC00028	• Developing King Pond into a minewater settling facility
SC01111[1]	• Construction of a dike in Desperation-Carrie stream • The use of Desperation Pond for Waste Rock placement, sedimentation, and water management associated with the development of Misery Pit

[1] FAA closure was requested due to completion of works described in the Authorization, including the dyke construction in Desperation-Carrie Stream and the use of Desperation Pond for Waste Rock placement, sedimentation, and water management, associated with the development of Misery pit. The dyke construction in Desperation-Carrie Stream was completed in 2002.

4.2 Results and Findings of Studies and Research Conducted in the Preceding Year (Clause 5.1.a.ii)

In 2019, several studies and research projects were conducted at the Ekati Diamond Mine. A brief summary of the studies is provided in the following sections.

4.2.1 Aquatic Effects Monitoring Program

Please refer to Appendix D for a summary of the results from the 2019 AEMP that is in accordance with Part J of the W2012L2-0001 Water Licence.

4.2.2 Aquatic Response Framework

The Ekati Diamond Mine Aquatic Response Framework (ARF), Version 3.0, was submitted to the Board on March 9, 2018 and included the updated proposed fluoride benchmark and addressed Directives related to the ARF provided in the Decision on the nitrogen, selenium, potassium, and fish Response Plans. Version 3.0 of the ARF was approved on November 19, 2018 along with the fluoride water quality benchmark. The following Response Plans or Response Plan updates were submitted or approved during 2019:

- Potassium Response Plan Version 3.0 (approved on December 19, 2019)
- Chloride Response Plan Version 2.1 (approved with additional direction on October 16, 2019)
- Dissolved Oxygen Response Plan Version 1.2 (approved on January 24, 2019)
- Fish Response Plan Version 2.0 (currently under review; response to comments due on April 20, 2020)
- Total Phosphorus Response Plan Version 2.0 (update to be submitted before November 16, 2020)

4.2.3 Reclamation Research

A summary of 2019 reclamation and closure research is provided in Section 4.2 of Appendix F – Reclamation and Closure Progress Report. Findings from the reclamation and closure research activities and highlights of ongoing research are provided below.

LLCF Reclamation Research

The following research efforts were undertaken in the LLCF in 2019:

- Surface water management research through trial channel construction and further bio-engineering of existing channels;
- Expanded implementation of rough and loose mounding through depressions as erosion mitigation;
- Seeded 2.2 hectares of Cell B with annual grasses as companion crops (Triticale and Fall Rye);
- Establishment of topsoil propagule islands utilizing topsoil material from Pigeon;
- Monitoring of existing species trials and investigation into optimal planting strategies;

- Use of indigenous mycorrhiza to evaluate their potential to enhance vegetation growth;
- Expanding of trials to evaluate the feasibility of using organic matter generated from the Ekati mine composter facility;
- Collecting of native plant seeds around Ekati mine for future seeding efforts and trials;
- Establishment of vegetation trials utilizing seed and seedlings collected from Kugluktuk in 2018; and
- Fertilization of trial areas within the boulder field

Ekati Waste Rock Seep Hydrology Monitoring

A flow monitoring program was initiated at Ekati mine to evaluate seasonal variability in Panda-Koala and Pigeon WRSA seepage rates. Two weirs were installed with pressure transducers and conductivity probes, downstream of the Pigeon WRSA at SEEP-389 and the Panda-Koala WRSA at SEEP-018B. Data were collected over a two-month period during the open-water season of 2018, from July 12 to September 6, and over a 3-month period during 2019, from June 23 to September 5. The memo in Appendix E presents the design, installation, and results from two flow monitoring stations, which collected continuous water level measurements during the 2018 and 2019 open-water seasons, in seepage channels downstream of the WRSA. Monitoring locations selected for the program were SEEP-018B downstream of the Panda-Koala WRSA, and SEEP-389 downstream of the Pigeon WRSA.

SEEP-018B flows were correlated with air temperature as well as localized fluctuations from rainfall events. Increases in flow produced a mirrored decrease in specific conductivity levels, suggesting the melt water and direct precipitation provided dilution to the WRSA seepage. Rainfall events have a longer lasting effect in SEEP-389 flows. Specific conductivity steadily increases over time as flows decrease but were diluted and decreased during the higher rainfall periods. This is likely to be linked with the age of the Waste Rock storage areas since the Pigeon WRSA is still an active area and is much newer than the Panda-Koala WRSA. Continued monitoring is required before comprehensive conclusions can be drawn regarding the WRSA seepage seasonality and rates.

Pigeon WRSA GTC Install

Waste Rock from the Pigeon Pit is comprised primarily of mixed metasediment and granite-diabase. Operational acid-base accounting data for Pigeon Waste Rock indicates that the material is of uncertain acid-generating potential; this finding differs from results of laboratory-scale humidity-cell tests conducted using core-sample charges, which identified that the rock was potentially acid generating. The scope of the proposed research project is to re-assess the acid-generating and metal-leaching potential of Waste Rock from the Pigeon Pit through an integrated program of field-sample collection, laboratory experimentation and characterization, and reactive transport modelling. The Pigeon Waste Rock Storage Area Closure Cover Research Plan (RP 4) will look to provide critical insights into the potential long-term water quality impacts that may arise from Waste-rock weathering; and develop scaling relationships to predict contaminant release, transport, and attenuation in the field. The information will help determine acceptable closure strategy for the WRSA, specifically influencing whether the use of a thermal till cover at closure is necessary to manage metasediment.

Subsurface Flow Evaluation

Subsurface (groundwater) flow is a complicated interaction of processes in a heterogenous environment. It is further complicated in permafrost environments where frozen ground can restrict or impede groundwater movement. Dominion tasked Tetra Tech with providing a general overview of groundwater processes, particularly as they relate to the areas surrounding the WRSAs. Site-specific variances can be expected and will require individual consideration. The investigation was limited to subsurface flow through the active layer and does not address deep groundwater movement underlying the permafrost. The Conceptual Subsurface Flow memo is available in Appendix F. The work completed indicates that surface flow is considered the likely transport mechanism for most seepage from the Waste Rock piles at the Ekati site and only a limited quantity is transmitted via subsurface flow. This conclusion is supported by site observations and established permafrost hydrology:

- During freshet most surface water and seepage occurs overland when the active layer is still frozen;
- Measured hydraulic conductivities are low to moderate and calculated flow velocities are far less than associated surface flow velocities;
- Surficial geology shows the Waste Rock piles are surrounded by glacial material whose seepage potential is far less than from overland flow potential;
- EM surveys show subsurface flow velocities around the Waste Rock piles to be relatively slow; and
- WRSA seepage is typically observed as ponding water at the toe or as visible surface flow.

Vegetation Monitoring

In support of vegetation reclamation research, annual vegetation monitoring activities are completed at various sites. Vegetation monitoring activities completed in 2019 are summarized in the Ekati Diamond Mine 2019 Vegetation Annual Report and included the following vegetation reclamation sites:

- Fay Bay
- Paul Lake Laydown
- Old Camp
- Misery topsoil storage stockpile

Jay WRSA Co-Placement Study

The study design was developed to meet the requirements of the Ekati mine Water Licence amended to include the Jay Project. The overall objective of the co-placement study design is “to optimize the co-placement strategy, determine the target NP/AP [neutralization potential/acid potential] ratio and identify the scale of mixing that will prevent Acid Rock Drainage from the Jay Waste Rock Storage Area.”

To date, a laboratory-scale geochemical testing program has been undertaken to determine the effective NP of blasted Waste Rock from the Ekati Diamond mine including material characterization, detailed mineralogical analysis, and laboratory leach testing. Leach testing is ongoing with results to be included within a future Effective Neutralizing Potential Report. A report providing preliminary laboratory results and an updated Jay WRSA Co-Placement study design is planned to be provided in 2020.

4.2.4 Dust Suppression

With an intent to continually improve environmental practices, and to address comments and concerns received from community members, regulators, and the Independent Environmental Monitoring Agency (IEMA), Dominion undertook an Envirokleen pilot study in 2015 and expanded on the pilot study from 2016 - 2019 to investigate ways to improve dust suppression practices at the Ekati Diamond Mine. Dominion is committed to this advanced dust mitigation study through Measure 6.2(a) of the Jay Project Report of Environmental Assessment.

In 2019, the entire Sable Road and Pigeon Haul Road to the intersection of Misery Road were treated, with the exception of the buffer areas surrounding waterbodies. The application of this dust suppressant on Sable Road in 2019 offered a unique opportunity to test the effectiveness of Envirokleen on a newly surfaced road, free of previous applications of other dust suppressant, which will have increasing traffic demands in the coming years.

Results to date suggest that EnviroKleen is an effective dust suppressant, able to maintain a sustained suppression of dust with repeat applications over the year and, to some degree, between years. The efficacy of EnviroKleen appears similar to that of DL-10 and water, although each of these has limitations; for water, the frequency of application needed and the subsequent loss of road fines, and for both DL-10 and EnviroKleen, the fact that these surfaces break down with heavy use and road grading. It has been anecdotally observed that this break-down of chemical dust suppressant occurs more quickly with DL-10 than with EnviroKleen, but this difference has not been systematically quantified and is confounded by differences in weather conditions and road use from year to year.

Soil sampling has shown that EnviroKleen may be transported off the road to a distance of at least 10 m, although it is not anticipated to cause harm to aquatic life due to the applied buffers, insolubility in water, and the fact that it is non-toxic in low concentrations. There are opportunities to improve the efficacy of EnviroKleen through modification in application techniques (e.g., pre-application road watering as well as more frequent re-application events) as well as road maintenance protocols (e.g., use of materials with higher fines content and selective grading and spot-repair).

The year 2019 marked the fifth and final year of the pilot program. Lessons learned and best management practices for applying the alternative dust suppressant product, including topics on road preparation and pre-treatment, application schedule and execution, ongoing road maintenance, product longevity, and measuring effectiveness, are provided in the Dust Suppression Pilot Study Report 2018/2019 (DDM 2020).

4.3 Results and Findings of Environmental Monitoring Programs (Clause 5.1.a.iii)

4.3.1 Ambient Water, Including Quality, Hydrology, Lake and Stream Ecology, and Groundwater

2019 Aquatic Effects Monitoring Program

Please refer to Appendix D (2019 Aquatic Effects Monitoring Program Summary) in accordance with Part J of this Licence.

4.3.2 Climate at the Permanent Camp

Meteorology

The meteorological monitoring program includes the operation of the Koala automated meteorological station that has been in continuous operation since 1993. The Koala station operates year-round and continuously monitors wind speed and direction (at 10 m height), air temperature, humidity, total precipitation, and snow depth.

The Polar Lake micrometeorological station is operated during the open-water season. In 2019, the station was installed on July 14 and removed on September 21. Dates with complete days of data included July 15 to September 20. The station included sensors for measuring wind speed, air temperature, humidity and water temperature all at two different heights, and measuring wind direction, solar radiation, net radiation and rainfall at one height above the water. Data from this station were used to calculate open-water evaporation (Table 17).

Manual snow course surveys are typically completed near the end of each winter period in April. In 2019, seven snow course surveys were completed between March 27 and April 3. Each snow course survey sample location involved the collection of ten cores along a snow course, measured over a 100 m distance. Each snow core was collected using a Federal Snow Sampler (or metric equivalent) that measures the snow depth and extracts a snow core to determine the snow-water-equivalent (SWE) using the mass. Snow density is calculated by dividing the SWE by snow depth.

Table 14 Mean Monthly Air Temperatures (°C) at the Koala, Polar Lake, and Regional Meteorological Stations

Month	Koala	Polar Lake[1]	Kugluktuk	Bathurst Inlet Climate Station	Yellowknife
2018					
October	-7.7	-	-6.7	-6.0	-2.3
November	-20.4	-	-17.7	-18.9	-13.3
December	-21.1	-	-19.9	-20.4	-18.6
2019					
January	-29.8	-	-29.8	-29.1	-25.7
February	-28.9	-	-25.1	-27.9	-26.0
March	-16.8	-	-16.3	-16.3	-9.6
April	-15.1	-	-18.0	-16.5	-4.7
May	-5.0	-	-4.6	-4.0	3.5
June	7.0	-	4.6	4.3	12.4
July	11.1	12.4[1]	9.5	9.5	15.2
August	9.3	9.1	8.5	10.3	12.4
September	4.8	6.0[1]	3.6	4.1	7.6
Mean[2]	**-9.4**	**-**	**-9.3**	**-9.2**	**-4.1**
Normal	**-10.8[3]**	**-**	**-10.3[4]**	**-**	**-4.3[4]**

Notes:

[1] Polar Lake station data from July 15 to September 20, 2019
[2] Mean of October 2018 to September 2019 monthly values
[3] Data source: BHP and Dia Met 2000
[4] Data source: ECCC 2019b

Table 15 Summary of 2019 Snow Surveys

Site Name	Location	Sample Date	Mean Depth of Snow (cm)	Mean SWE (mm)	Mean Density (%)	Koala Station Daily Mean Snow Depth (cm)
M-1	Vulture	29-Mar-2019	41.0	10.2	24.0	8.1
M-2	Grizzly	31-Mar-2019	39.6	9.3	20.7	8.1
M-4	Slipper	3-Apr-2019	32.1	6.2	18.4	8.0
M-6	Paul	3-Apr-2019	53.7	15.6	26.8	8.0
M-7	Fox	3-Apr-2019	52.0	12.1	22.8	8.0
M-8	Big Hill	3-Apr-2019	25.6	3.7	14.3	8.0
M-12	Eagle	27-Mar-2019	44.3	11.0	23.1	8.0
Mean[1]			**41.2**	**9.7**	**21.4**	**8.0**
Koala Mean[2]			**38.1**	**8.3**	**20.0**	**N/A**

Notes:
[1] Mean for all the sampling stations with available data
[2] Mean for the 5 stations that are within the Koala watershed (M-1, M-2, M-4, M-7, M-8)

Table 16 Monthly Precipitation (mm) at the Koala Station, Polar Lake Meteorological Stations, and Regional Stations in 2018/2019

Month	Total Precipitation (mm)					
	Koala Station (Unadjusted)	Koala Station (Adjusted[1])	Polar Lake Station[2]	Kugluktuk Airport	Bathurst Inlet Climate Station	Yellowknife Airport
2018						
October	8.6	11.9	NA	16.0	9.8	10.1
November	6.7	8.1	NA	5.6	9.0	22.8
December	2.4	2.9	NA	22.5	7.1	2.9
2019						
January	2.8	4.0	NA	7.4	5.8	17.9
February	2.2	3.3	NA	12.8	4.7	2.2
March	6.5	9.1	NA	7.2	3.4	1.4
April	5.7	10.9	NA	15.6	11.6	22.0
May	4.6	6.7	NA	7.2	12.8	16.2
June	19.3	20.2	NA	22.6	41.1	49.4
July	58.2	58.2	6.6	39.1	108.9	33.6
August	99.2	99.2	105.7	45.0	119.6	51.7
September	29.3	37.0	21.3	21.1	21.7	41.5
12 Month Total	**245.5**	**271.7**	**-**	**222.1**	**355.5**	**271.7**
Normal	**345.0[3]**	**345.0[3]**	**-**	**247.2[4]**	**-**	**288.6[4]**

Notes:
Dashes (-) indicate data not available at time of reporting.
NA indicates data not available (station not operational).
[1] Adjusted precipitation corrects for wind undercatch
[2] Polar Lake station data from July 15 to September 20, 2019
[3] Data source: BHP and Dia Met 2000
[4] Data source: ECCC 2019b

Table 17 2019 Penman Method Open-Water Evaporation (mm) at Polar Lake

Month	Penman Method Open Water Evaporation (mm)		Priestly-Taylor Method Open-Water Evaporation (mm)	
	Measured[1]	Gap-Filled	Measured[1]	Gap-Filled
July	63.3	115.5	62.8	114.5
August	53.8	53.8	50.8	50.8
September	27.2	40.8	24.6	36.9
Total	**144.4**	**210.1**	**138.2**	**202.2**

Net radiation data from August 2 to September 20 were erroneous due to sensor wire damage and data were gap-filled (see Table 3.1-8). The net radiation parameter is the most important parameter in the Penman and Priestly-Taylor evaporation equations.

[1] *Polar Lake station measured data available from July 15 to September 20, 2019*

Ambient Air Quality

The Ekati Diamond Mine Air Quality Monitoring Program (AQMP) is comprised of the following components:

- air emissions and GHG calculations
- monitoring of total suspended particulate matter (TSP) and particulate matter with aerodynamic diameter less than 2.5 µm ($PM_{2.5}$)
- continuous ambient air quality monitoring of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), nitric oxide (NO), and nitrogen oxides (NO_X)
- monitoring for total dustfall, acid deposition, and metal deposition
- snow chemistry sampling
- lichen tissue monitoring

Emissions calculations, TSP, and $PM_{2.5}$ monitoring have been conducted yearly since the start of the program in 1997, while snow and lichen sampling have been conducted every three years. Continuous ambient monitoring has been performed continuously since the beginning of 2008 and is housed within the Continuous Air Monitoring Building (CAMB). Air Quality Monitoring Program results are reported every three years. The most recent AQMP report was issued in April 2020 for the 2019 reporting period. A summary of the 2019 AQMP report is provided in Appendix G.

Stationary Emission Sources

Dominion reports GHG emissions to the Environment and Climate Change Canada (ECCC) Greenhouse Gas Emissions Reporting Program. Reported GHG emissions are based on diesel consumption from the mobile fleet, aviation, power generation, heating, blasting, incineration, and non-motive fuel consumption such as crushers, compressors, and pumps. Dominion also reports estimated emissions from the sewage treatment plant, the in-vessel composter and used oil consumption. Greenhouse gas emissions for the Ekati Diamond Mine totaled 165,458 tonnes CO_2 equivalent (CO_2 e) in 2019, which is a decrease of

55,875 tonnes from what was reported to ECCC for 2018. A breakdown of 2019 emissions as compared to 2018 emissions is provided below in Table 18.

Table 18 2019 Greenhouse Gas Emissions

Emission Source	2019 Emissions (tonnes CO_2 e)	2018 Emissions (tonnes CO_2 e)	% Decrease	Reason for Variability
Stationary • Heating • Power • Non-motive • Waste Oil	86,785	116,670	25.61 %	Decrease in heating demands in 2019 vs. 2018 due to closure of some outbuildings and decreased use of Waste oil for UG heating
Industrial • Blasting	1,370	2,046	33.04 %	Decreased mining activity in 2019 vs. 2018 based on mine plan
Transportation • Motive • Helicopter	77,230	102,507	24.66 %	Transition to larger equipment (CAT 793 and DPRT vs. CAT 777 and Haulmax) as well as decreased mining More efficient hauling practices (stockpiling ore near pit, hauling to Process Plant with DPRT)
Waste • Incinerator biomass **(does not include diesel consumption)** • Composter	41	65	36.92 %	Reduced camp occupancy due to Koala Underground closure, reduction in number of site projects, and improved mine planning.
Wastewater	32	45	28.89 %	Reduced camp occupancy due to Koala UG closure, reduction in site projects, and improved mine planning.

4.3.3 Wildlife, Including Caribou and Bears

Wildlife Effects Monitoring Program

The Wildlife Effects Monitoring Program (WEMP) monitors wildlife and documents wildlife effects resulting from mining development and associated activities at the Ekati Diamond Mine. The WEMP also assesses the effectiveness of wildlife mitigation and management efforts. The program focuses on animal species identified as species of greatest concern, termed Valued Ecosystem Components (VEC; e.g., caribou, grizzly bear, wolf, and wolverine).

More information is provided in Appendix H, Wildlife Effects Monitoring Program Summary.

Caribou

In 2019, there were incidental observations of 9,507 caribou on 119 separate days within the Ekati Diamond Mine study area. The majority of caribou (88%) were incidentally observed within the winter period (January 1 to April 14, 2019 and November 1 to December 31, 2019) and incidental observations likely included same caribou individuals or groups recorded on multiple occasions. The remaining observations were made during the spring migration (9%), the summer period (2%), and the fall migration period (0.3%). Across all observations, sex or age was assigned to 196 individuals; 32% were identified as bulls, 56% as cows, 1% as calves and 11% as yearlings.

Zone of Influence Monitoring

As per Jay Project EA Measure 6.5, Dominion has committed $500,000 of funding towards Zone of Influence (ZOI) monitoring between 2018 and 2020. Dominion has also developed a collaborative research program incorporating Traditional Knowledge designed to identify the causes of the Bathurst herd's ZOI for caribou avoidance and has sourced funding for both community-based traditional knowledge and western science investigations towards this cause. Dominion held an initial workshop in December 2017 with land users and Traditional Knowledge holders to build key elements in the design of the research program and the work plan was further developed during a meeting with IBA Communities on September 12, 2018. Further work on these initiatives was deferred in 2019 while the Jay Project continued to undergo an optimization study. Dominion also supports cumulative effects assessment and management initiatives by the GNWT, through participation in the Zone of Influence Technical Task Group, which is tasked with determining the most effective methods for future monitoring of caribou distribution near mine sites. Dominion has agreed to provide funding ($250,000) for studies to determine the key drivers of the magnitude and spatial extent of the ZOI. In November 2019, Dominion provided in-kind support for caribou surveys conducted by ENR.

Grizzly Bear

A total of 252 grizzly bears were recorded incidentally over 74 separate days in 2019. The earliest spring sighting was on May 4, 2019, and the last grizzly bear sighting prior to winter was recorded on October 26, 2019. Multiple animals or family groups were observed on 48 occasions in 2019, including adult females with up to two cubs. The number of grizzly bear sightings (161) and family groups (48) observed in 2019 is the highest since Dominion began recording grizzly bear incidental sightings in 2001.

4.3.4 Traditional Knowledge Projects and Community Outreach

Multiple Traditional Knowledge (TK) projects and TK preservation programs occurred throughout 2019. The programs that Dominion supports vary year-to-year based on requests from communities and annual reviews. No long-standing programs were discontinued by Dominion in 2019. The following is a list of assessments, and the development and implementation of 2019 projects:

- March 2019: *YKDFN Caribou Monitoring Program.* This project converted YKDFN's archive of barren-ground caribou TK into an online database where it is now readily available to be used at the community's discretion. The project worked with community members to lay the groundwork for a future caribou monitoring program linked to the database using cutting edge technology but led by and based upon YKDFN TK.
- March 2019: *FRMC/DKFN – Dog Derby*. The Annual Dog Derby is thought of as a celebration of warmer weather coming after a long cold winter in Fort Resolution. The community continues to honor the local traditions of dog racing.

- March 2019: *Canadian Championship Dog Derby*. The Canadian Championship Dog Derby is a tradition dating over sixty years, representing the resilience of a sport and trade that shaped the Canadian North. After sixty years of showcasing the skills that dogs acquired on traplines, helping their owners feed and shelter their families, the Derby is now a world-class event celebrating traditional knowledge, athleticism, and endurance. The Derby challenges dog racers to take on the harsh conditions of the Canadian Arctic in a three-day series of races.
- March to July 2019: *Sable, Lynx, and Pigeon Pit Raptor Surveillance Team.* This program provided the opportunity for local Impact Benefit Agreement (IBA) Community Members to become familiar with the Ekati Diamond Mine environmental monitoring programs. Participants provided surveillance of raptors that attempted to establish nests close to the Misery, Lynx, Pigeon, and Sable Pits.
- April 2019: *LKDFN – Caribou Monitoring Program.* The Lutsel K'e Wildlife, Lands, and Environment Department have been working closely with Environment and Natural Resources of NWT. Local monitors snowmobiled from Lutsel K'e to Yellowknife and ENR hauled their snowmobiles and equipment up the winter road to do the Bathurst Caribou Monitoring. Drybones Lake was selected by ENR as the only location where Bathurst caribou are not mixed with other herds.
- April 2019: *Kugluktuk Youth & Elder's Language Video Project.* The project supports youth to connect with and learn more about their Elder's, traditional wisdom, culture, history and language through short films while earning school CTS credit. The Films recorded traditional songs and storytelling from local community Elder's.
- April 17, 2019: *Fort Smith Fisheries Act Engagement.* The was a community engagement meeting to discuss the Fisheries Offsetting project regarding the Jay Project at the Ekati Diamond Mine.
- May 2019: *On-the-Land Collaborative*. The NWT On-the-Land Collaborative provides funding, resources, and support for programs that centre around land-based education and cultural revitalization. Youth engagement is a very important component of these programs, as is the development of skills and knowledge that enhance community strength and resiliency.
- June 2019: *NSMA, National Indigenous People's Day.* Annually, the North Slave Métis Alliance hosts the Indigenous People's Day in Yellowknife. The event brings hundreds of people around the city to celebrate the traditional lifestyles of all the cultures across the NWT, including the Dene, Inuit and Métis traditions.
- June 2019: DKFN/FRMC, *National Indigenous People's Day.* Annually, Fort Resolution Métis Council hosts traditional activities for National Indigenous People's Day in Fort Resolution. The event brings local activities such as a fish fry and TK activities to celebrate the traditional Métis lifestyle for all community members.
- July 2019: *Tłı̨chǫ Government – Whatì, Justice Program*. The community government's Justice Program empowers youth with a life skills program, which promotes positive values, healthy choices, education and employment through traditional cultural practices. The program includes a boat trip that encourages the community youth to learn their Tłı̨chǫ traditional and culture way by participating in hunting and fishing.
- July 2019: *Gamètì Sewing Program*. The program featured hands-on classroom instruction with the objective of providing local residents with the continued experience of improving their sewing

skills. Teaching community members modern sewing techniques with modern sewing machines has given many members the skills to enhance their traditional sewing skills.

- August 2019: *Tłįchǫ Government – Whatì, Sewing Program*. The community government's sewing program is a significant project to preserve and teach the Tlicho language, culture and way of life. Whati Elder's teach and share their knowledge and expertise on traditional skills of sewing to young girls in the community.
- July 2019: *DKFN – Cultural Week*. Fort Resolution community members gather at Mission Island for a week-long event of cultural activities that encourage traditional knowledge sharing. This includes bannock making, drymeat and dry fish making, setting nets and snares, cleaning fish and other traditional knowledge activities.
- August 2019: *YKDFN – Cultural Cabin*. Dechįta N owo requires a more permanent structure on the land that is accessible by road, and therefore easier to access year-round. We are looking to build a cabin off Highway 3 as a permanent camp for use by both the adult students and youth, as well as other community members from the YKDFN. Having a permanent camp set up will enable Dechįta N owo to take adult and youth students out on the land more often to learn about traditional economies and environmental monitoring.
- August 2019: *Hamlet of Kugluktuk – Sewing Program.* The sewing classes allow community members to learn lifelong sewing skills that will allow them to contribute to Nunavut's land-based economy. It gives community members a culturally strong foundation to learn and grow their traditional knowledge and skills from local Elder's.
- August 2019: *Hamlet of Kugluktuk – Youth & Elder's Program*. Kugluktuk's Youth and Elders Program operates out of the local Elders Centre ("Inuhaat Ilihakviatmade") and offers the opportunity for community members (children and young adults) to participate in cultural activities, with assistance from our community's elders. Program activities include, Elder's gathering, storytelling/cultural teachings, traditional games, drum making/dancing instruction, preparation of country foods with ulus.
- September 2019: *Whatì Youth Hand Games Program*. Over the course of three months, the program preserved TK skills by teaching youth how to drum and play hand games during a weekly practice. The program not only taught hand games but it taught the youth the importance of maintenance and care of the traditional drum and how to repair them.
- November 12, 2019: *YKDFN Fisheries Offsetting Options Engagement.* This is a community engagement meeting to discuss the Fisheries Offsetting options for the Jay Project at the Ekati Diamond Mine.
- December 2019: *Ekati Plus School Partnership Program*. This program allows each Impact & Benefit Agreement (IBA) Community school to identify areas within their school curriculum that could use additional financial assistance. Some of the schools used funds towards enhancing their educational, extracurricular and cultural programs by purchasing literature, bookshelves, camping equipment, material to build a gazebo as a cultural activity space and snowmobiles for easier access to traditional land use areas.
- December 2019: *Tłįchǫ Government – Boots on the Ground*. The Tłįchǫ Government Boots on the Ground Caribou Monitoring Program is based on the TK of indigenous Elders and harvesters across the Tłįchǫ region.

4.3.5 Reclamation, Including Re-vegetation Success, Soils Suitability, and the Diversity and Density of Plants

The 2019 Ekati Vegetation Annual Report is presented in Appendix G of the 2019 Closure and Reclamation Progress Report. Details on Reclamation Research work conducted in 2019 are located in the Closure and Reclamation Progress Report (Section 4: Reclamation Research and Appendix F: 2018 LLCF Research Report).

The 2019 Closure and Reclamation Progress Report (including the 2018 LLCF Research Report and 2019 Vegetation Annual Report) can be found in Appendix F of this report.

4.3.6 Esker Disturbances

No eskers were disturbed in 2019.

4.3.7 Vegetation, Including the Loss of Habitat

From January 1, 2019 to December 31, 2019, 78.9 ha of additional surface area of habitat were disturbed at the Ekati Diamond Mine due to mine development, including continued development of Lynx, Pigeon, and Sable Pits and associated Waste Rock Storage Areas. A total of 3,897.7 ha of habitat have been lost by development of the project footprint since 1997, or 2.5% of the total pre-development habitat in the study area.

Some of the habitat loss will be mitigated as reclamation activities will be undertaken following mine closure.

4.3.8 Permafrost

The monitoring of permafrost response to operations at the Ekati Diamond Mine occurred from July 16-19, 2019 as part of the annual geotechnical inspection. The annual geotechnical inspection of the completed water retaining structures on site was conducted, and nine structures were visually assessed: Panda Diversion Dam, Long Lake Outlet Dam, Intermediate Dike B, King Pond Dam, Waste Rock Dam, Desperation Pond Cofferdams, Bearclaw Diversion Dam, Intermediate Dike C, and Two Rock Dam and Filter Dike. Each review consisted of visual observations and collection and review of ground temperature and settlement survey data, where possible. The results of this inspection are presented in Appendix I: 2019 Annual Geotechnical Inspection Executive Summary.

4.4 Summary of Operational Activities during the Reporting Year (Clause 5.1.a.iv)

4.4.1 Koala Watershed

The Koala Watershed contains the PDC and the majority of the Ekati Diamond Mine infrastructure including the main camp, the process plant, the LLCF, and the airstrip, as well as the Panda, Koala, Koala North, Fox, and Beartooth pits with associated WRSAs. The following major activities took place in the Koala Watershed during the 2019 AEMP period (October 1, 2018 to September 30, 2019):

Mining Activities

- No open pit or underground mining activity.

- Stockpiled kimberlite ore from Koala Zone 6 (north area of Koala WRSA) was hauled to the process plant.
- Stockpiled kimberlite ore from the Fox low grade pile (northwest area of the Fox WRSA) was hauled to the process plant.

Dewatering and Discharge

- Approximately of 3,031,000 m^3 of water was Discharged from the LLCF to Leslie Lake from July 20 to August 29, 2019. Results of the pre-approval and Discharge samples indicate that water quality was below the Effluent Quality Criteria (EQC) in Water Licence W2012L2-0001 between July 20 and August 29, 2019.
- Freshwater sourced from Grizzly Lake for use at main camp continued. The total volume of water drawn from Grizzly Lake (including for use in the underground) was approximately 85,000 m^3.
- Approximately 22,200 m^3 of water was Discharged from Fox Berm Pond to South Fox Lake 2 from July 15 to August 2, 2019. Results of the pre-approval and Discharge samples indicate that water quality was below the EQC in Water Licence W2012L2-0001 between July 15 and August 2, 2019.
- Approximately 224,500 m^3 of water was pumped from Bearclaw Lake to North Panda Lake from July 31 to September 30, 2019.

4.4.2 King-Cujo Watershed

The King-Cujo Watershed contains the KPSF, as well as a portion of the Misery Camp and Misery WRSA. The following major activities took place in the King-Cujo Watershed during the 2019 AEMP period (October 1, 2018 to September 30, 2019):

Mining Activities

- Mining was completed in Lynx Open Pit.
- Kimberlite ore from Lynx Pit and stockpiled kimberlite ore from the Misery Ore Storage were transported to the process plant.
- Misery Underground Development mining began in July 2018 and continued through 2019. Misery Waste Rock was transported to the Misery WRSA.
- Misery Underground Production mining began, with the first production blast in ore in June 2019, and is continuing.
- Making a change from ammonium nitrate (AN)/fuel oil to emulsion for Development mining in the near future. This will help reduce nitrates in the mine water.

Dewatering and Discharge

- Misery Pit dewatering began late June 2019 to the KPSF and was completed in summer 2019. Pumping was completed through the existing 12-inch high-density polyethylene line.
- A temporary dewatering system was established within Misery Underground, which includes two sumps and a mud tank.

- The permanent dewatering system (mud wizard) will be completed Fall 2019 in Misery Pit. The mud wizard removes the suspended solids from the mine water, improving water quality prior before pumping to KPSF.
- Water was pumped from KPSF to Lynx Pit using the existing 12-inch HDPE uninsulated line.
- There was no Discharge from the KPSF to Cujo Lake in 2019.

4.4.3 Carrie Pond Watershed

The Carrie Pond Watershed contains a portion of the Misery Pit, the associated WRSA, and Desperation Sump. In 2014, as part of expansion of the Misery WRSA, the majority of Desperation Pond was encapsulated within the WRSA. The small area that remains is currently being utilized as a sump to collect Seepage and runoff from the Misery WRSA for management through the KPSF. Thus, no pumping from Desperation Sump to the Receiving Environment occurred during the 2019 AEMP period (October 1, 2018 to September 30, 2019).

4.4.4 Pigeon-Fay and Upper Exeter Watershed

The Pigeon-Fay and Upper Exeter Watershed contains the Pigeon Pit and the Pigeon Stream Diversion (PSD). The following major activities took place in the Pigeon-Fay and Upper Exeter Watershed during the 2019 AEMP period (October 1, 2018 to September 30, 2019):

Mining Activities

- Development mining continued at Pigeon Open Pit.
- Kimberlite ore from Pigeon was transported to the process plant.
- Pigeon Waste Rock was transported to the Pigeon WRSA.

Dewatering and Discharge

- Minewater from Pigeon Pit (sump) was transported to Beartooth Pit.

4.4.5 Horseshoe Watershed and Lower Exeter Lake

The Horseshoe Watershed contains the Sable Pit, Sable South WRSA, and TRSP. The following major activities took place in the Horseshoe Watershed during the 2019 AEMP period (October 1, 2018 to September 30, 2019):

Mining Activities

- Development mining continued at the Sable Open Pit.
- Kimberlite ore from Sable Pit was transported to the process plant.
- Sable Waste Rock was transported to the Sable South WRSA.

Dewatering and Discharge

- Sump water from Sable Pit was pumped or trucked to the TRSP.
- Approximately 1,400 m^3 was drawn from TRSP for road watering.
- There was no Discharge from the TRSP to Horseshoe Lake in 2019.

4.4.6 Other Watersheds

- Approximately 18,000 m^3 was drawn from Falcon Lake (approximately kilometre five along the Sable Haul Road) for road watering.

4.4.7 Waste Management

Version 6.0 of the Waste Management Plan was submitted on December 31, 2019 and is currently under Board review. The Waste Management Plan is the overarching Plan that includes the Landfill Management Plan, Hazardous Wastes Management Plan, Compost Management Plan, Hydrocarbon Impacted Materials Management Plan, and Incinerator Management Plan.

The in-vessel composter continues to be an effective means of organic Waste management at the Ekati mine. Organic Waste such as food scraps, paper, and cardboard are broken down in an agricultural mixer and conveyed into the in-vessel composter in batches. The composter completes one full rotation at one revolution per minute at set intervals throughout the day to aerate the organic material and provide optimal conditions for microorganisms. In 2019, the composter processed an average of 10,566 kg/month of organic Waste. This resulted in an estimated reduction of 13,575 L of diesel consumption per month.

The incinerators continued to operate as per the approved Incinerator Management Plan in 2019, though the use of the incinerators has decreased significantly as Dominion optimizes the use of the in-vessel composter. Dominion staff now only operate one incinerator at any given time, and usually only once every three to four days depending on the amount of Waste generated at site. The incinerators remain on a preventative maintenance plan with the manufacturer to inspect the condition of the chamber refractory, check system settings, and maintain proper fuel-to-air ratios in the burners. The second stack emissions test for the Ekati Diamond Mine incinerators was conducted in late 2016 and the results showed continued excellent performance of the units. Both units had emission concentrations were well below Canada Wide Standards for mercury and dioxins and furans.

The Waste Management Building continues to operate as a Waste transfer facility; collecting and processing hazardous Waste such as oily rags, aerosol cans, Waste grease, Waste oil, fuel filters, and other miscellaneous Waste. Hazardous Waste transferred off site is sent to KBL Environmental Waste transfer facility in Yellowknife, NT, where it is combined with Waste from other facilities and economies of scale allow for further recycling. In 2019 Dominion shipped 161,700 L of liquid Waste and 102,431 kg of solid Waste off site for disposal.

Landfill inspections are conducted daily by the Waste Management technicians, and results of the inspections are reported to the Superintendent of Site Services. The Environment Department conducts three landfill inspections and one Waste bin survey per week and reports results to the Team Leader – Environment Operations. Inspections are completed for compliance with the Waste Management Plan. The inspection outcomes are twofold: to measure the success of the communication to all Ekati mine staff of the expectations of Waste management, and to address any issues of non-compliance in a timely manner.

4.5 Actions Taken or Planned to Address Impacts or Compliance Problems Which Are Set Out in the Annual Report (Clause 5.1.a.v)

Dominion utilizes an adaptive management approach to identify potential future issues (through rigorous monitoring programs) and to develop action plans to address these potential future issues before they become impacts and/or compliance concerns. The following discussion is designed to provide an update on current adaptive management programs and highlight new initiatives.

4.5.1 Water Quality Exceedances

Dominion had multiple EQC exceedances in Seep-081 and Seep-081A over the summer of 2019 and was made aware of the exceedances as part of consultant summary of seepage data on November 15, 2019. As per Part B, Condition 18 of the Water Licence, Dominion informed the Board and Inspector of the non-compliance.

Dominion committed to two corrective actions in a letter to the Board and Inspector on November 26, 2019. Dominion installed four silt fences upstream of Seep-081 to mitigate high TSS. Dominion will also develop criteria and action levels for Cujo Lake focusing on protecting the Receiving Environment from seepage input sources.

Dominion also observed exceedances for Seep-019 (Panda-Koala WRSA North East) and Seep-373A (Fox WRSA North East) during the summer of 2019. These EQC exceedances were reported to the Board and the Inspector in a letter dated March 23, 2020. For Seep-019, a geochemical investigation determined that the dissolved aluminum exceedances resulted from an external source of aluminum from soils along the flow path. No corrective action is planned for this seep. For Seep-373A, a sample was collected after a significant rainfall on July 5th and showed exceedance for TSS. The seep was re-sampled on July 9th and showed no exceedance. Dominion committed to installing a silt fence upstream of Seep-373A as soon as possible in 2020 to protect the Receiving Environment in the event of a significant rainfall.

4.5.2 AEMP Sampling

On July 30, 2019 Dominion sent a letter to the Board and the Inspector informing of a non-compliance with the AEMP Design Plan. Water quality samples were not collected during freshet from three stream locations; 1616-30 (LLCF), 1616-43 (KPSF), and 0008-Sa3 (TRSP). The samples were not collected at these locations because Discharge was not taking place and field personnel assumed that no sample collection was necessary.

Dominion was served a Notice of Non-Compliance with Water Licence Part J, Condition 2 of W2012L2-0001 by the Inspector on August 19, 2019. The Inspector conducted a full inspection of the Environment Department's sampling program and sent an Update of Notice of Non-Compliance letter on October 10th. As per the letter, the Inspector found no indication of systematic failures with the sampling program or lack of due diligence on Dominion's part. There was no enforcement action related to this non-compliance.

Dominion has reviewed AEMP sampling requirements and protocols with field personnel, and Dominion does not anticipate similar non-compliances in the future.

4.5.3 Equipment Disposal

During the 2019 Winter Road season Dominion shipped several pieces of retired equipment off site. Most of the units were used for underground mining operations in Koala and Panda and were no longer needed on site. Retired equipment stored on site creates reoccurring issues with leakage in various storage areas across the Ekati mine and Dominion works to remove this equipment from site when the opportunity arises. The following equipment was sent off site in 2019:

- (1) Getman Lube Truck
- (1) Western Star Lube Truck
- (13) Minecat UG Mining Trucks
- (4) Minecat Service Trucks
- (1) Minecat Scizzor Deck
- (2) MacLean 928 Bolters

4.6 Summary of Operational Activities for the Next Reporting Year (Clause 5.1.a.vi)

Below is a summary of operational activities, as well as Waste and ore movement forecasts in wet metric tonnes (wmt), for 2020.

MUG Development

The following activities are scheduled to take place in 2020:

- Commercial production achieved in Q1
- Commissioning of main ventilation system achieved in Q1
- Construction of permanent services including the main underground power distribution center, underground compressors, main underground de-sliming and dewatering stations

Waste Movement

- Pigeon Waste: 2,764,451 wmt
- Sable Waste: 24,315,997 wmt
- MUG Waste: 99,050 wmt

Ore Movement

- Pigeon ore: 2,335,687 wmt
- Sable ore: 1,247,999 wmt
- MUG ore: 716,457 wmt

4.7 Lists and Abstracts of All Environmental Plans and Programs (Clause 5.1.a.vii)

Figure 7 provides all environmental plans and programs ongoing at the Ekati Diamond Mine. Dominion implements a number of environmental plans and programs at the Ekati mine site, all of which are interrelated (Figure 7). The results and components of environmental programs are driven directly and/or indirectly by the plans in place each with the overarching goal to protect land, air, water and wildlife.

Below is a list of 2019 environmental plans and programs with brief abstracts. Summaries of the plans can be found in the related appendices. Further detail on the environmental plans and programs can be found in the approved plans and/ or published technical reports.

4.7.1 Surveillance Network Program (SNP) W2012L2-0001 (formerly MV2009L2-0001 Koala Watershed, and MV2001L2-0008 Sable Pigeon Beartooth)

The SNP required in the Water Licence W2012L2-0001 outlines a series of monitoring stations within the Ekati Diamond Mine claim area. The SNP prescribes a sampling frequency for each station with a specific set of water quality parameters that are to be monitored. In addition, it requires monitoring and measurement of water pumping and Discharge volumes, fresh and recycled water use, sewage effluents, Waste Rock and ore production, and meteorological data. This information can be found in Appendix A of this report as per Schedule 1, Part B, Condition 1(j) of W2012L2-0001.

4.7.2 2019 Waste Rock and Waste Rock Storage Area Seepage Survey Report

As a condition of Water Licence W2012L2-0001, it is required to monitor WRSA seepage quality and characterize Waste Rock at the Ekati Diamond Mine. Findings of these monitoring programs are reported annually in the Waste Rock and Waste Rock Storage Area Seepage Survey reports (see Appendix B).

4.7.3 2019 Aquatic Effects Monitoring Program

The AEMP is a requirement specified in the Class A Water Licence (W2012L2-0001). The program is designed to detect changes in the aquatic ecosystem that may be caused by mine activities. The 2018 program included monitoring of the following physical, chemical, and biological components of the aquatic ecosystem: hydrology, physical limnology, lake and stream water quality, phytoplankton, zooplankton, sediment sampling, and lake and stream benthos, and fish health and community. Meteorological data are also reported in the AEMP because of their relationship to site hydrology. An extension request for the submission of the AEMP Annual Report was granted by the Board, and the 2019 AEMP report was submitted to the Board as per the requirements of Part J, Item 7 in the Water Licence on April 30, 2020. The Summary Report of the 2019 AEMP can be found in Appendix D of this report.

4.7.4 2019 Wildlife Effects Monitoring Program

The WEMP (see Appendix H for a summary) monitors wildlife and documents wildlife effects resulting from mining development and associated activities at the Ekati Diamond Mine. The WEMP also assesses the effectiveness of wildlife mitigation and management efforts. The program focuses on wildlife species identified as species of greatest interest, termed Valued Ecosystem Components (VECs). This was submitted March 31, 2020 and distributed to regulators, IEMA, and communities.

4.7.5 Engagement Plan

The Ekati Mine Engagement Plan guides the communication and outreach activities Dominion undertakes with affected parties. The Engagement Plan addresses how affected parties can develop an understanding of proposed projects, and also assists Dominion in developing an understanding of the social, cultural, and environmental conditions in the area. Dominion has developed and implemented new dispute resolution and community question follow-up procedures for the latest version of this Engagement Plan. Version 4.1 of the Ekati Mine Engagement Plan was submitted to the Board on July 27, 2018 and approved on August 27, 2018.

4.7.6 Spill Contingency Plan

This Spill Contingency Plan was developed to establish and document practices for responsible management of controlled substance spills at the Ekati Diamond Mine. The principle guiding its development and implementation has been that an effective and high-quality Spill Contingency Plan must provide the following:

- 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
- Reporting and record keeping requirements to track program progress

This Spill Contingency Plan has been developed with the Ekati mine and area-specific hazard/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. This Spill Contingency Plan also contains sufficient detail to enable those who are involved to respond effectively. Each person within the facility must know their role as well as the roles of those with whom they will interact.

See section 3.2 (q) of this report for a summary of recent revisions.

4.7.7 Interim Closure and Reclamation Plan

The ICRP describes the proposed reclamation activities for the Ekati Diamond Mine based on the Life of Mine Plan at the time of submission. The Ekati Diamond Mine is required under Water Licence W2012L2-0001 and the Environmental Agreement to have a closure plan in place during active mining operations, and to update that plan on a regular basis and/or when there is a significant change to the Life of Mine Plan. A final closure plan will be prepared and submitted to the Board at least two years before the end of active mining.

The ICRP is developed with input from IBA communities 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 Agreements.

Reclamation of the mine site is guided by the Reclamation Goal to return the Ekati Diamond Mine to viable, and wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment, human activities, and the surrounding environment. Closure objectives are used to guide reclamation activities through closure criteria and performance-based standards that measure how successfully closure activities meet closure objectives.

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. A closure monitoring plan is also in place as a method of observing and tracking the performance of reclamation work against closure criteria. Monitoring programs and schedules are tailored to individual criteria, with identified parameters, methods, evaluation, and response thresholds. Monitoring results indicate when reclamation work has been successful, or if there is a need for further reclamation work.

Version 3.0 of the Interim Closure and Reclamation Plan was submitted on August 15, 2018 as per Part K Condition 6 in the Water Licence W2012L2-0001. The Board approved selected elements of the ICRP on February 19, 2020. For those items that were not approved, the Board has identified a path forward for resolving these issues. This work will occur throughout 2020.

4.7.8 Air Quality Monitoring Program

The AQMP is a requirement under Section VII of the Environmental Agreement. In accordance with the agreement and commitments made in the 1995 Environmental Impact Statement, an AQMP was initiated in 1998 to support the management of air quality throughout the life of the Ekati Diamond Mine's operations.

Program results of the AQMP are reported every three years in concert with the three-year snow and lichen sampling programs. Results for 2015-2017 were reported in the 2017 AQMP report distributed in March 2018.

The AQMP consists of six components:

- Meteorological monitoring
- Air emissions and GHG calculations
- Ambient air quality monitoring:
  - Partisol TSP monitoring
  - Continuous air monitoring
- Dustfall monitoring
- Snow chemistry monitoring
- Lichen tissue monitoring

The executive summary of the 2019 AQMP can be found in Appendix G of this report.

4.7.9 Waste Management Plan

The objective of the Waste Management Plan is to maintain a safe and healthy workplace at the Ekati Diamond Mine such that potential adverse effects to the environment and wildlife are minimized through sound Waste management practices. The Waste Management Plan provides clear direction to Dominion staff, contractors and stakeholders on how Waste from the Ekati Diamond Mine is managed through each of the Waste streams to final disposal.

The Waste Management Plan documents the approach to Waste and outlines strategies for dealing with the various Waste streams. As with any other management document, periodic reviews of the plan are necessary. The purposes of these reviews are two-fold:

- To confirm continuing compliance
- To allow the plan to be updated in the light of operational or technical changes

The plan upholds the "Four Rs" of Waste management, namely: reduce, reuse, recycle, and recover.

The Waste Management Plan includes a series of supporting plans which include the following:

- The Incinerator Management Plan
- The Compost Management Plan
- The Solid Waste Landfill Management Plan
- The Hazardous Waste Management Plan

See section 3.2 (q) of this report for a summary of recent revisions.

4.7.10 Hydrocarbon-Contaminated Materials Management Plan

The management of hydrocarbon-impacted materials at the Ekati mine, in accordance with our legal requirements as stated in Water Licence W2012L2-0001, is detailed in the Hydrocarbon-Contaminated Materials Management Plan. Activities carried out under this plan are reported to the WLWB in the Annual Report. Materials generated through operation of the mine are identified, and instructions regarding the management of each hydrocarbon-impacted Waste stream are provided.

See section 3.2 (q) of this report for a summary of recent revisions.

4.7.11 Wastewater and Processed Kimberlite Management Plan

The maintenance of a current WPKMP for the Ekati Diamond Mine is required by the Type A Water Licence (W2012L2-0001). The WPKMP incorporates the placement of PK within the LLCF over the Life of Mine, an update of operations (since 2006), and the site-wide Wastewater management strategy. The WPKMP is a guidance document that allows the Ekati Diamond Mine to adapt to changes in the Life of Mine Plan, processing performance in the plant, and the characterization of kimberlite being mined.
The Ekati Diamond Mine is committed to meeting the Water Licence Discharge criteria and cause no significant adverse environmental effects in the Receiving Environment downstream.

See section 3.2 (r) of this report for a summary of recent revisions.

4.7.12 Waste Rock and Ore Storage Management Plan

The maintenance of a current WROMP for the Ekati Diamond Mine is required by the Type A Water Licence (W2012L2-0001). Requirements of the Plan are outlined in Schedule 6, Condition 2 of the Water Licence. The Plan includes acid rock drainage characterization and the overall Waste Rock and ore storage management strategy for the Ekati Diamond Mine. The WROMP is frequently updated to reflect the current Mine Plan and the characterization of Waste Rock and kimberlite being mined.

See section 3.2 (r) of this report for a summary of recent revisions.

Figure 7 Environmental Protection through Environmental Management Programs and Plans

APPENDIX A
2019 SURVEILLANCE NETWORK PROGRAM
SUMMARY W2012L2-0001

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Appendix A - 2019 Surveillance Network Program Summary W2012L2-0001

Water Licence W2012L2-0001 – Ekati Mine Site Effluent Requirements

All water or waste from the Project that enters the receiving Environment, including all discharges from Surveillance Network Program Station 1616-30 shall meet the following effluent quality requirements:

Parameter	Max. Average Concentration (mg/L)	Max. Concentration of any Grab Sample (mg/L)
Dissolved Aluminum	0.1	0.2
Total Antimony	0.01	0.02
Total Arsenic	0.004	0.008
Chloride	116.6(ln[Hardness])-204.1	2(116.6(ln[Hardness])-204.1)
Nitrate - N	$e^{(0.9518(\ln[Hardness])-2.032)}$	$2(e^{(0.9518(\ln[Hardness])-2.032)})$
Nitrite - N	0.006	0.12
Potassium	53	103
Total Selenium	0.001	0.002
Total Strontium	3	6
Sulphate	$e^{(0.9116(\ln[Hardness])+1.712)}$	$2(e^{(0.4163(\ln[Hardness])+4.878)})$
Total Suspended Solids (TSS)	15	25
Total Petroleum Hydrocarbons (TPH)	3.0	5.0

All Discharges from Desperation Pond at Surveillance Network Program Station 1616-47 shall meet the following effluent quality requirements:

Parameter	Max. Average Concentration (mg/L)	Max. Concentration of any Grab Sample (mg/L)
Total Ammonia - N	1.34	2.68
Total Copper	0.004	0.008
Nitrate - N	$2.27(e^{(0.9518(\ln[Hardness])-2.032)})$	$4.54(e^{(0.9518(\ln[Hardness])-2.032)})$
Potassium	41	82
Sulphate	$2.27(e^{(0.9116(\ln[Hardness])+1.712)})$	$e^{(0.4163(\ln[Hardness])+4.878)}$
Total Suspended Solids	15	25
Total Petroleum Hydrocarbons	3.0	5.0

All water or waste from the Lynx and Misery Developments that enters the Receiving Environment including Discharges from Surveillance Network Program Station 1616-43 shall meet the following effluent quality requirements:

Parameter	Max. Average Concentration (mg/L)	Max. Concentration of any Grab Sample (mg/L)
Ammonia - N	1.7	3.4
Total Arsenic	0.0085	0.017
Cadmium	$1.7 \times [(10^{[0.83 \log(\text{Cujo Lake Hardness})-2.46]})/1000]$	$3.4 \times [(10^{[0.83\log(\text{Cujo Lake Hardness})-2.46]})/1000]$
Chloride	1.7 x [116.6 x ln(Cujo Lake Hardness) - 204.1]	Minimum of: 13.4 x [116.6 x ln(Cujo Lake Hardness) - 204.1] OR $10^{[0.297 \log(\text{KPSF Hardness})+2.232]}$
Chromium	0.0017	0.0034
Total Copper	0.0034	0.007
Iron	0.51	1
Nitrate - N	$1.7(e^{(0.9518(\ln[\text{Hardness}])-2.032)})$	$3.4(e^{(0.9518(\ln[\text{Hardness}])-2.032)})$
Phosphate	0.017	0.0034
Potassium	41	82
Sulphate	$1.7(e^{(0.9116(\ln[\text{Hardness}])+1.712)})$	$e^{(0.4163(\ln[\text{Hardness}])+4.878)}$
TSS	15	25
Uranium	0.026	0.033
TPH	3.0	5.0

Any water or Waste from the Sable Development that enters the Receiving Environment including Discharges at Surveillance Network Program Station 0008-Sa3 shall meet the following effluent quality requirements.

Parameter	Max. Average Concentration (mg/L)	Max. Concentration of any Grab Sample (mg/L)
Total Ammonia-N	4.0	8.0
Total Aluminum	1.0	2.0
Total Arsenic	0.05	0.1
Total Copper	0.02	0.04
Total Cadmium	0.0015	0.003
Total Chromium	0.02	0.04
Total Lead	0.01	0.02
Total Zinc	0.03	0.06
Total Nickel	0.05	0.1
Nitrite-N	1.0	2.0
Nitrate-N	20.0	40.0
Total Suspended Solids	15.0	25.0
Total Petroleum Hydrocarbons	3.0	5.0
Turbidity	10 NTU	15 NTU
Total Phosphorus	0.2	0.4

Any water or Waste entering the Receiving Environment shall have a pH between 6.0 and 9.0 except surface runoff, which shall have a pH between 5.0 and 9.0.

Any water or waste entering the Receiving Environment shall be non-acutely toxic as determined by the acute toxicity tests described in Part A of the Surveillance Network Program.

Any EQC exceedances are highlighted in red in the data tables provided for points of compliance in this Appendix.

All required bioassays were collected except for the first week of discharge bioassay at site 0008-Sa3 where the chronic toxicity test was accidentally omitted; only acute lethality tests were completed. All submitted bioassays came back to be non-toxic and non-lethal.

Summary of Monthly SNP Sampling W2012L2-0001 conducted in 2019 (number of samples)

	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Sampling Stations	1616-12						1	1	1	1				**4**
	1616-13						1	1	1	1				**4**
	1616-20					1								**1**
	1616-26b							1						**1**
	1616-28a			2				2						**4**
	1616-29a			2				2						**4**
	1616-30a			1	1			3	1	1			1	**8**
	1616-30b							2	5					**7**
	1616-43							2						**2**
	1616-46a					1	4	3	2	1				**11**
	1616-46b								3	4	5	4	1	**17**
	1616-48						1	1		1				**3**
	1616-50						3							**3**
	0008-Be4				2					2				**4**
	0008-Pi2					1	3	5	4	4				**17**
	0008-Pi6					1								**1**
	0008-Sa2						2	5	4	5				**16**
	0008-Sa8						1							**1**
	0008-Sa10								1					**1**
QAQC	F1			1	1	1	3	3	3	3	1	1	1	**18**
	FB			1	1	1	3	2	2	2	1	1	1	**15**
	TB			1	1	1	3	2	2	2	1	1	1	**15**
	EB			1	1			1		1				**4**
	Monthly Total	**0**	**0**	**9**	**7**	**7**	**25**	**36**	**29**	**28**	**8**	**7**	**5**	**161**

Tabular and Graphical Summaries of 2019 SNP Data

All parameters in the tables below are reported in mg/L except for pH (pH), turbidity (NTU), and Bioassay concentrations (% v/v).

1616-12 Inlet to Panda Diversion Channel

Station Point	1616-12			
Date Sampled	30-Jun-19	30-Jul-19	30-Aug-19	13-Sep-19
Time Sampled	16:30	12:00	15:38	9:40
ALS Sample ID	L2304282	L2320655	L2340162	L2347540
Physical Tests				
Hardness	8.30	7.40	11.5	14.3
pH	6.87	6.89	6.80	6.77
Total Suspended Solids	<3.0	<3.0	<3.0	<3.0
Anions and Nutrients				
Chloride	0.57	<0.50	1.21	2.02
Nitrate	<0.0050	<0.0050	0.0181	0.0458
Nitrite-N	<0.0010	<0.0010	<0.0010	<0.0010
Sulphate	3.04	2.61	6.37	8.98
Total Metals				
Antimony Total	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic Total	0.00033	0.00034	0.00030	0.00032
Potassium Total	0.873	0.685	0.89	1.08
Selenium Total	<0.000050	<0.000050	<0.000050	<0.000050
Strontium Total	0.0115	0.0100	0.0143	0.0191

1616-13 Outlet of Panda Diversion Channel

Station Point	1616-13			
Date Sampled	30-Jun-19	30-Jul-19	30-Aug-19	13-Sep-19
Time Sampled	16:05	12:15	15:18	10:05
ALS Sample ID	L2304282	L2320655	L2340162	L2347540
Physical Tests				
Hardness	339.00	7.80	10.3	12.1
pH	8.72	6.97	6.77	6.73
Total Suspended Solids	22.7	<3.0	<3.0	<3.0
Anions and Nutrients				
Chloride	16.3	<0.50	0.77	1.31
Nitrate	67.8000	0.0278	0.0314	0.0502
Nitrite-N	0.931	<0.0010	<0.0010	<0.0010
Sulphate	118.00	2.96	5.52	7.32
Total Metals				
Antimony Total	0.0021	<0.00010	<0.00010	<0.00010
Arsenic Total	0.00214	0.00027	0.00027	0.00026
Potassium Total	22.600	0.803	0.87	1.00
Selenium Total	0.00261	<0.000050	<0.000050	<0.000050
Strontium Total	2.8400	0.0110	0.0139	0.0160

1616-20 Runoff Southern Catchment Area of Plant Site

Station Point	1616-20
Date Sampled	23-May-19
Time Sampled	14:42
ALS Sample ID	L2279264
Physical Tests	
Hardness	184
pH	7.50
Total Suspended Solids	3.7
Anions and Nutrients	
Chloride	23.5
Nitrate	1.710
Nitrite-N	0.0691
Sulphate	224
Total Metals	
Antimony	0.00067
Arsenic	0.00041
Potassium	14.5
Selenium	0.001200
Strontium	0.375
Hydrocarbons	
TPH C5-30	<0.27

1616-26b Long Lake Containment Facility (LLCF) Upstream of Dyke C

Sample 1616-26b located in Cell C of the LLCF was not sampled during winter 2019 for the following reason:

- The ice typically freezes to the bottom due to low water levels at the time of freezing, resulting in no water to sample or a mud slurry being retrieved.

Station Point	1616-26b
Date Sampled	4-Jul-19
Time Sampled	17:15
ALS Sample ID	L2305054
Physical Tests	
Hardness	337
pH	7.72
Total Suspended Solids	25.7
Anions and Nutrients	
Chloride	165
Nitrate	4.21
Nitrite-N	0.779
Sulphate	262
Total Metals	
Antimony	0.00337
Arsenic	0.00425
Potassium	48
Selenium	0.000336
Strontium	0.99

1616-28a LLCF Downstream of Dyke C

Station Point	1616-28a-M		1616-28a-T	
Date Sampled	26-Mar-19	4-Jul-19	26-Mar-19	4-Jul-19
Time Sampled	14:25	16:27	14:15	16:13
ALS Sample ID	L2250029	L2305054	L2250029	L2305054
Physical Tests				
Hardness	355	302	344	288
pH	7.83	7.60	7.85	7.76
Total Suspended Solids	<3.0	3.7	<3.0	<3.0
Anions and Nutrients				
Chloride	320	270	318	247
Nitrate	6.63	5.76	6.64	5.36
Nitrite-N	<0.0050	0.0274	0.0250	0.0329
Sulphate	297	250	297	230
Total Metals				
Antimony Total	0.00183	0.00218	0.00186	0.00209
Arsenic Total	0.00132	0.00132	0.00142	0.00127
Potassium Total	72.0	60.1	76.0	57.0
Selenium Total	0.000806	0.000736	0.000792	0.000722
Strontium Total	1.52	1.34	1.54	1.28

1616-29a LLCF Downstream Dyke D

Station Point	1616-29a-M		1616-29a-T	
Date Sampled	24-Mar-19	4-Jul-19	24-Mar-19	4-Jul-19
Time Sampled	16:45	14:57	16:30	14:45
ALS Sample ID	L2250029	L2305054	L2250029	L2305054
Physical Tests				
Hardness	233	150	231	155
pH	7.96	7.68	7.91	7.70
Total Suspended Solids	<3.0	3	<3.0	<3.0
Anions and Nutrients				
Chloride	237	155	237	156
Nitrate	3.00	1.86	3.48	1.87
Nitrite-N	<0.0050	<0.0050	0.0059	<0.0050
Sulphate	222	141	227	141
Total Metals				
Antimony Total	0.00118	0.00095	0.00114	0.00094
Arsenic Total	0.00053	0.00036	0.00054	0.00038
Potassium Total	52.4	31.2	50.4	32.1
Selenium Total	0.000500	0.000331	0.000477	0.000327
Strontium Total	1.08	0.714	1.05	0.723

1616-30a LLCF Cell E Upstream of Leslie Lake

1616-30a Quarterly

Station Point	Max Conc. Avg.	Max Conc. Grab	1616-30a - Quarterly			
Date Sampled			19-Mar-19	16-Jul-19	16-Sep-19	9-Dec-19
Time Sampled			10:13	9:28	14:05	14:39
ALS Sample ID			L2246622	L2311552	L2348784	L2394500
Physical Tests						
Hardness			207	153	182	218
pH	6 - 9		7.78	7.91	7.82	7.84
Total Suspended Solids	15	25	<3.0	3.0	<3.0	<3.0
Anions and Nutrients						
Nitrate	15.74*	31.47*	2.99	2.01	2.20	2.73
Nitrite-N	0.06	0.12	<0.0050	<0.0050	0.01	0.01
Hydrocarbons						
TPH C5-30	3	5	<0.27	<0.27	<0.27	<0.27

calculated with the lowest available hardness value = 153 mg/L

1616-30a Under-ice and Open-water Bioassays

Parameter	1616-30a	1616-30a
Date Sampled	29-Apr-19	4-Jul-19
Time Sampled	16:00	15:20
ALS Sample ID	L2264997	L2305042
Bioassay Endpoints	**% v/v**	**% v/v**
Ceriodaphnia dubia survival LC50	>100	>100
Ceriodaphnia dubia reproduction IC25	>100	1.1 (0.8 -3.9)
Pseudokirchneriella subcapitata growth IC25	>91	>91
Daphnia magna immobility EC50	>100	>100
Daphnia magna survival LC50	>100	>100
Oncorhynchus mykiss survival LC50	>100	>100

LC = Lethal Concentration, IC = Inhibition Concentration, EC=Effective Concentration

1616-30a Pre-Approval

Station Point	Max Conc. Avg.	Max Conc. Grab	1616-30a Pre-Approval			
Date Sampled			29-Apr-19	4-Jul-19	11-Jul-19	29-Aug-19
Time Sampled			16:00	15:20	15:57	16:55
ALS Sample ID			L2264997	L2305042	L2309264	L2340143
Physical Tests						
Hardness			251	149	174	172
pH	6 - 9		7.82	7.80	8.01	7.77
Total Suspended Solids	15	25	<3.0	1.3	1.6	3.0
Anions and Nutrients						
Chloride	379.36*	758.72*	241.0	157.0	157.0	163
Nitrate	15.34*	30.69*	3.0	1.9	1.8	2
Nitrite-N	0.06	0.12	0.01	<0.0050	0.004	0.01
Sulphate	418.84	837.67	222	145	143	147
Total Metals						
Antimony	0.01	0.02	0.00125	0.00133	0.00066	0.00078
Arsenic	0.004	0.008	0.00153	0.00332	0.00138	0.00164
Potassium	41	82	36.2	31.1	41.2	53.2
Selenium	0.001	0.002	0.00374	0.00450	0.00702	0.00805
Strontium	3	6	0.700	0.810	1.09	1.34
Dissolved Metals						
Aluminum	0.1	0.2	0.0089	0.0184	0.0230	0.0221
Hydrocarbons						
TPH C5-30	3	5	<0.27	<0.27	<0.27	<0.27

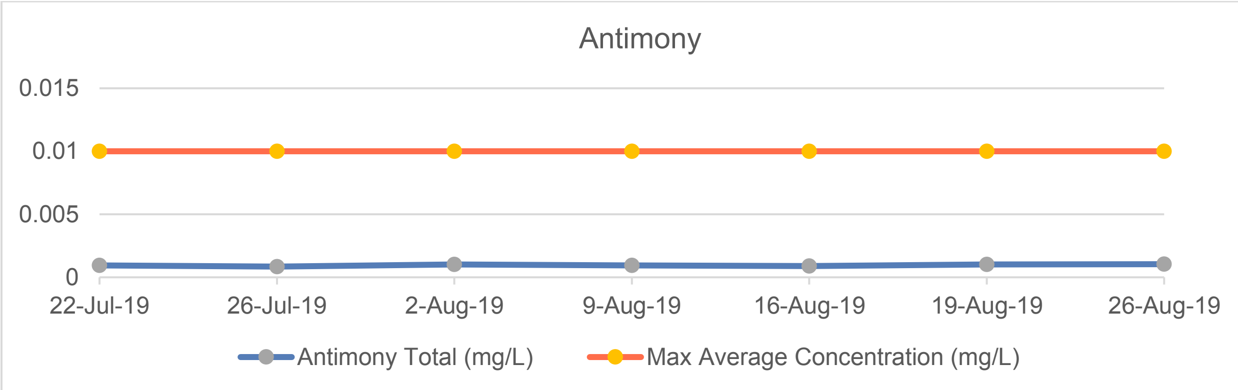
**calculated with the lowest available hardness value = 149 mg/L*

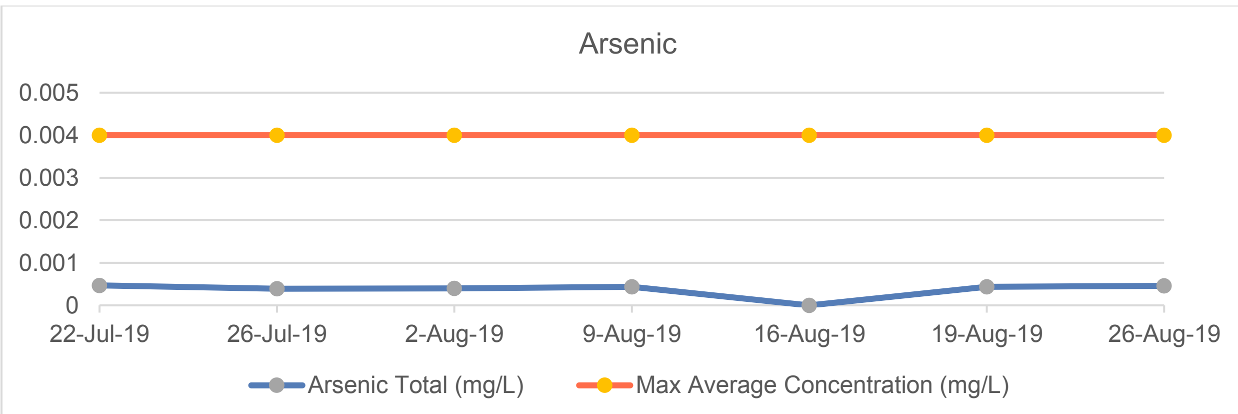
1616-30b Cell E Discharge from LLCF

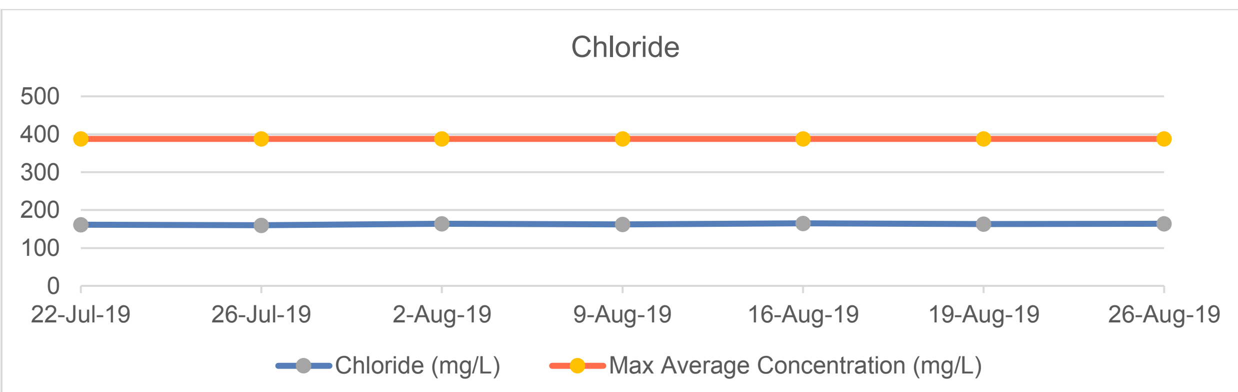
Station Point	Max Conc. Avg.	Max Conc. Grab	1616-30b			
Date Sampled			22-Jul-19	26-Jul-19	2-Aug-19	9-Aug-19
Time Sampled			15:01	8:11	10:50	8:30
ALS Sample ID			L2315138	L2318176	L2322293	L2326201
Physical Tests						
Hardness			169	165	177	184
pH	6 - 9		7.95	7.98	7.87	7.98
Total Suspended Solids	15	25	18.1	1.4	<1.0	4.1
Anions and Nutrients						
Chloride	387.67	775.33	161.0	160.0	164.0	162
Nitrate	16.42	32.84	1.8	1.8	1.8	2
Nitrite-N	0.06	0.12	0.01	0.01	0.01	0.01
Sulphate	418.84	837.67	148	148	152	151
Total Metals						
Antimony	0.01	0.02	0.00094	0.00085	0.00103	0.00094
Arsenic	0.004	0.008	0.00047	0.00039	0.00040	0.00044
Potassium	53	103	33.8	30.7	31.7	33.0
Selenium	0.001	0.002	0.00037	0.00033	0.00039	0.00032
Strontium	3	6	0.724	0.748	0.75	0.76
Dissolved Metals						
Aluminum	0.1	0.2	0.0229	0.0200	0.0190	0.0201
Hydrocarbons						
TPH C5-30	3	5	<0.27	<0.27	<0.27	<0.27

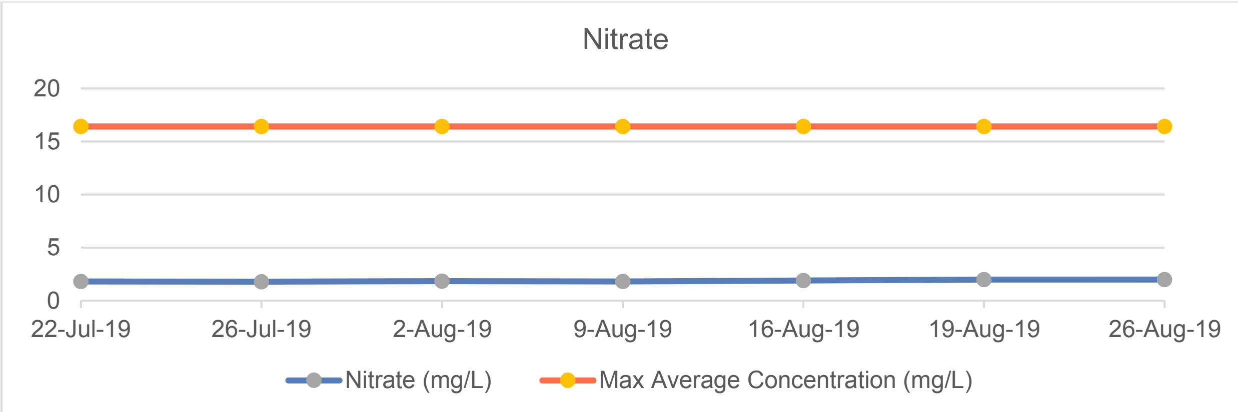
Station Point	Max Conc. Avg.	Max Conc. Grab	1616-30b		
Date Sampled			16-Aug-19	19-Aug-19	26-Aug-19
Time Sampled			10:40	16:35	9:34
ALS Sample ID			L2330552	L2333125	L2336762
Physical Tests					
Hardness			157	171	184
pH	6 - 9		7.80	7.91	7.79
Total Suspended Solids	15	25	1.2	<1.0	<1.0
Anions and Nutrients					
Chloride	387.67	775.33	165.0	163.0	164.0
Nitrate	16.42	32.84	1.9	2.0	2.0
Nitrite-N	0.06	0.12	0.01	0.01	0.01
Sulphate	418.84	837.67	152	154	152
Total Metals					
Antimony	0.01	0.02	0.00089	0.00102	0.00104
Arsenic	0.004	0.008	<0.00050	0.00044	0.00046
Potassium	53	103	32.3	34.6	35.4
Selenium	0.001	0.002	0.00035	0.00038	0.00039
Strontium	3	6	0.781	0.827	0.85
Dissolved Metals					
Aluminum	0.1	0.2	0.0221	0.0269	0.0211
Hydrocarbons					
TPH C5-30	3	5	<0.27	<0.27	<0.27

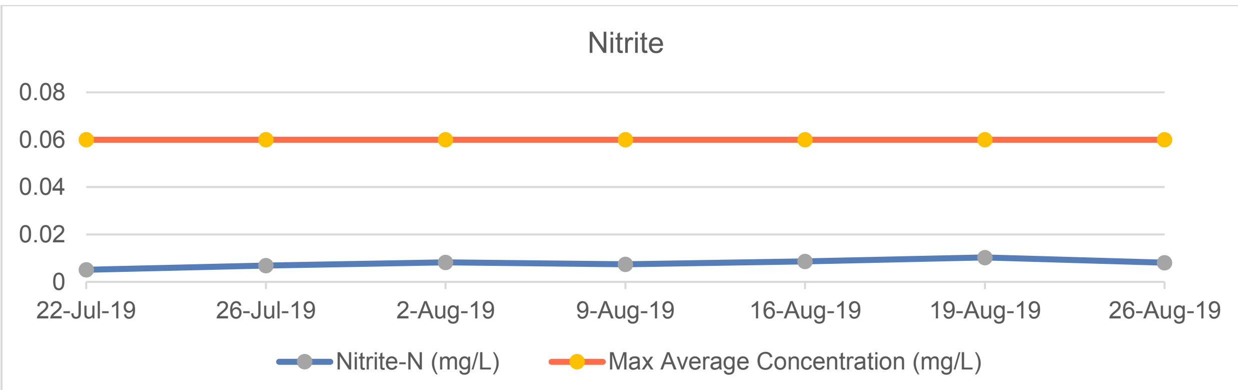
1616-30a Discharge Graphical Summary

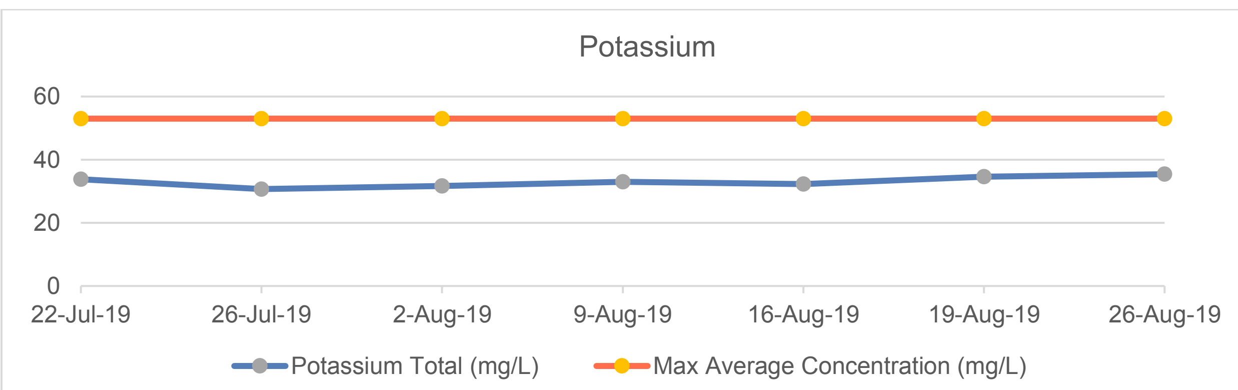


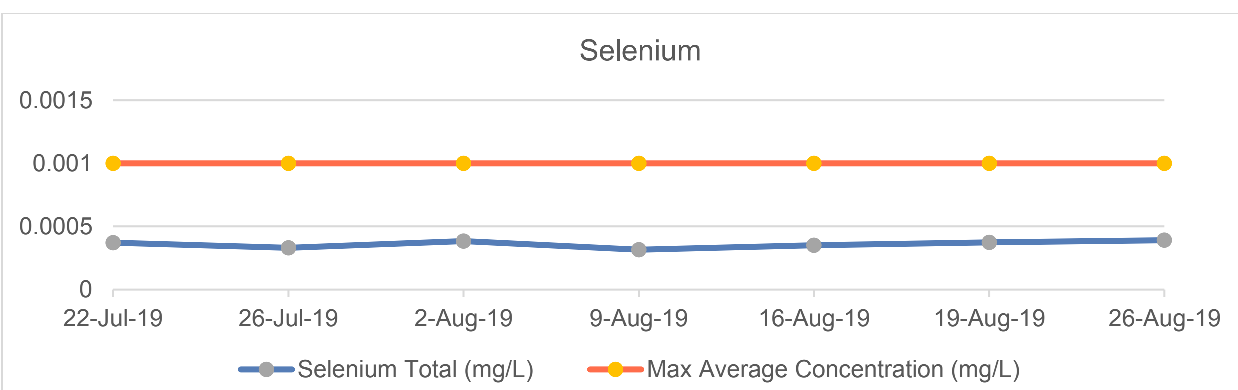


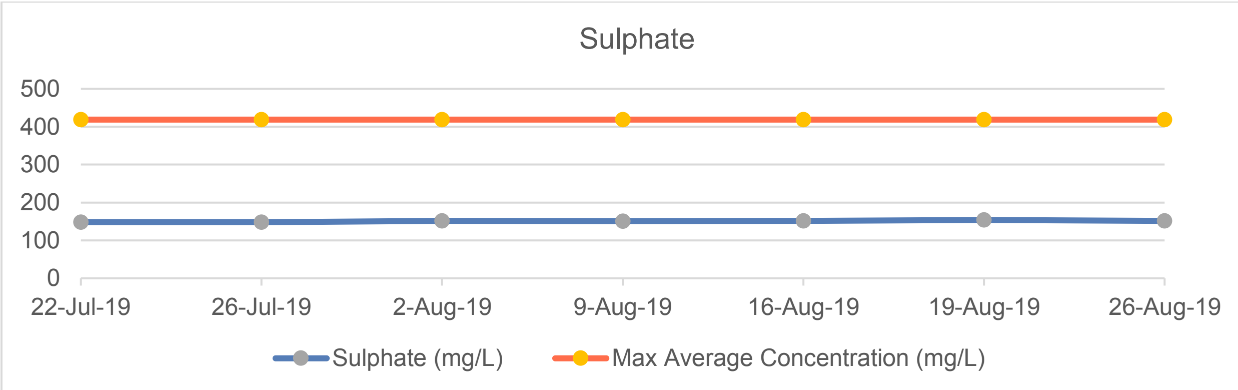


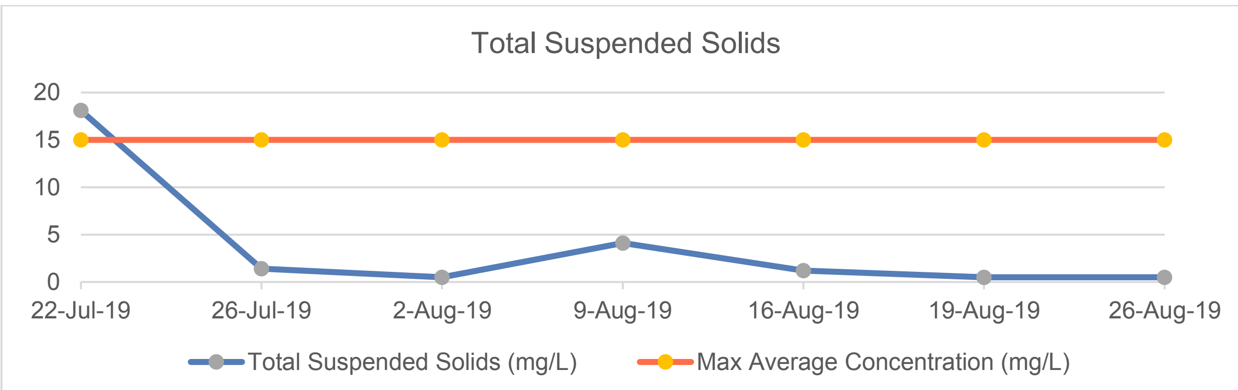

Nitrate
20
15
10
5
0
22-Jul-19
26-Jul-19
2-Aug-19
9-Aug-19
16-Aug-19
19-Aug-19
26-Aug-19
Nitrate (mg/L)
Max Average Concentration (mg/L)

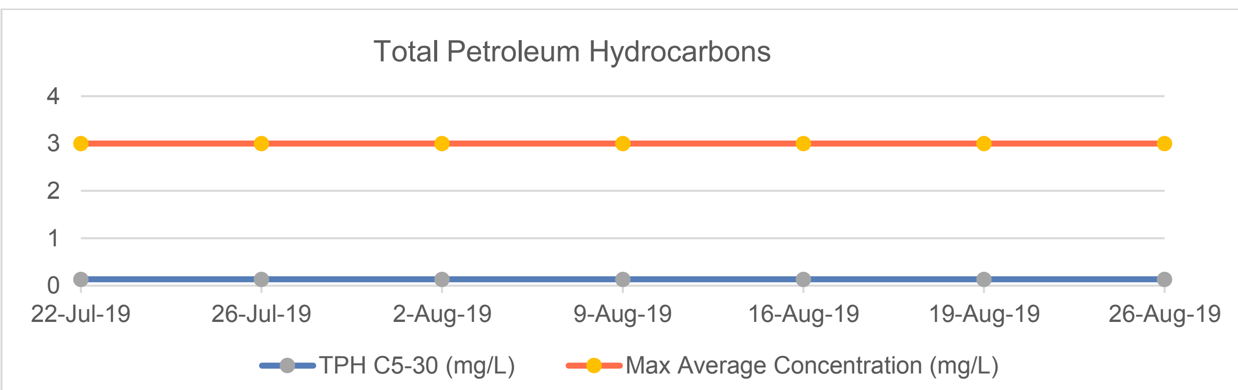

Nitrite
0.08
0.06
0.04
0.02
0
22-Jul-19
26-Jul-19
2-Aug-19
9-Aug-19
16-Aug-19
19-Aug-19
26-Aug-19
Nitrite-N (mg/L)
Max Average Concentration (mg/L)

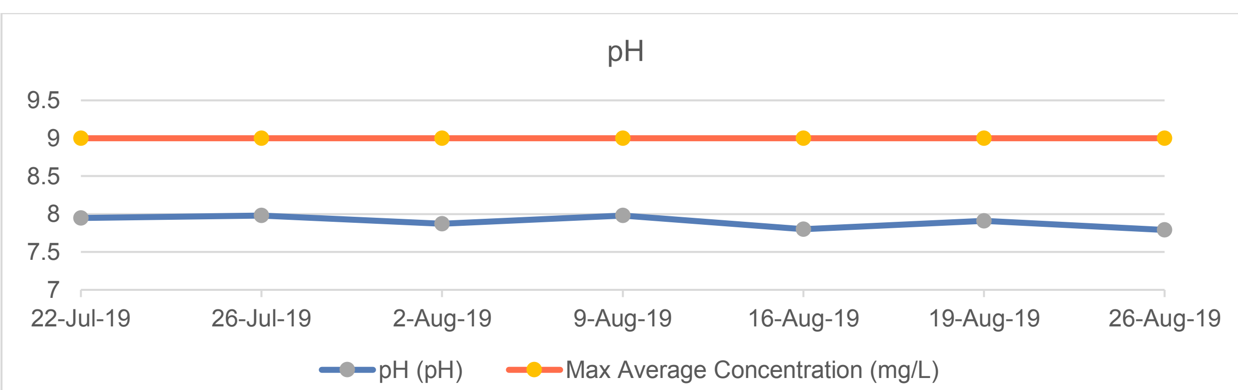

Potassium
60
40
20
0
22-Jul-19
26-Jul-19
2-Aug-19
9-Aug-19
16-Aug-19
19-Aug-19
26-Aug-19
Potassium Total (mg/L)
Max Average Concentration (mg/L)


Selenium
0.0015
0.001
0.0005
0
22-Jul-19
26-Jul-19
2-Aug-19
9-Aug-19
16-Aug-19
19-Aug-19
26-Aug-19
Selenium Total (mg/L)
Max Average Concentration (mg/L)


Sulphate
500
400
300
200
100
0
22-Jul-19
26-Jul-19
2-Aug-19
9-Aug-19
16-Aug-19
19-Aug-19
26-Aug-19
Sulphate (mg/L)
Max Average Concentration (mg/L)


Total Suspended Solids
20
15
10
5
0
22-Jul-19
26-Jul-19
2-Aug-19
9-Aug-19
16-Aug-19
19-Aug-19
26-Aug-19
Total Suspended Solids (mg/L)
Max Average Concentration (mg/L)


Total Petroleum Hydrocarbons
4
3
2
1
0
22-Jul-19
26-Jul-19
2-Aug-19
9-Aug-19
16-Aug-19
19-Aug-19
26-Aug-19
TPH C5-30 (mg/L)
Max Average Concentration (mg/L)

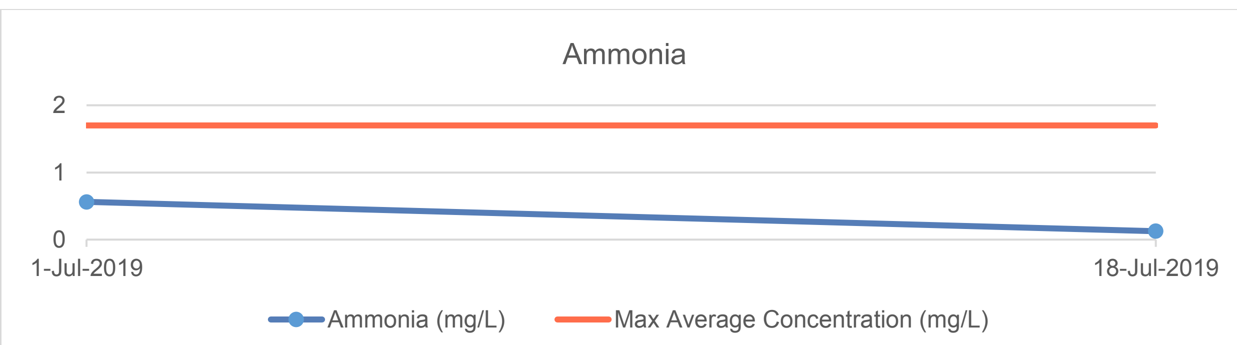

pH
9.5
9
8.5
8
7.5
7
22-Jul-19
26-Jul-19
2-Aug-19
9-Aug-19
16-Aug-19
19-Aug-19
26-Aug-19
pH (pH)
Max Average Concentration (mg/L)

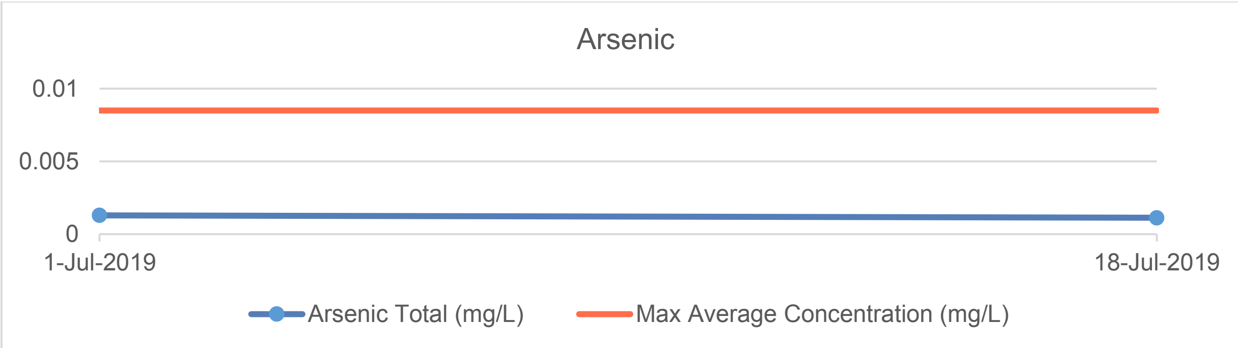
1616-43 King Pond Settling Facility (KPSF)

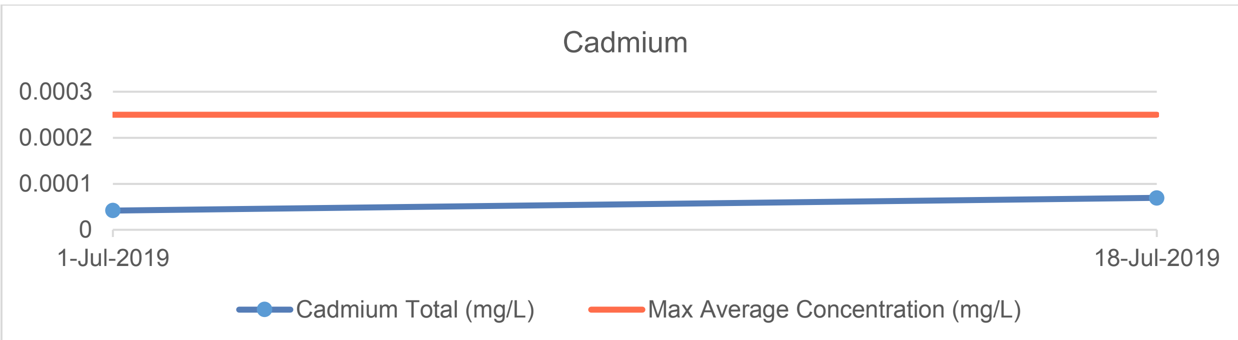
Station Point	Max Conc. Avg.	Max Conc. Grab	1616-43	
Date Sampled			1-Jul-19	18-Jul-19
Time Sampled			16:45	14:45
ALS Sample ID			L2302042	L2313821
Physical Tests				
Hardness			176	201
pH	6 - 9		8.02	8.05
TSS	15	25	7.7	<3.0
Anions and Nutrients				
Ammonia	1.7	3.4	0.5620	0.1250
Chloride	544.98*	1089.96*	53.1	101.0
Nitrate	16.14*	32.29*	9.440	6.030
Phosphorus Total	0.017	0.034	0.0165	0.0060
Sulphate	423.27	746.8	117.0	141.0
Total Metals				
Arsenic	0.0085	0.017	0.00129	0.00113
Cadmium	0.00025*	0.00049*	0.0000417	0.0000694
Chromium	0.0034	0.007	0.00108	0.00025
Copper	0.0017	0.0034	0.00120	0.00134
Iron	0.51	1	0.293	0.065
Potassium	41	82	25.50	38.70
Uranium	0.026	0.033	0.00678	0.00696
Hydrocarbons				
TPH	3	5	<0.27	<0.27

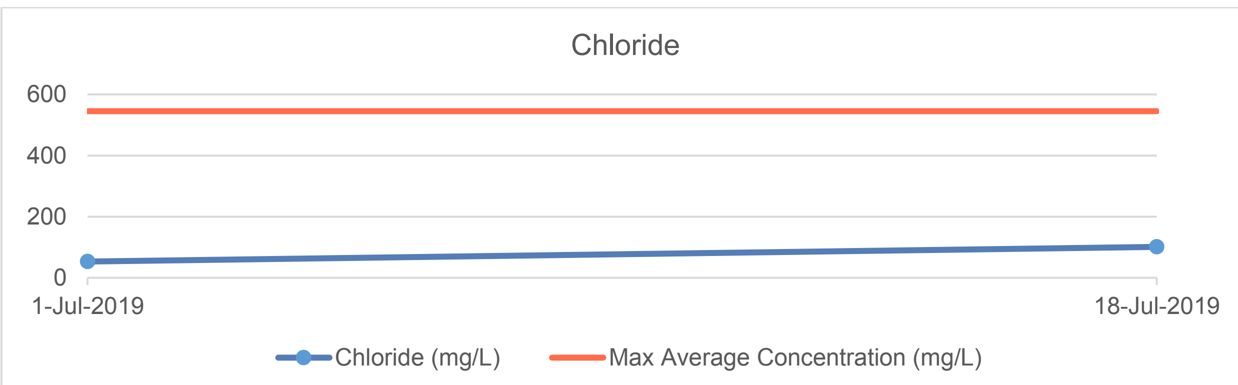
**Calculated using lowest available Cujo Lake hardness value = 90 mg/L*

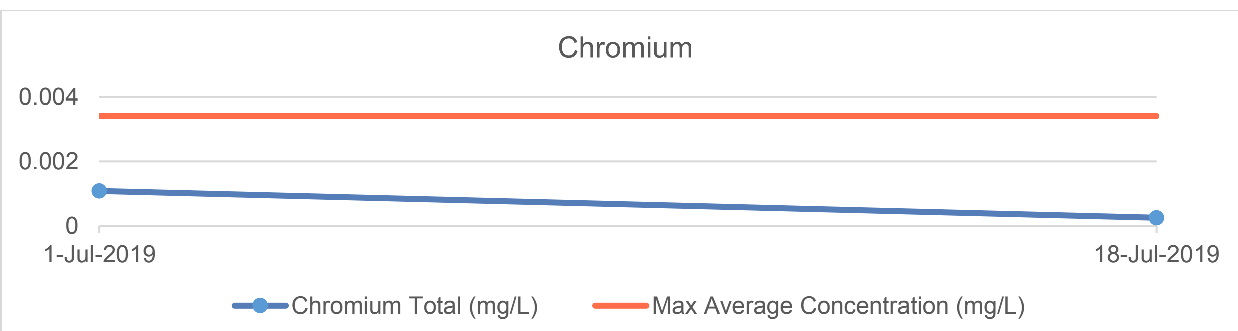
1616-43 King Pond Settling Facility (KPSF) Graphical Summary

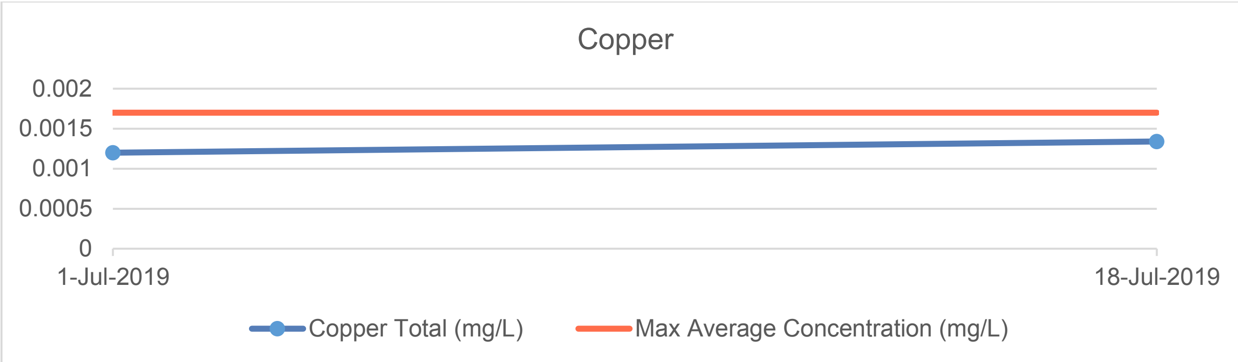


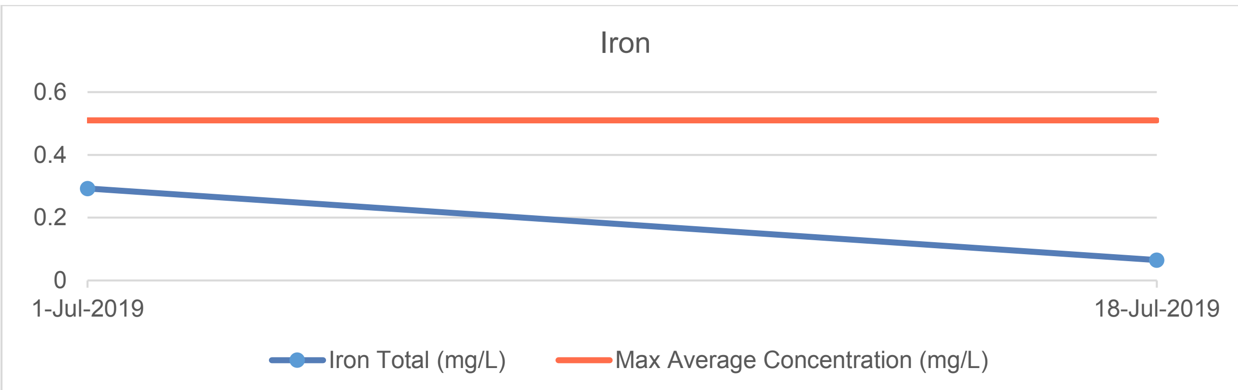

Arsenic
0.01
0.005
0
1-Jul-2019
18-Jul-2019
Arsenic Total (mg/L)
Max Average Concentration (mg/L)

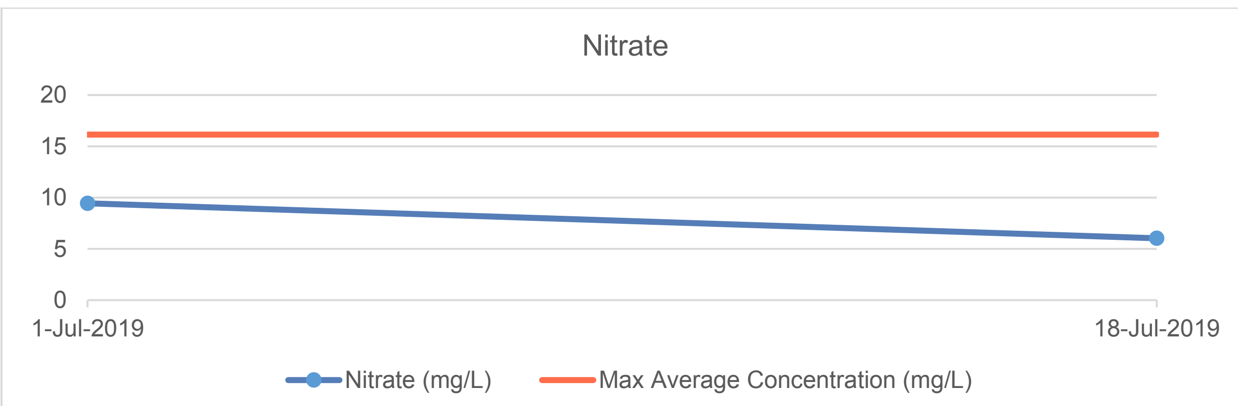

Cadmium
0.0003
0.0002
0.0001
0
1-Jul-2019
18-Jul-2019
Cadmium Total (mg/L)
Max Average Concentration (mg/L)

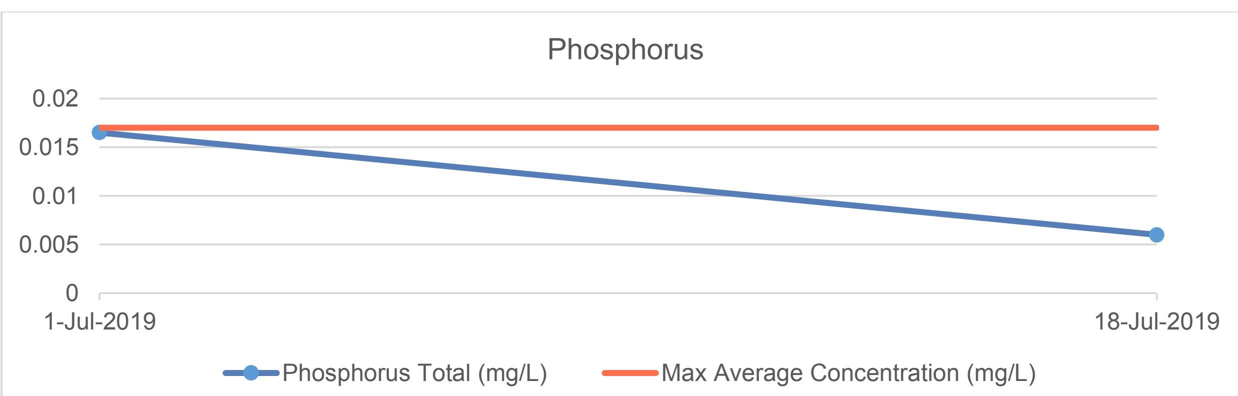

Chloride
600
400
200
0
1-Jul-2019
18-Jul-2019
Chloride (mg/L)
Max Average Concentration (mg/L)

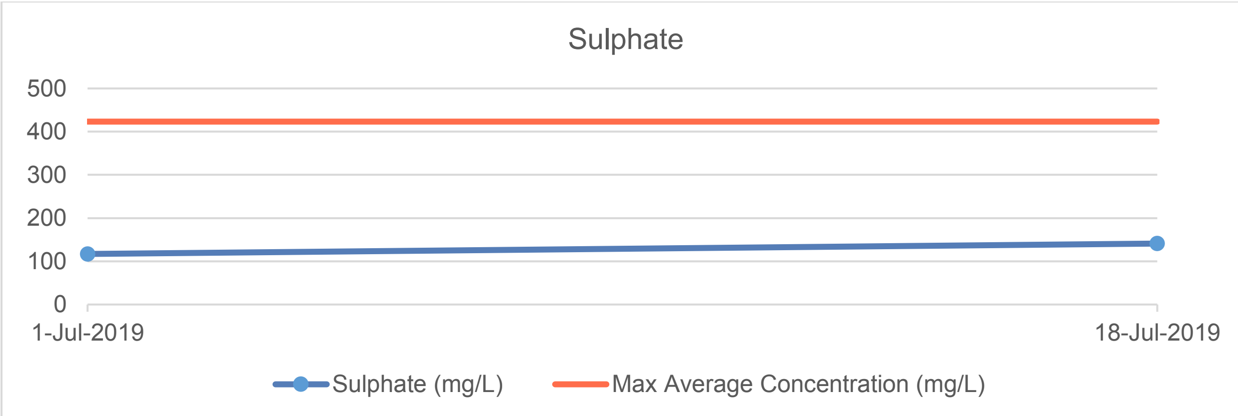

Chromium
0.004
0.002
0
1-Jul-2019
18-Jul-2019
Chromium Total (mg/L)
Max Average Concentration (mg/L)

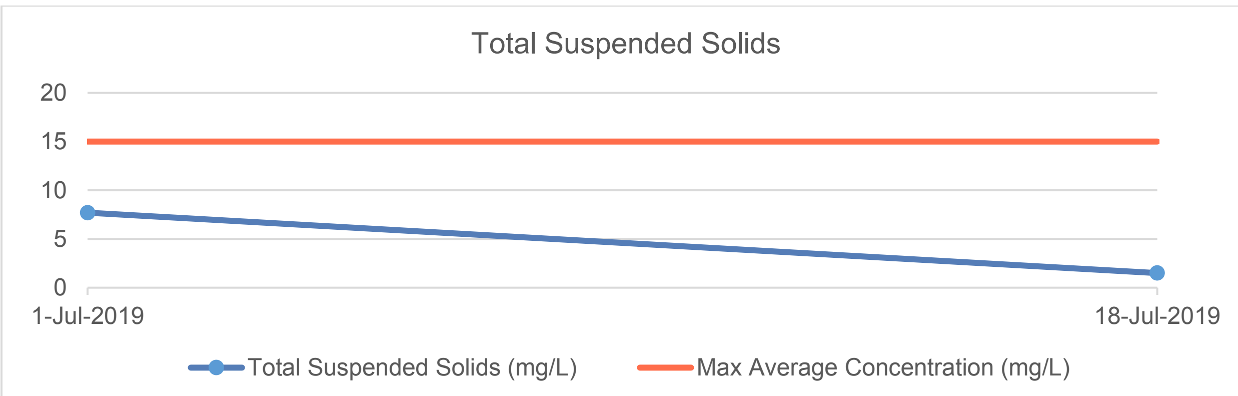

Copper
0.002
0.0015
0.001
0.0005
0
1-Jul-2019
18-Jul-2019
Copper Total (mg/L)
Max Average Concentration (mg/L)

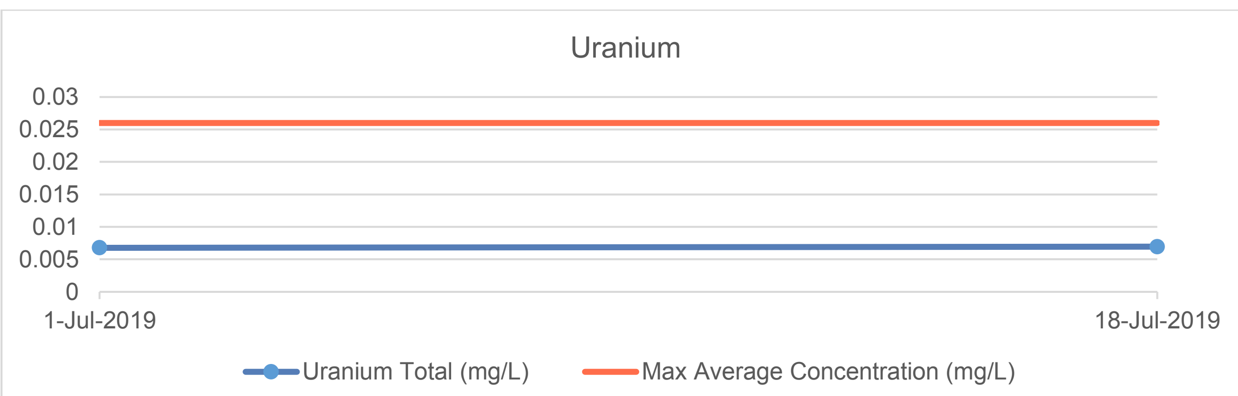

Iron
0.6
0.4
0.2
0
1-Jul-2019
18-Jul-2019
Iron Total (mg/L)
Max Average Concentration (mg/L)

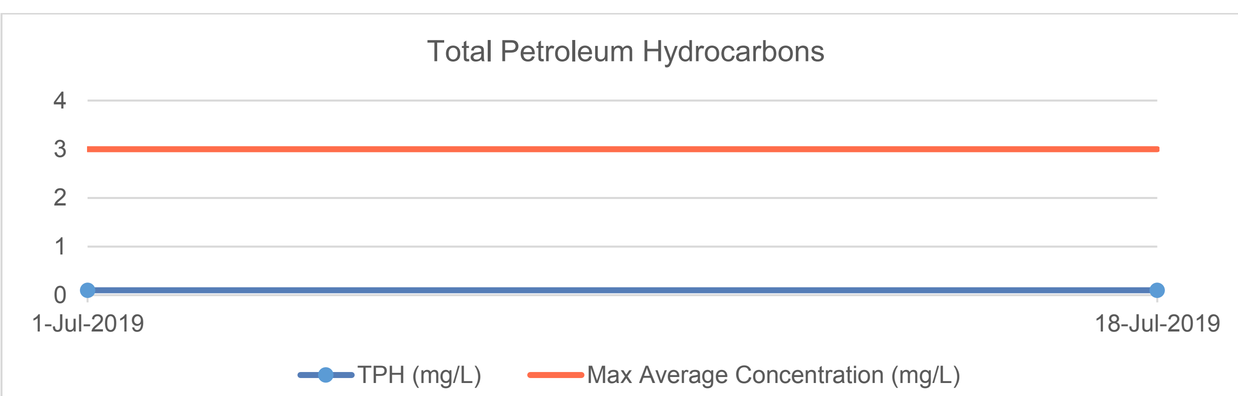

Nitrate
20
15
10
5
0
1-Jul-2019
18-Jul-2019
Nitrate (mg/L)
Max Average Concentration (mg/L)

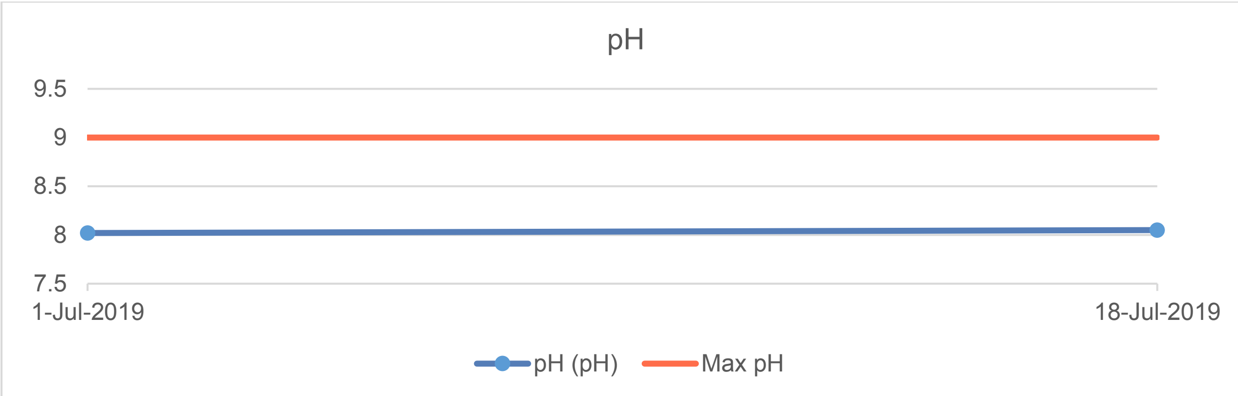

Phosphorus
0.02
0.015
0.01
0.005
0
1-Jul-2019
18-Jul-2019
Phosphorus Total (mg/L)
Max Average Concentration (mg/L)


Sulphate
500
400
300
200
100
0
1-Jul-2019
18-Jul-2019
Sulphate (mg/L)
Max Average Concentration (mg/L)


Total Suspended Solids
20
15
10
5
0
1-Jul-2019
18-Jul-2019
Total Suspended Solids (mg/L)
Max Average Concentration (mg/L)


Uranium
0.03
0.025
0.02
0.015
0.01
0.005
0
1-Jul-2019
18-Jul-2019
Uranium Total (mg/L)
Max Average Concentration (mg/L)


Total Petroleum Hydrocarbons
4
3
2
1
0
1-Jul-2019
18-Jul-2019
TPH (mg/L)
Max Average Concentration (mg/L)



1616-43 Open-water Bioassay

The 1616-43 under ice bioassay was not sampled during winter 2019 because ice freezes to the bottom due to low water levels at the time of freezing, resulting in no water to sample or mud being retrieved.

Parameter	1616-43
Date Sampled	1-Jul-19
Time Sampled	16:45
ALS Sample ID	L2302042
Bioassay Endpoints	**% v/v**
Ceriodaphnia dubia survival LC50	>100
Ceriodaphnia dubia reproduction IC25	>100
Pseudokirchneriella subcapitata growth IC25	>95.2
Pseudokirchneriella subcapitata growth IC50	>95.2
Daphnia magna survival LC50	>100
Oncorhynchus mykiss survival LC50	>100

LC = Lethal Concentration, IC = Inhibition Concentration

1616-46a Monitor water pumped from Misery Pit to KPSF

Station Point	1616-46a					
Date Sampled	26-May-19	2-Jun-19	9-Jun-19	26-Jun-19	7-Jul-19	14-Jul-19
Time Sampled	14:45	14:12	15:26	16:37	15:50	12:00
ALS Sample ID	L2280531	L2285052	L2289592	L2301325	L2306862	L2310973
Physical Tests						
Hardness	293	510	779	369	1240	1050
pH	7.68	7.84	7.69	7.76	7.55	8.08
TSS	5.7	11.3	4.3	5.0	11.3	23.0
Anions and Nutrients						
Ammonia	4.23	7.04	7.83	2.08	11.50	9.40
Chloride	162.0	327.0	615.0	318.0	1010.0	1030.0
Nitrate	30.8	31.1	30.2	20.4	66.0	61.2
Phosphorus Total	0.0059	0.0078	0.0042	0.0105	0.0119	0.0161
Sulphate	680	572	566	265	778	754
Total Metals						
Arsenic Total	0.00500	0.00478	0.00417	0.00205	0.00659	0.00503
Cadmium Total	0.000188	0.000127	0.000168	0.000100	0.000102	0.000161
Chromium Total	0.00044	0.00100	0.00066	0.00061	0.00122	0.00247
Copper Total	0.0007	<0.0025	0.0016	0.0010	<0.0025	0.0022
Iron Total	0.291	0.419	0.228	0.180	0.265	0.414
Potassium Total	173.0	163.0	178.0	121.0	263.0	312.0
Uranium Total	0.0630	0.0705	0.0664	0.0313	0.0832	0.0535

Station Point	1616-46a				
Date Sampled	23-Jul-19	3-Aug-19	22-Aug-19	25-Aug-19	2-Sep-19
Time Sampled	9:00	11:31	13:40	13:40	15:50
ALS Sample ID	L2316364	L2323958	L2335364	L2336837	L2341139
Physical Tests					
Hardness	1360	1270	1160	850	681
pH	7.94	7.85	8.05	7.91	8.28
TSS	26.7	68.7	17.0	24.3	146.0
Anions and Nutrients					
Ammonia	18.20	12.50	12.10	9.51	29.90
Chloride	921.0	860.0	681.0	417.0	443.0
Nitrate	73.7	66.7	55.4	47.3	71.0
Phosphorus Total	0.0221	0.0256	0.0170	0.0132	0.0940
Sulphate	628	665	698	646	705
Total Metals					
Arsenic Total	0.00542	0.00589	0.00486	0.00653	0.00402
Cadmium Total	0.000104	0.000114	0.000128	0.000098	0.000147
Chromium Total	0.00181	0.00683	0.00258	0.00232	0.00567
Copper Total	0.0010	0.0034	<0.0025	<0.0025	0.0074
Iron Total	0.323	1.850	0.373	0.595	1.550
Potassium Total	274.0	217.0	193.0	165.0	220.0
Uranium Total	0.0710	0.1300	0.1290	0.1490	0.0672

1616-46b Monitor water pumped from Misery Underground to KPSF

Station Point	1616-46b					
Date Sampled	20-Aug-19	25-Aug-19	1-Sep-19	12-Sep-19	19-Sep-19	26-Sep-19
Time Sampled	15:40	14:30	15:45	10:30	15:53	11:00
ALS Sample ID	L2335359	L2336846	L2340182	L2347552	L2351870	L2356130
Physical Tests						
Hardness	858	665	632	933	939	671
pH	7.46	7.83	7.80	9.55	7.79	8.85
TSS	4.0	<3.0	<3.0	210.0	87.3	423.0
Anions and Nutrients						
Ammonia	7.87	7.66	5.65	32.40	130.00	6.01
Chloride	713.0	421.0	486.0	701.0	733.0	299.0
Nitrate	49.3	44.8	46.0	65.4	189.0	40.6
Phosphorus Total	0.0039	0.0030	0.0023	0.0514	0.0410	0.2040
Sulphate	683	665	655	702	790	777
Total Metals						
Arsenic Total	0.00223	0.00378	0.00262	0.00220	0.00360	0.00441
Cadmium Total	0.000131	0.000089	0.000131	0.000114	0.000120	0.000181
Chromium Total	0.00059	0.00063	<0.00050	0.02880	0.00570	0.04050
Copper Total	<0.0025	<0.0025	<0.0025	0.0032	<0.0050	0.0067
Iron Total	<0.050	0.055	<0.050	2.670	1.620	7.400
Potassium Total	285.0	227.0	229.0	214.0	190.0	164.0
Uranium Total	0.0427	0.0811	0.0441	0.0099	0.0989	0.0356

Station Point	1616-46b					
Date Sampled	3-Oct-19	10-Oct-19	17-Oct-19	23-Oct-19	30-Oct-19	6-Nov-19
Time Sampled	13:34	14:55	12:30	10:55	9:40	12:00
ALS Sample ID	L2360554	L2365126	L2368148	L2372484	L2376247	L2380091
Physical Tests						
Hardness	800	470	687	380	891	753
pH	10.82	10.68	9.91	9.90	10.86	9.61
TSS	2320.0	140.0	1120.0	15300.0	4160.0	13800.0
Anions and Nutrients						
Ammonia	7.31	11.70	3.60	12.00	15.50	22.30
Chloride	411.0	439.0	452.0	531.0	661.0	797.0
Nitrate	32.2	40.5	53.5	43.3	57.3	57.5
Phosphorus Total	1.3800	0.0330	0.6470	0.8350	0.6590	0.4040
Sulphate	639	585	680	514	487	363
Total Metals						
Arsenic Total	0.00393	0.00237	0.00668	0.01020	0.00700	0.00545
Cadmium Total	0.000142	0.000300	0.000323	0.000445	0.000820	0.000251
Chromium Total	0.11000	0.03080	0.13800	0.21000	0.12200	0.09320
Copper Total	0.0131	0.0029	0.0319	0.0427	0.1240	0.0194
Iron Total	11.000	1.040	18.100	38.800	20.900	13.000
Potassium Total	187.0	193.0	207.0	198.0	224.0	212.0
Uranium Total	0.0039	0.0034	0.0218	0.0254	0.0143	0.0073

Station Point	1616-46b			
Date Sampled	13-Nov-19	20-Nov-19	27-Nov-19	6-Dec-19
Time Sampled	12:00	14:20	12:50	10:50
ALS Sample ID	L2383270	L2386792	L2390063	L2394674
Physical Tests				
Hardness	492	299	395	305
pH	8.84	10.25	9.08	9.23
TSS	230.0	122.0	218.0	36.7
Anions and Nutrients				
Ammonia	41.80	18.80	35.10	38.40
Chloride	707.0	762.0	817.0	767.0
Nitrate	79.6	54.0	86.5	83.6
Phosphorus Total	0.1640	0.0479	0.0568	0.0729
Sulphate	294	201	208	129
Total Metals				
Arsenic Total	0.00347	0.00305	0.00430	0.00355
Cadmium Total	0.000153	0.000112	0.000079	0.000095
Chromium Total	0.03680	0.03160	0.02150	0.00959
Copper Total	0.0112	0.0120	0.0136	0.0121
Iron Total	2.870	2.180	2.190	0.902
Potassium Total	191.0	232.0	226.0	248.0
Uranium Total	0.0122	0.0023	0.0053	0.0018

1616-48 Cujo Lake

Station Point	1616-48			
Date Sampled	24-Jun-19	18-Jul-19	22-Aug-19	13-Sep-19
Time Sampled	16:00	15:45	11:55	14:40
ALS Sample ID	L2299717	L2313834	L2335355	L2349640
Physical Tests				
Hardness	91.4	93	90	93

1616-50 Monitor water pumped from Lynx Pit to KPSF

Station Point	1616-50		
Date Sampled	2-Jun-19	12-Jun-19	29-Jun-19
Time Sampled	15:10	7:00	12:44
ALS Sample ID	L2285020	L2291993	L2304269
Physical Tests			
Hardness	130	317	8
pH	7.56	8.12	6.90
Total Suspended Solids	63.0	28.3	<3.0
Anions and Nutrients			
Ammonia	14.20	9.49	<0.0050
Chloride	6.5	12.8	<0.50
Nitrate	29.4	38.2	0.0
Phosphorus Total	0.0666	0.0144	0.0029
Sulphate	80	178	4
Total Metals			
Arsenic Total	0.00305	0.01020	0.00023
Cadmium Total	0.000079	0.000045	0.000018
Chromium Total	0.00470	0.00723	0.00030
Copper Total	0.0111	0.0019	0.0023
Iron Total	2.290	1.230	0.092
Potassium Total	15.1	21.5	0.8
Uranium Total	0.0186	0.0078	0.0001

0008-Be4 Beartooth Pit

Station Point	0008-Be4-M		0008-Be4-T	
Date Sampled	5-Apr-19	16-Sep-19	5-Apr-19	16-Sep-19
Time Sampled	10:16	16:55	10:00	16:35
ALS Sample ID	L2254556	L2349604	L2254556	L2349604
Physical Tests				
Hardness	656	689	612	547
pH	7.12	7.42	7.16	7.55
TSS	<3.0	3.3	<3.0	<3.0
Anions and Nutrients				
Chloride	728	671	724	501
Nitrate	16.8	16.2	16.8	14.4
Nitrite	<0.0050	0.023	<0.0050	0.235
Sulphate	468	465	462	387
Total Metals				
Antimony	0.00505	0.00494	0.00545	0.00371
Arsenic	0.00225	0.00207	0.00235	0.00131
Potassium	216	241	187	173
Selenium	0.00116	0.00110	0.00115	0.00099
Strontium	2.45	2.43	2.43	1.97
Dissolved Metals				
Aluminum	0.0048	0.0081	0.0060	0.0366

0008-Pi2 Pigeon Pit Minewater

Station Point	0008-Pi2					
Date Sampled	27-May-19	5-Jun-19	17-Jun-19	27-Jun-19	3-Jul-19	8-Jul-19
Time Sampled	13:40	17:17	12:17	14:48	16:10	13:00
ALS Sample ID	L2280520	L2288009	L2295058	L2301334	L2305049	L2306850
Physical Tests						
Hardness	186	164	233	585	682	625
pH	6.60	4.90	6.48	7.40	5.13	7.18
TSS	13.7	14.7	28.0	5.0	17.7	18
Anions and Nutrients						
Chloride	3.2	2.0	2.5	6	7	9
Nitrate	8.7	8.1	14.9	38	40	45
Nitrite-N	0.34	0.30	0.39	2.04	1.75	2.09
Sulphate	175	200	221	442	602	613
Total Metals						
Antimony	0.00054	0.00047	0.00145	0.00473	0.00245	0.00205
Arsenic	0.00095	0.00139	0.00226	0.00144	0.00294	0.00250
Potassium	23.9	12.2	16.1	32.9	28.0	29.2
Selenium	0.00123	0.00154	0.00272	0.00447	0.0048	0.0049
Strontium	0.265	0.232	0.39	1.70	1.55	1.34

Station Point	0008-Pi2					
Date Sampled	15-Jul-19	23-Jul-19	29-Jul-19	5-Aug-19	12-Aug-19	18-Aug-19
Time Sampled	13:25	12:40	10:20	11:20	9:48	16:30
ALS Sample ID	L2310956	L2316166	L2319952	L2323941	L2328132	L2333022
Physical Tests						
Hardness	756	912	925	811	752	1010
pH	7.68	7.75	7.68	7.64	5.20	7.65
Total Suspended Solids	27.7	9.3	11.7	40	40.3	81.0
Anions and Nutrients						
Chloride	12.3	16	15	9	7.3	12
Nitrate	63	79	77	54	46	50
Nitrite-N	5.18	5.91	8.11	3.50	2.05	4.66
Sulphate	634	703	678	708	775	794
Total Metals						
Antimony	0.00441	0.00334	0.00494	0.00294	0.00191	0.00347
Arsenic	0.00366	0.00304	0.00310	0.00337	0.00259	0.00317
Potassium	43.5	55.4	46.3	42.5	34.1	47.1
Selenium	0.0054	0.0062	0.0045	0.0068	0.0063	0.0052
Strontium	2.44	2.03	2.71	1.95	1.64	2.69

Station Point	0008-Pi2				
Date Sampled	27-Aug-19	2-Sep-19	9-Sep-19	16-Sep-19	24-Sep-19
Time Sampled	8:35	11:20	11:34	9:45	11:29
ALS Sample ID	L2337667	L2340281	L2344805	L2349623	L2354080
Physical Tests					
Hardness	605	949	943	1000	905
pH	7.58	7.70	7.68	7.53	7.30
Total Suspended Solids	9.4	<3.0	8.7	6.7	14.3
Anions and Nutrients					
Chloride	6	12	10.1	10	9
Nitrate	37	58	55	63	53
Nitrite-N	1.56	4.64	3.03	2.32	1.43
Sulphate	551	742	668	712	842
Total Metals					
Antimony	0.00207	0.00459	0.00421	0.00420	0.00280
Arsenic	0.00249	0.00438	0.00279	0.00120	0.00257
Potassium	33.0	40.9	36.3	38.2	32.1
Selenium	0.0044	0.0042	0.0036	0.0031	0.0046
Strontium	1.37	2.84	2.32	2.50	2.42

0008-Pi6 Outflow of Little Reynolds Pond

Station Point	0008-Pi6
Date Sampled	29-May-19
Time Sampled	15:18
ALS Sample ID	L2283635
Physical Tests	
Hardness	20.9
pH	7.28
Total Suspended Solids	10.7
Anions and Nutrients	
Chloride	1.0
Nitrate	0.29
Nitrite-N	0.0029
Sulphate	7.52
Total Metals	
Antimony	<0.00010
Arsenic	0.00069
Potassium	4.09
Selenium	<0.000050
Strontium	0.0368

0008-Sa2 Monitor Water from Sable Pit to Two Rock Sedimentation Pond (TRSP)

Station Point	0008-Sa2					
Date Sampled	17-Jun-19	24-Jun-19	1-Jul-19	8-Jul-19	15-Jul-19	23-Jul-19
Time Sampled	13:03	10:57	12:35	13:55	16:00	11:35
ALS Sample ID	L2295062	L2299256	L2304288	L2306841	L2310964	L2316186
Physical Tests						
pH	7.63	7.67	7.82	7.82	7.93	7.97
Total Suspended Solids	81.3	7.7	13.7	5.0	35.0	8.7
Turbidity	73.9	10.1	5.27	3.61	24.1	5.8
Anions and Nutrients						
Ammonia	20.7	14	7.9	18.3	16.3	29.9
Nitrite-N	1.91	0.91	0.923	2.710	3.150	3.250
Nitrate	48.8	32	32	66	70.1	88.7
Phosphorus	0.1320	0.0450	0.0256	0.0148	0.2100	0.0127
Total Metals						
Aluminum	2.75	0.19	0.316	0.099	0.73	0.103
Arsenic	0.00259	0.00205	0.00140	0.00113	0.00168	0.00126
Copper	0.0101	0.0052	0.0020	0.0046	0.0090	0.0046
Cadmium	0.00006	0.000056	0.0000582	0.0000803	0.00045	0.0000951
Chromium	0.00356	0.00107	0.00226	0.00043	0.00356	0.00098
Lead	0.00367	0.00107	0.001110	0.00051	0.00460	0.00021
Nickel	0.1720	0.0698	0.0996	0.077	0.1090	0.1220
Zinc	0.0220	0.0032	0.0063	0.0067	0.0246	<0.0030

Station Point	0008-Sa2					
Date Sampled	29-Jul-19	5-Aug-19	12-Aug-19	19-Aug-19	26-Aug-19	2-Sep-19
Time Sampled	12:15	10:35	11:20	11:10	11:45	11:55
ALS Sample ID	L2319958	L2323953	L2328129	L2332867	L2336817	L2340237
Physical Tests						
pH	7.93	7.83	7.75	7.78	7.76	8.83
TSS	84.3	23.7	15.7	6.3	36.3	209000
Turbidity	68.3	27.8	14.40	7.11	23.60	>4000
Anions and Nutrients						
Ammonia	59.4	23.9	19.0	18.4	14.7	7.6
Nitrite	6.09	2.13	2.00	1.36	0.73	3.22
Nitrate	132.0	66.9	49	51	37	38
Phosphorus	0.0465	0.0400	0.0170	0.0250	0.0243	150
Total Metals						
Aluminum	1.940	0.7430	0.452	0.196	0.764	2160
Arsenic	0.00150	0.00159	0.00184	0.00191	0.00165	0.457
Copper	0.03270	0.00701	0.00582	0.00511	<0.0025	4.190
Cadmium	0.0000500	0.000044	0.000071	0.000093	0.000085	0.047
Chromium	0.00300	0.00337	0.00274	0.00122	0.00543	38.100
Lead	0.004100	0.000947	0.000789	0.000680	0.002730	1.430
Nickel	0.2210	0.115	0.141	0.139	0.120	250
Zinc	<0.015	0.0154	0.0040	0.0052	<0.015	9.2600

Station Point	0008-Sa2			
Date Sampled	10-Sep-19	16-Sep-19	23-Sep-19	30-Sep-19
Time Sampled	15:20	11:00	15:45	11:10
ALS Sample ID	L2347533	L2349616	L2353208	L2357691
Physical Tests				
pH	7.99	8.02	7.75	7.81
TSS	64.7	8.7	<3.0	186.0
Turbidity	45.1	4.8	2.01	158.00
Anions and Nutrients				
Ammonia	4.4	3.1	1.8	2.4
Nitrite	4.130	8.720	5.820	5.67
Nitrate	48.8	44.6	32	34
Phosphorus	0.1610	0.0159	0.0059	0.1290
Total Metals				
Aluminum	2.830	0.1260	0.033	2.450
Arsenic	0.00345	0.00302	0.00215	0.00280
Copper	0.00446	0.00064	<0.0025	0.00410
Cadmium	0.0000943	0.000122	0.000075	0.000145
Chromium	0.04240	0.00129	<0.00050	0.03470
Lead	0.001540	0.000075	<0.00025	0.001520
Nickel	0.2650	0.056	0.093	0.252
Zinc	0.0130	0.0054	<0.015	<0.015

0008-Sa8 Runoff from Southern Catchment Area

Station Point	0008-Sa8
Date Sampled	3-Jun-19
Time Sampled	16:11
ALS Sample ID	L2285071
Physical Tests	
pH	6.34
Total Suspended Solids	4.0
Turbidity	12.5
Anions and Nutrients	
Ammonia	0.570
Nitrite-N	0.0139
Nitrate	2.07
Phosphorus	0.0362
Total Metals	
Aluminum	0.74
Arsenic	0.00063
Copper	<0.0025
Cadmium	0.0000350
Chromium	0.00132
Lead	0.00058
Nickel	0.00480
Zinc	<0.015

0008-Sa10 Upstream portion of TRSP

Station Point	0008-Sa10
Date Sampled	26-Aug-19
Time Sampled	12:10
ALS Sample ID	L2336852
Physical Tests	
pH	6.42
Total Suspended Solids	5
Turbidity	3.05
Anions and Nutrients	
Ammonia	3.60
Nitrite-N	0.1220
Nitrate	18.10
Phosphorus	0.0030
Total Metals	
Aluminum	0.165
Arsenic	0.00038
Copper	0.00162
Cadmium	0.0000462
Chromium	0.00034
Lead	0.000252
Nickel	0.01630
Zinc	0.0053

APPENDIX B

2019 Seepage and Waste Rock Report Executive Summary

Executive Summary

Background

As a condition of the current Water Licence W2012L2-0001 (WLWB 2019a), Dominion Diamond Mines ULC (Dominion) is required to monitor waste rock storage area seepage quality and characterize waste rock at the Ekati Diamond Mine. Findings of these monitoring programs are reported annually in the Waste Rock and Waste Rock Storage Area Seepage Survey reports.

Table 1-1 summarizes the conditions listed under Part H, Item 3 and 4 of Water Licence W2012L2-0001 (WLWB 2019a). This table includes the activities undertaken in 2019 by Dominion to comply with all conditions, and the section of this report that documents how each Water Licence condition has been satisfied.

2019 Monitoring Program

Waste rock and coarse kimberlite reject (CKR) sampling continued as per the approved Waste Rock and Ore Storage Management Plan (Version 9.0; Dominion 2018), with an update to the plan awaiting the Board's approval (Version 10.1; Dominion 2019b). The following samples of waste rock and CKR were collected:

- Three samples were collected from the underground operations at Misery from three levels (2075, 2100, 2340),
- 23 samples were collected from four benches (360, 370, 380, 390) in Pigeon Pit,
- 26 samples were collected from six benches (434, 446, 458, 470, 480, 490) in Sable Pit,
- 23 samples were collected from five benches (340, 350, 360, 370, 380) in Lynx Pit, and
- Eight samples of CKR were collected.

During 2019, routine monitoring of waste rock seepage during freshet and fall, and rainfall events in July and August was continued following established protocols. The toes of each waste rock pile (Panda/Koala/Beartooth, including the CKRSA, Fox, Misery, Pigeon, Lynx, Sable) were checked on foot along the tundra in all areas where drainage flowed away from the waste rock. All existing seeps were checked for flow and samples were collected from all seeps that had measurable flow. Seeps with standing water were not sampled.

Fifty (50) seeps were sampled during freshet and 17 seeps were sampled during the fall survey. Eight (8) seeps were sampled following rainfall events in July and August.

This report addresses comments and decisions provided by WLWB (2019b and 2019c).

Summary of Results

Reference Areas

Overall, REF-005, which is located upstream of Bearclaw Lake, continues to show only minimal influence of mining activities, likely through the deposition of dust from the nearby haul road. However, concentrations were well below those of WRSA seeps for key parameters and continue to allow for comparison of long-term trends. REF-037, located upstream of Horseshow Lake in the Sable Area, showed no significant changes in chemistry to historical monitoring results and continues to be a suitable reference station.

Overall, differences in water chemistry between REF-005 and REF-037 have been evident since onset of monitoring and are likely a result of the different catchment areas of these two stations, as opposed to influence of mining activities at REF-005.

Panda/Koala/Beartooth Waste Rock Storage Area

No waste rock material was removed from the Panda, Koala, and Beartooth developments in 2019.

Seepage Monitoring in the North-East

Seepage from the Panda/Koala WRSA continued to show influence of waste rock leaching and flushing of explosive residues at stations SEEP-018B, SEEP-331, SEEP-019 and SEEP-357. Generally, there were no significant changes to trends in leaching in recent years.

Seepage Monitoring in the North-West

Results from SEEP-501 and SEEP-527 samples indicated minimal influence of waste rock leaching and likely influence of dilution by meltwater.

Seepage Monitoring in the North of Koala Pit

Results from SEEP-006A indicated on-going influence of waste rock and kimberlite leaching, as well as flushing of explosive residues, with concentrations of major elements that were higher than the median WRSA concentrations. Trace element concentrations were similar to those for median WRSA seepage. Seepage from this station flows towards the Koala Pit.

Coarse Kimberlite Reject Storage Area

An estimated 1.24 million tonnes of CKR were produced during 2019. Based on the eight samples analyzed, median sulphur content (0.47%) was higher than the long-term median (0.24%). The NP/MPA and CO_3-NP/MPA ratio indicated that the samples were non-PAG. Results continue to indicate that overall in the CKRSA, there is sufficient NP within CKR to neutralize any acid produced as a result of oxidation of contained sulphides. Various median metal concentrations were greater in 2019 than the historic average values which likely reflects changes in geochemical composition in the kimberlite which is typically a mixture of kimberlite from more than one pipe, with proportions from the different pipes changing over time.

Seepage Monitoring Downstream of the CKRSA (South-West)

All seepage from the CKRSA drains into the Long Lake Containment Facility. Seeps that showed the highest influence of weathering and leaching of coarse kimberlite rejects (CKR) included:

- Seeps at the toe of the WRSA berm: SEEP-368, SEEP-393, SEEP-371, SEEP-387
- Seeps downstream of the WRSA berm: SEEP-333, SEEP-012

Other seeps indicated kimberlite leaching that was diluted by meltwater or highly attenuated through contact with the tundra:

- Seeps at the toe of the WRSA berm: SEEP-343, SEEP-355, SEEP-515, SEEP-516, SEEP-392
- Seeps downstream of the WRSA berm: SEEP-383, SEEP-384, SEEP-502, SEEP-526

Evidence of erosion and sediment transport was also noted at several seeps (e.g. SEEP-355).

Petroleum hydrocarbons were only detected twice in CKRSA seepage between 2017 and 2019. Detected results were within five times the detection limit.

Fox Waste Rock Storage Area

Mining at Fox Pit was completed in March 2014, and no materials have been removed from the pit since then. In the summer of 2019, blasting was carried out at the Fox WRSA to dislodge material from the low-grade ore stockpiles on top of the WRSA for processing.

Seepage Monitoring Around the Fox WRSA

Seepage draining from the Fox WRSA that indicated more pronounced influence of sulphide oxidation and kimberlite leaching from the WRSA or kimberlite storage areas included:

- Seeps at the toe of the WRSA: SEEP-373, SEEP-377, SEEP-370, SEEP-529
- Seeps downstream of the WRSA: SEEP-373A

Seepage that indicated less pronounced sulphide oxidation and kimberlite leaching either due to dilution or interaction with the tundra included:

- Seeps at the toe of the WRSA: SEEP-510, SEEP-374, SEEP-512, SEEP-391, SEEP-513, SEEP-514, SEEP-521, SEEP-522, SEEP-378, SEEP-523, SEEP-524, SEEP-390, SEEP-326, SEEP-360, SEEP-362, SEEP-362A and SEEP-388
- Seeps downstream of the WRSA: SEEP-377A, SEEP-382, SEEP-302

Seepage that indicated flushing of fine rock from the WRSA included:

- Seeps at the toe of the WRSA: SEEP-377, SEEP-390, SEEP-529, SEEP-362

Seepage that is similar to background and likely heavily influenced by meltwater during freshet or interaction with the tundra included:

- Seeps at the toe of the WRSA: SEEP-512
- Seeps downstream of the WRSA: SEEP-367, SEEP-508, SEEP-509, SEEP-507, SEEP-517, SEEP-518, SEEP-519, SEEP-519A, SEEP-304/304A

Misery Waste Rock Storage Area

Misery underground granite samples collected in 2019 were all classified as non-PAG based on NP/MPA and had similar characteristics to previously sampled Misery granite.

<u>Seepage Monitoring at the Misery WSRA and Jay Crusher Pad</u>

Seepage results downstream of the Waste Rock Dam can be summarized as follows:

- SEEP-057 and SEEP-059, downstream of the Waste Rock Dam, showed increasing trends of various parameter concentrations, indicating a greater, though still minimal, influence of waste rock leaching in recent years. Higher trace element concentrations were observed in the upstream station SEEP-057, compared to downstream.
- Generally, results of the other upstream seeps SEEP-506 and SEEP-525 showed minimal influence of waste rock leaching.
- Comparison of pond water upstream of the Waste Rock Dam, runoff from the direction of the Misery camp and SEEP-057 results, indicate that seepage downstream of the Waste Rock Dam does in fact show signs of WRSA influence. However, it does not necessarily originate from the Waste Rock Dam pond. Results at REF-040 indicate that contact water may be flowing from the Misery Camp.

Seepage results from the south side of the Misery WRSA at SEEP-528 indicated minor influence of sulphide oxidation at this seep, with trace element concentrations that were between the median and 95th percentile WRSA values.

Seepage results from downstream of the Jay Crusher Pad at SEEP-081 indicated that concentrations of key parameters have mostly stabilized since the sharp increases from 2015 to 2016. In 2019, concentrations of several dissolved trace elements (Cd, Co, Cu, Pb, Mn, Ni, Se, Sr, Zn) were above the 95th percentile values for the catchment area. The results indicate a higher influence of sulphide oxidation in recent years, however not necessarily an increase of kimberlite leaching.

Pigeon Waste Rock Storage Area

Geological observations at the Pigeon pit have determined that intermixing of granite and metasediment precludes the identification and isolation of all but a small amount of granite from metasediment at a mining scale. In 2019, eight samples of diabase and 15 samples of metasedimentary rocks were collected. Not all data were received in time for inclusion into the report. The four samples of Pigeon diabase reviewed had non-PAG (75% of samples) to uncertain (25% of samples) ARD potential based on the NP/MPA criteria from DIAND (1992). The eight samples of the Pigeon metasediment reviewed were classified as non-PAG (75% of samples) to uncertain (25% of samples) ARD potential based on NP/MPA.

Seepage Monitoring Around the Pigeon WRSA

Most of the seeps monitored downstream of the Pigeon WRSA flow from the western edge of the WRSA, and most of the seeps flow into Little Reynold Pond through SEEP-389A. Results indicate a decrease in waste rock leaching at SEEP-389, while all seeps on the west side of Pigeon (except SEEP-398) showed influence of sulphide oxidation. There is a lack of influence of kimberlite leaching at all seeps, and a lack of influence of waste rock leaching at SEEP-394 and SEEP-398.

Lynx Waste Rock Storage Area

Monitoring of Lynx waste rock began in 2018. During 2019, all 17 granite monitoring samples collected were all classified as non-PAG based on NP/MPA and had similar geochemical characteristics to the 2018 Lynx granite waste rock and Misery granite waste rock samples. The seven Lynx diabase monitoring samples in 2019 were all classified as non-PAG based on NP/MPA and had similar geochemical characteristics to the previously sampled diabase.

Seepage Monitoring Around the Lynx WRSA

No seepage was encountered during the 2019 freshet and fall surveys around the Lynx WRSA.

Sable Waste Rock Storage Area

Annual monitoring as outlined in the WROMP for Sable included the collection of waste rock at a rate of three samples per rock type per bench per year for two years. This requirement ended in 2019 given that monitoring commenced in 2017. Not all data were received in time for inclusion into the report. Eighteen Sable granite monitoring samples from 2019 were all classified as non-PAG based on NP/MPA and had similar characteristics to samples of previously mined Sable granite. Five samples of Sable diabase were all classified as non-PAG based on NP/MPA and had similar characteristics to previous Sable diabase. Diabase is estimated to be less than 5% of the material within the proposed pit limits

Seepage monitoring of the Sable WRSA commenced in 2017. SRK traversed the perimeter of the Sable WRSA on foot during the freshet and fall seepage surveys from 2017 to 2019 but no seepage was observed.

Field pH-Conductivity Assessment

During the freshet surveys of 2018 and 2019, SRK sampled waters that were flowing out of snow-covered sections of the WSRAs, mostly at Fox. This was due to either early surveys or late freshets. These flows had low conductivity (generally <50 µS/cm), slightly acidic pH (<6) and very low concentrations of dissolved elements of interest. This suggests that samples from some of the new monitoring stations established during these surveys may represent melt water as opposed to WRSA seepage.

SRK thus recommended evaluating conductivity and pH to determine whether these parameters may be measured in the field to differentiate between contact water (seepage) and melt water. SRK (2020) documented the approach used for the assessment, the results and conclusions, a discussion on the potential risks of implementing a pH-EC based criteria for establishing new seepage monitoring stations during freshet, and recommendations on how to implement the criteria to mitigate the potential risks.

SRK has made recommendations on how to identify melt water in the field based on observations and field measurements of pH and conductivity, as well as criteria for identifying melt water using the data collected.

APPENDIX C
2019 Summary of Ground Temperature Conditions

TETRA TECH

March 13, 2020

ISSUED FOR USE
FILE: E14103036-08

Dominion Diamond Mines ULC
900-606 4 Street SW
Calgary, AB T2P 1T1

Attention: Annie Larrivee, P.Eng.
Waste and Wastewater Advisor

Subject: 2019 Summary of Ground Temperature Conditions in the Waste Rock Storage Areas
Ekati Diamond Mine, NT

1.0 INTRODUCTION

1.1 General

Tetra Tech Canada Inc. (Tetra Tech) was retained by Dominion Diamond Mines ULC (Dominion) to review the 2019 ground temperature data and provide a summary of the ground temperature conditions within the waste rock storage areas (WRSAs) at the Ekati Diamond Mine (Ekati), NT.

Tetra Tech typically measures ground temperatures in the WRSAs a minimum of four times annually, using ground temperature cables (GTCs) installed at various locations. The locations and current operating status of the GTCs are shown in Figures 1 through 3 and summarized in Table 1.

Table 1: Ground Temperature Cable Installation Summary

Cable ID	Date Installed	Location	Comments
1378	2000-08-30	Panda/Koala WRSA Site 1 – 15 m Bench	Installed by BBCI with design input from EBA Can no longer be read safely
1379	2000-08-30	Panda/Koala WRSA Site 2 – 15 m Bench	Installed by BBCI with design input from EBA Can no longer be read safely
1377	2000-08-30	Panda/Koala WRSA Site 3 – 15 m Bench	Installed by BBCI with design input from EBA
1380	2000-08-30	Panda/Koala WRSA Site 4 – 30 m Bench	Installed by BBCI with design input from EBA
1534	2002-02-16	Panda/Koala WRSA Site 4 – centre of pile	All beads not operational
1482	2002-01-31	Panda Toe Berm	
1483	2002-01-31	Panda Toe Berm	
1484	2002-01-31	Panda Toe Berm	
1485	2002-01-31	Panda Toe Berm	
1468	2001-07-08	CPKSP	Cable destroyed in 2005
1469	2001-07-08	CPKSP	Cable buried between the spring and fall in 2014
1746	2004-11-30	Bearclaw Toe Berm	
1931	2006-10-19	Fox Low Grade Kimberlite Dump	Installed by BBCI
1932	2006-10-14	Fox Waste Granite Dump	Installed by BBCI; not found in April 2009

Tetra Tech Canada Inc.
14940 - 123 Avenue
Edmonton, AB T5V 1B4 CANADA
Tel 780.451.2121 Fax 780.454.5688

Table 1: Ground Temperature Cable Installation Summary

Cable ID	Date Installed	Location	Comments
1933	2006-10-23	Fox Waste Kimberlite Dump	Installed by BBCI
1743	2004-11-28	Fox Toe Berm Southeast Valley	
1744	2004-11-28	Fox Toe Berm 3 Hump Lake Streams	
1745	2004-11-30	Fox Toe Berm Fox Lake Trail	
WRP#1 – 1466	2001-06-05	Misery WRSA	WRP#1 consists of two cables. Second cable installed to coincide with additional waste rock placement. Cable damaged during mining and could not be read
WRP#1 – 1541	2002-03-07		
WRP#2 – 1467	2001-06-13	Misery WRSA	WRP#2 consists of two cables. Second cable installed to coincide with additional waste rock placement
WRP#2 – 1542	2002-03-06		
WRP#3 - 1606	2002-06-13	Misery WRSA	Started supplying readings in July 2009. Cable damaged in 2014 and could not be read
WRP#4 - 1773	2005-04-26	Misery WRSA	Cable buried since the last reading taken in 2015
WRP#5 - 1772	2005-04-26	Misery WRSA	
WRP#6 - 1774	2005-04-26	Misery WRSA	Cable buried under waste rock in 2013
2303	2018-02-28	Misery WRSA	Installed by Golder Associates Ltd. Data provided by Dominion
BH15-1 / 2538	2015-06-11	Fox Low Grade Kimberlite Dump	Installed by Tetra Tech EBA
BH15-2 / 2539	2015-06-19	Fox Waste Granite/Kimberlite Dump	Installed by Tetra Tech EBA
BH15-3 / 1920	2015-06-15	Fox Waste Kimberlite Dump	Installed by Tetra Tech EBA; Cable damaged in 2017
BH15-4 / 2541	2015-06-13	Fox Waste Kimberlite Dump	Installed by Tetra Tech EBA
BH15-6 / 2540	2015-06-20	Fox Waste Granite/Kimberlite Dump	Installed by Tetra Tech EBA

Note: BBCI refers to BHP Billiton Canada Inc., now Dominion Diamond Mines ULC

Ground temperature data is presented in Figures 4 through 33. This data is presented in two formats:

- Profiles showing ground temperature versus depth; and
- Plots displaying ground temperature versus time for selected depths within the WRSAs and toe berms. These Figures are denoted by the suffix “a” in the Figure number.

Typically, only ground temperatures from the spring and late fall have been plotted on these figures. This allows for easier interpretation of cooling or warming trends as these are usually the times of year when ground temperatures are at their coolest (spring) or warmest (late fall).

1.2 Climate Condition

As part of the ground temperature summary, historical monthly air temperatures at Ekati were reviewed to assist with interpreting the measured waste rock temperatures. Air temperatures do not exclusively influence ground temperatures (other factors such as snow cover, wind speed, and solar radiation also play a role); however, they do provide some help in understanding the currently observed temperature change and future trends.

Historical air temperature data at Ekati is available from September 1993 to present; however, significant portions of the data set prior to 2002 are incomplete and were not included as part of this analysis. Table 2 summarizes the historical air temperatures and calculated freezing index at Ekati. The freezing index provides a measure of how cold a winter is and allows for relative comparison between years (higher values indicate colder winter temperatures or a longer season duration). It is calculated by summing the mean daily temperatures for those days when air temperatures are below 0°C.

The data shows that the winter of 2005/2006 was the warmest winter on record, which was evident with a reduced winter road season due to particularly warm temperatures. The winter temperatures of 2007/2008 were the coldest temperatures on record. The most recent winter temperatures from 2018/2019 show a slightly warmer winter when compared to the previous winter.

Table 2: Summary of Monthly Air Temperature at Ekati Diamond Mine, NT

Year	Month												Mean (°C)	Freezing Index (°C·day)
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.		
2002	-25.9	-28.2	-24.1	-18.9	-7.0	8.5							-9.5	
							12.9	9.2	3.4	-8.6	-16.4	-19.2		4,370
2003	-26.5	-31.6	-24.9	-12.3	-3.6	6.6							-8.9	
							14.4	11.0	4.4	-3.0	-17.6	-23.5		4,835
2004	-32.8	-27.2	-27.4	-18.1	-10.1	6.1							-12.2	
							13.1	7.8	1.8	-9.2	-20.4	-29.7		4,757
2005	-29.9	-28.3	-22.3	-10.2	-7.2	6.4							-9.3	
							10.6	9.4	1.0	-5.7	-15.8	-19.3		3,599
2006	-24.7	-22.5	-17.1	-11.5	1.4	11.4							-6.3	
							14.2	11.5	4.9	-4.9	-20.0	-18.9		4,279
2007	-24.4	-27.5	-26.5	-12.0	-3.8	6.9							-9.4	
							14.2	7.7	-0.1	-5.7	-20.5	-20.6		4,875
2008	-28.6	-30.8	-28.0	-15.5	-2.5	7.4							-10.3	
							13.5	10.3	1.1	-4.6	-17.3	-28.7		4,670
2009	-26.7	-26.6	-27.3	-12.8	-8.9	5.8							-9.8	
							11.8	9.9	6.0	-8.4	-16.3	-24.3		3,792
2010	-26.3	-21.2	-16.3	-7.0	-6.9	7.6							-7.0	
							14.3	11.0	3.5	-4.1	-15.8	-22.5		4,208
2011	-28.6	-25.6	-23.3	-17.9	-0.5	7.7							-8.3	
							15.8	12.2	5.8	-3.0	-18.8	-22.8		4,047
2012	-28.5	-21.8	-22.4	-13.8	2.4	11.2							-7.6	
							15.2	12.5	7.8	-5.4	-19.9	-28		4,516
2013	-31.6	-26.2	-24.9	-17.7	-3.2	12.3							-9.0	
							11.3	12.6	5.4	-2.8	-20.1	-23.1		3,815
2014	-29.9	-28.0	-26.7	-17.6	-2.4	11.1							-10.0	
							15.7	9.8	3.0	-8.3	-22.1	-24.7		4,378
2015	-29.0	-31.0	-24.1	-16.0	0.0	10.0							-8.9	
							12.2	12.8	4.5	-8.3	-16.0	-21.7		4,327
2016	-24.5	-27.7	-22.0	-17.9	1.0	10.7							-8.1	
							14.4	12.0	4.5	-7.4	-13.2	-27.7		4,280
2017	-24.6	-26.5	-24.2	-17.1	1.3	9.5							-8.3	
							13.5	16.2	5.0	-8.2	-20.8	-24.1		4,507
2018	-25.9	-27.9	-22.4	-16.4	-5.9	10							-9.6	
							13.8	10.3	-1.3	-8	-20.6	-21.4		4,479
2019	-30.0	-29.1	-16.8	-15.2	-5.1	7.2							-9.3	
							11.2	9.6	5.2	-4.3	-17.4	-27.3		

2.0 GROUND TEMPERATURE DATA

2.1 Panda/Koala WRSA and Toe Berms

Ten GTCs were installed in the Panda/Koala WRSA and adjacent toe berms as shown in Figure 1. Ground temperature data for the WRSA is presented in Figures 4 through 8, while the toe berm data is presented in Figures 9 through 13.

2.1.1 Panda/Koala WRSA

Ground temperature data from the Panda/Koala WRSA (GTCs 1534, 1377, 1378, 1379, and 1380) shows that the waste rock pile continues to be in a permafrost condition, with the exception of the seasonal active layer. Temperature conditions in the Panda/Koala WRSA are summarized in Table 3 and discussed below.

Table 3: Panda/Koala WRSA Ground Temperature Summary

GTC	Spring 2019 Temperature in WR (°C)	Fall 2019 Temperature in WR (°C)	Fall 2019 Temperature at Original Ground (°C)	Figures
1377	-2.7 to -8.7	-3.8 to 3.7	-4.9	6 & 6a
1378	N/A	N/A	N/A	4 & 4a
1379	N/A	N/A	N/A	5 & 5a
1380	-0.6 to -15.0	0.0 to -6.9	-2.2	7 & 7a
1534	N/A	N/A	N/A	8 & 8a

Note: WR refers to Waste Rock

Material is being removed from the northeast portion of the Panda/Koala WRSA for use as crusher feed. GTCs 1378 and 1379 can no longer be safely read and the casings containing these GTCs are exposed.

Ground temperature measurements, for cables 1377 and 1380 (Figures 6 and 7), from fall 2019 show that the measured active layer thickness ranges from approximately 2 m to 4 m, consistent with observations from previous years. Fall 2015 ground temperature data from GTC 1534 suggest the active layer may be somewhat deeper at this location; however, readings from this GTC are suspect as discussed below.

Ground temperatures around the perimeter of the WRSA (Figures 4 through 7) range from -3.3°C to -6.8°C at the pile base, which is slightly cooler than typical permafrost temperatures observed at Ekati (typically around -3.0°C to -5.0°C). Historically, temperatures around the perimeter of the WRSA are significantly colder than near the centre of the pile (Figure 8). These cooler temperatures are thought to be the result of convective cooling cells developing around the WRSA perimeter, which provides enhanced cooling for the pile.

Figure 6a shows a constant temperature at the base of the WRSA since approximately 2006. Figures 4a, 5a, and 7a (GTCs 1378, 1379, and 1380, respectively) show a steep increase in basal temperature of the waste rock due to the removal of the thermal cover material in this area. This result of removal of material is shown clearly in the warmer temperatures on Figures 4, 5, and 7.

One cable was installed in the central portion of the pile (GTC 1534, Figure 8). Since 2006, several beads on the cable have malfunctioned and only partial readings are available. In January 2008, the cable was buried during waste deposition. The cable was exposed and all the beads are no longer operational.

2.1.2 Panda/Koala Toe Berm

Ground temperature conditions in the Panda/Koala toe berms are summarized in Table 4 and discussed below.

Table 4: Panda/Koala Toe Berm Ground Temperature Summary

GTC	Spring 2019 Temperature through Fill Material (°C)	Fall 2019 Temperature through Fill Material (°C)	Fall 2019 Temperature at Original Ground (°C)	Figures
1482	-7.2 to -8.4	-5.6 to -6.9	-7.2	11 & 11a
1483	-7.0 to -7.7	-2.5 to -3.7	-5.2	9 & 9a
1484	-5.7 to -6.1	-4.5 to -4.8	-5.0	10 & 10a
1485	-7.4 to -7.7	-6.5 to -6.9	-7.2	12 & 12a
1746	-10.9 to -12.9	-2.1 to -5.0	-5.9	13 & 13a

In 2010, excavation occurred around the northeast portion of the Panda/Koala WRSA, in the vicinity of the Bearclaw and Panda toe berms, and some of the thermal cover over the toe berms was removed. Warming of the ground temperatures were observed in 2010 in two of the toe berm GTCs (GTCs 1482 and 1485) due to the impact of the construction activities (crusher feed excavation) coupled with the warmer winter season in 2009/2010 (Figures 11a and 12a). These cables have shown an increase in temperatures since 2012 and the 2019 temperature measurements continue to show a general warming of the original ground surface and through the fill material of the pile at these two locations; however, ground temperatures are still below typical permafrost temperatures at Ekati.

The review of the ground temperature data for the GTCs installed in the toe berms shows the following:

- Spring and fall 2019 readings in GTCs 1483 and 1484 (Figures 9 and 10) show slightly cooler temperatures when compared with 2018 readings. There is evidence with the 2015 and 2016 temperature measurements that the ground temperatures could now be stabilized from the crusher feed excavation in 2010.
- Spring and fall 2019 readings in GTCs 1482 and 1485 (Figures 11 and 12) show slightly warmer temperatures when compared with 2018 readings.
- GTC 1746 (Figure 13), in the Bearclaw toe berm, shows slightly warmer temperatures when compared with 2018 readings.

Temperatures in the toe berm are still generally below typical permafrost temperatures observed at Ekati. However, GTCs 1482 through 1485 show a significant warming of the upper 4 m possibly due to the removal of some of the thermal cover, as material is currently being removed for use as crusher feed.

2.2 Fox WRSA and Toe Berms

A total of 11 GTCs have been installed in and around the Fox WRSA and toe berms, with locations provided in Figure 2. Three GTCs were installed in the Fox WRSA in 2006 and three GTCs installed in the toe berms in 2004. In June 2015, five additional GTCs were installed in the Fox WRSA during a geotechnical drilling investigation program. Ground temperature data for the Fox WRSA is provided in Figures 14 through 21, while toe berm data is presented in Figures 22 through 24.

2.2.1 Fox WRSA

Ground temperature conditions in the Fox WRSA are summarized in Table 5 and discussed below. No spring readings were obtained for the year of 2019 at the Fox WRSA.

Table 5: Fox WRSA Ground Temperature Summary

GTC	Active Layer Thickness (m)	Spring 2019 Temperature in WR (°C)	Fall 2019 Temperature in WR (°C)	Fall 2019 Temperature at Original Ground (°C)	Figures
1920	5.0(1)	N/A	N/A	N/A	14
1931	6.1(2)	N/A	-2.5 to 3.6	0.8(3)	15 & 15a
1932	7.0(2)	N/A	-0.3 to 3.6	2.5	16 & 16a
1933	4.8	N/A	-2.1 to 3.2	0.3(4)	17 & 17a
2538	3.8	N/A	-0.3 to 5.9	1.7	18
2539	5.0	N/A	-0.4 to 11.0	2.3(5)	19
2540	5.6	N/A	-0.1 to 6.9	1.9	20
2541	5.9	N/A	-1.7 to -0.2	-1.7	21

Note: WR refers to Waste Rock
(1) active layer thickness is based on the 2016 measurements
(2) active layer thickness is based on 2018 fall measurements
(3) measurements are taken 1.6 m from original ground
(4) measurements are taken 6.0 m from original ground
(5) measurements are taken 0.5 m from original ground

With the exception of an active layer that displays period freezing behaviour, large portions of the waste rock pile continue to be unfrozen. GTC 1932 (Figure 16) and GTC 1933 (Figure 17) have seen gradual cooling mid depth over the last 12 years. GTC 2538 (Figure 18) and GTC 2539 (Figure 19) also show cooling mid depth.

The 2019 temperatures in the original three GTCs (GTCs 1931, 1932, and 1933) show slight variations from those observed in 2018. Specific observations are presented as follows:

- Temperature data in 2019 for GTCs 1931 and 1932 (Figures 15 and 16) shows slightly cooler temperatures mid-depth when compared with the 2018 measurements. 2019 GTC 1933 (Figure 17) has comparable temperatures when compared to the 2018 temperatures at mid depth.
- The original ground elevation of GTC 1932 (Figure 16) remains unfrozen, consistent with observations in the previous year.
- The base of GTC 1931 (Figure 15), located 1.6 m above the original ground, remains in an unfrozen condition, but has progressively cooled since 2007 (from 2.0°C in 2007 to 0.8°C in 2018); however, the rate of cooling has slowed since 2011.

The newest GTCs (GTCs 2538, 2539, 2540, and 2541) were installed in 2015. Ground temperature conditions have been reported based on the limited data available; however, more data is needed to accurately interpret the thermal trend conditions in the new GTCs. Specific observations are presented as follows:

- GTCs 2538 (Figure 18), 2539 (Figure 19), and 2540 (Figure 20) show temperatures mostly above 0°C, consistent with previously installed GTCs.
- The temperatures in GTC 2539 (Figure 19) are the warmest of the new cables, reaching temperature of 11.0°C. The maximum temperatures in GTCs 2538 (Figure 18) and 2540 (Figure 20) are 5.9°C and 6.9°C, respectively.
- The temperatures seen in GTC 2541 (Figure 21) are frozen beneath the active layer. The minimum temperature of -6.2°C was recorded in the fall of 2018.
- GTC 1920 (Figure 14) is damaged with only the first bead giving temperature readings.

2.2.2 Fox Toe Berms

Ground temperature conditions in the Fox toe berms are summarized in Table 6 and discussed below. Due to the lack of snow clearing and accessibility no spring readings were obtained in 2019 at the Fox Toe Berms.

Table 6: Fox Toe Berm Ground Temperature Summary

GTC	Spring 2019 Temperature through Lacustrine Material (°C)	Fall 2019 Temperature through Lacustrine Material (°C)	Fall 2019 Temperature at Original Ground (°C)	Figures
1743	N/A	-8.8 to -10.6	-8.8	22 & 22a
1744	N/A	-4.5 to -6.7	-6.7	23 & 23a
1745	N/A	-1.0 to -7.1	-7.1	24 & 24a

Ground temperature data has been collected for the Fox toe berms since their construction in 2004. In all cases, the low permeable lacustrine materials remain in a permafrost condition with temperatures ranging from -1.0°C to -10.6°C. A review of the ground temperatures indicates the following:

- GTCs 1743, 1744, and 1745 (Figures 22, 23, and 24) indicate that the entire section is in continuous permafrost.
- GTCs 1743 and 1745 (Figures 22 and 24) show a slightly cooling in ground temperatures compared to the 2018 readings. GTC 1744 (Figure 23) shows a slight warming in ground temperatures compared to the 2018 readings.

2.3 Misery WRSA

GTCs have been installed at seven locations in the Misery WRSA, as shown on Figure 3. GTCs at Misery were installed over several years, from June 2001 to May 2005. Of the originally installed cables only GTC 1772 remains active. All the other cables have been damaged or destroyed. On February 28, 2018, two new GTCs were installed by Golder Associates Ltd. One of the GTCs was damaged after installation. Readings have been received for the remaining GTC (GTC 2303, Figure 31). Ground temperature data for the WRSA is presented in Figures 25 through 31. Table 7 summarizes the ground temperature conditions in the Misery WRSA. Discussion pertaining to the ground temperatures is provided below.

Table 7: Misery WRSA Ground Temperature Summary

GTC	Active Layer Thickness (m)	Spring 2019 Temperature in WR (°C)	Fall 2019 Temperature in WR (°C)	Fall 2019 Temperature at Pile Base (°C)	Cable Status	Figures
1541 / 1466	N/A	N/A	N/A	N/A	Destroyed	25 & 25a
1542 / 1467	N/A	N/A	N/A	N/A	Destroyed	26 & 26a
1606	N/A	N/A	N/A	N/A	Damaged	27 & 27a
1772	12.0	-7.3 to -5.0	-6.6 to 6.2	-5.2	Active	28 & 28a
1773	N/A	N/A	N/A	N/A	Buried	29 & 29a
1774	N/A	N/A	N/A	N/A	Buried	30 & 30a
2303	4.0	-8.6 to -4.4	-5.2 to 5.5	-5.2	Active	31 & 31a

Note: WR refers to Waste Rock

The Misery GTC status is summarized in Table 7 above. All GTCs in the Misery WRSA, except for GTCs 1772 and 2303 have been damaged, destroyed, or buried. Historical data plots for the damaged cables have been included in the Figures section for reference.

- The fall 2019 readings from GTC 1772 (Figure 28) below the active layer are approximately 0.3°C cooler when compared to 2018 readings within the middle section of the pile.
- The active layer thickness in GTC 1772 for fall 2019 is 12.0 m.
- GTC 2303 currently only has two years of readings to analyze. More readings will be required to accurately interpret the thermal trend conditions. Currently the active layer is approximately 4.0 m deep, with permafrost temperatures below the active layer ranging from 0°C to -6.6°C.

Historical data suggests the WRSA below the active layer is in a permafrost state. The thickness of the active layer is quite variable in the Misery WRSA, ranging from an estimated 2.6 m to 13.0 m based on historical data. The large active layer thicknesses in the Misery WRSA are likely a function of the proximity of some cables to the sideslopes and the accumulation of snow, which acts as a thermal blanket reducing heat transfer from the waste rock at some locations. However, the Misery WRSA pile is continuing to be developed and the configuration is changing. Historical active layer measurements may not reflect current conditions.

2.4 Coarse Processed Kimberlite Storage Pile

GTCs 1468 and 1469 were installed in the Coarse Processed Kimberlite Storage Pile (CPKSP). Their locations are shown on Figure 1. Both cables were installed in summer 2001. GTC 1468 was damaged and no data was recorded after fall 2005. Ground temperature conditions in the CPKSP continued to be monitored by GTC 1469 until spring 2014. GTC 1469 was buried between the spring and fall of 2014 and there are no longer functioning GTCs in the CPKSP. Historical ground temperature data for the CPKSP is presented in Figures 32 and 33 and summarized in Table 8.

Table 8: Coarse PK Storage Pile Ground Temperature Summary

GTC	Active Layer Thickness (m)	Spring 2019 Temperature in CPK Pile (°C)	Fall 2019 Temperature in CPK Pile (°C)	Fall 2019 Temperature at Pile Base (°C)	Figures
1468	N/A	N/A	N/A	N/A	32 & 32a
1469	N/A	N/A	N/A	N/A	33 & 33a

Note: CPK refers to Coarse Processed Kimberlite

The materials making up the storage pile at the GTC locations are shown on Figures 32 and 33. The thickness of coarse processed kimberlite (CPK) at installation was 6.0 m and 8.5 m at the locations of GTCs 1468 and 1469, respectively. At the time of GTC installation, the surface of the CPKSP was roughly equal to the ground elevation at the cables.

As there are no longer functioning GTCs in the CPKSP the ground temperature data in the CPKSP is limited to the readings in GTC 1469 prior to spring 2014. The readings at the time allowed the following observations to be made.

- Ground temperatures in the CPKSP continued to stay warm compared to the normal ground temperatures in the native ground at Ekati (typically around -3.0°C to -5.0°C). Temperatures were also warmer than those measured in the Panda/Koala WRSA.
- Temperatures in the CPKSP are slightly warmer in the upper 4.0 m compared with 2009 measured data. Below 4.0 m, the temperatures remain consistent with those observed in previous years.
- The current temperature of the CPK remains slightly below 0°C. However, the freezing temperature is expected to be somewhat lower because of some salinity in the CPK pore water and the CPK mineralogy. Therefore, the CPK is likely unfrozen.
- The CPK has a high moisture content and, as such, contains a large amount of latent heat that must be liberated before freezing will occur. Freezing of the pile is expected; however, it will take a considerable amount of time.

3.0 DISCUSSION AND RECOMMENDATIONS

Ground temperatures within the Ekati WRSAs and toe berms generally show similar temperature trends to those observed last year. It is recommended that ground temperature readings continue to be obtained four times per year, keeping consistent with past practice.

The Panda/Koala WRSA and toe berms remain in a permafrost condition, consistent with previous years.

Large portions of the Fox WRSA remain unfrozen, as in previous years. Temperature measurements indicate that ground temperatures are cooling at the locations of GTCs 1931 and 1932; however, the time for freeze-back is unknown.

The GTC's at the Fox toe berms indicate that the berms are now in continuously frozen permafrost as in previous years and there was an active layer from 1.0 m to 4.0 m from the surface. The maximum temperature of the lacustrine core material is -1.0°C. There are no immediate concerns or issues with respect to thermal conditions in the Fox toe berms.

There are only two operating GTCs in the Misery WRSA. Data from the cable indicates the WRSA is in a permafrost condition; however, conditions across the entire pile cannot be evaluated with the current GTC network. There are no immediate issues or concerns with respect to the ground temperatures in the Misery WRSA. Tetra Tech recommends the installation of additional GTCs once the pile construction is completed.

Ground temperature data in the CPKSP is limited to readings prior to spring 2014 as there are no longer any functioning cables. Tetra Tech recommends the installation of additional GTCs at the CPKSP once its construction is completed.

4.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Dominion Diamond Mines ULC. and their agents. Tetra Tech Canada Inc. does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Dominion Diamond Mines ULC, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech Canada Inc.'s Services Agreement. Tetra Tech's Limitations on Use of this Document are provided in Appendix A of this report.

5.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

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March 13, 2020

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Date March 13, 2020
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NT/NU Association of Professional Engineers and Geoscientists

APPENDIX D
2019 AEMP Summary Report

Ekati Diamond Mine

2019 Aquatic Effects Monitoring Program – Summary Report

Dominion
Diamond Mines

June 2020

Ekati Diamond Mine

2019 Aquatic Effects Monitoring Program – Summary Report

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GLOSSARY AND ABBREVIATIONS

Action Level	"*A predetermined change, to a monitored parameter or other qualitative or quantitative measure, that requires the Licensee to take appropriate actions that may include, but that are not limited to: further investigations, changes to operations, or enhanced mitigation measures*" as defined in the Class A Water Licence (W2012L2-0001).
AEMP	Aquatic Effects Monitoring Program is a "*monitoring program designed to determine the short- and long-term effects in the Receiving Environment resulting from the Project; to evaluate the accuracy of impact predictions; to assess the effectiveness of planned impact mitigation measures; and to identify additional impact mitigation measures to reduce or eliminate environmental effects*" as defined in the Class A Water Licence (W2012L2-0001).
AES	Aquatic Ecology Synthesis
ARF	Aquatic Response Framework. "*Response Framework is a systematic approach to responding when the results of a monitoring program indicate that an Action Level has been reached"* as defined in the Class A Water Licence (W2012L2-0001).
BACI	Before-after-control-impact
BC MOECCS	BC Ministry of Environment and Climate Change Strategy
Benthic	Pertaining to the bottom region of a water body, on or near bottom sediments or rocks.
Benthos	Benthos communities are a group of organisms that live associated with the bottom of lakes or streams. These communities contain a diverse assortment of organisms that have different mechanisms of feeding. The term benthos is used interchangeably with benthic invertebrates in this report. Benthos are an important food source for fish.
Biomass	The amount of living matter as measured on a weight or concentration basis. Biomass is an indication of the amount of food available for higher trophic levels. In the AEMP, phytoplankton biomass is estimated as chlorophyll *a*, and zooplankton biomass is measured as milligrams of dry weight per cubic metre.
CCME	Canadian Council of Ministers of the Environment
Chlorophyll	Chlorophyll is a molecule contained in photosynthetic organisms which is required to carry out photosynthesis. Chlorophyll *a* is used as an indicator of phytoplankton biomass in this report.
Construction	"*Any activities undertaken to construct or build any components of, or associated with, the development of the Project*" as defined in the Class A Water Licence (W2012L2-0001).

Development	"*All of the activities and facilities associated with the Construction, operation and Reclamation of the Sable, Pigeon, and Beartooth pits*" as defined in the Class A Water Licence (W2012L2-0001). "*Misery Development means all of the activities and facilities associated with the Construction, operation, and Reclamation of the Misery pit*" and "*Sable Development means all of the activities and facilities associated with the Construction, operation, and Reclamation of the Sable pit"* as defined in the Class A Water Licence (W2012L2-0001).
Diatom	Diatoms are a type of single celled algae. They photosynthesize and may live either free-floating in water (as phytoplankton) or attached to substrates (as periphyton). Diatoms contain a silica shell (called a frustule) outside of their cell membrane.
Diptera	Refers to a taxonomic order of insects. Dipterans are the true flies, and their larval stages are a major component of lake and stream benthos communities. Dipterans are characterized by a single pair of functional wings and include a wide diversity of species. Diptera include the familiar mosquito and black fly, and their larvae are an important food source for fish. Their abundance and diversity can be used as an indicator of lake or stream water and sediment quality.
Diversity Indices	A measure of how varied in terms of genera a community of organisms is. In general, a healthy ecosystem will support a variety of species and have a high diversity index.
DL	Analytical detection limit
DO	Dissolved oxygen
Dominion	Dominion Diamond Mines ULC
EA	Environmental Assessment
Ecology	The study of the interactions between organisms and their environment.
Ecosystem	A community of interacting organisms considered together with the chemical and physical factors that make up their environment.
Effect	Refers to any change in the aquatic environment that is a result of project activities associated with the Ekati Diamond Mine.
EPT	Ephemeroptera, Plecoptera, and Trichoptera
EQC	Effluent Quality Criteria
ERM	ERM Consultants Canada Ltd.
EROD	Ethoxyresorufin-o-deethylase
Freshet	Freshet refers to a high-water flow event within a stream. In snowmelt driven systems such as the Arctic, the term is commonly used to refer to spring hydrology conditions in which the majority of annual water volume passes through streams in a short period of time. At the Ekati Diamond Mine, freshet typically begins in late May or early June, and lasts for a few weeks.
HAL	High Action Level
HWL2	Horseshoe Watershed Lake 2
Hydrology	The study of the properties of water and its movement in relation to land.

Invertebrates	Collective term for all animals without a backbone or spinal column.
KPSF	King Pond Settling Facility. "Comprises the basin and associated containment structures as generally described in the application for renewal of Water Licence N7L2-1616 filed on December 12, 2003 and given file number MV2003L2-0013 [see Figure 1.6c in the Mining Industry Questionnaire] or as modified in subsequent plans and/or drawings as approved by the Board" as defined in the Class A Water Licence (W2012L2-0001).
LAL	Low Action Level
Limnology	The study of lakes, including their physical, chemical, and biological processes.
LLCF	Long Lake Containment Facility "*comprises the basin and containment structures that are designed to contain Processed Kimberlite and other Waste*" as defined in the Class A Water Licence (W2012L2-0001).
MAL	Medium Action Level
Metals	For the purpose of the AEMP, the term metals includes metalloids.
Minewater	"*Runoff from facilities associated with the Project and all water or Waste pumped or flowing out of any open pit or underground mine"* as defined in the Class A Water Licence (W2012L2-0001).
PAH	polycyclic aromatic hydrocarbons
PDC	Panda Diversion Channel. An engineered channel used to divert water from North Panda Lake to Kodiak Lake.
Photosynthesis	The metabolic process by which carbon dioxide and sunlight are converted to simple sugars and oxygen. Organisms that photosynthesize contain the molecule chlorophyll.
Phytoplankton	Phytoplankton are microscopic primary producers that live free-floating in water. These organisms are single-celled algae that photosynthesize. Some common types of phytoplankton include diatoms and cyanobacteria.
Primary Producers	In this report, primary producers refer to organisms that convert sunlight into food through the process of photosynthesis. Aquatic primary producers can include phytoplankton, periphyton, macrophytes, and submerged vegetation. Only phytoplankton are examined as part of the Ekati Diamond Mine AEMP.
PSD	Pigeon Stream Diversion. An engineered diversion constructed to allow flows from the headwater reaches of the Yamba/Exeter Watershed to enter Fay Bay channel unaltered and to circumvent Pigeon Pit.
Receiving Environment	"*For the purpose of this Licence, the natural aquatic environment that receives any deposit or Discharge of Waste, including Seepage or Minewater, from the Project*" as defined in the Class A Water Licence (W2012L2-0001).
Response Plan	"*A part of the Response Framework that describes the specific actions to be taken by the Licensee in response to reaching or exceeding an Action Level*" as defined in the Class A Water Licence (W2012L2-0001).
Secchi Depth	Secchi depth is the depth at which a Secchi disc (standardized white and black disc) can no longer be seen when it is lowered into a lake. Secchi depth can be used to calculate the depth of the euphotic zone.

Seepage	“*Includes water or Waste that drains through or escapes from any structure designed to contain, withhold, divert or retain water or Waste, including Waste Rock Storage Areas*” as defined in the Class A Water Licence (W2012L2-0001).
Sewage	“*All toilet Waste and greywater*” as defined in the Class A Water Licence (W2012L2-0001).
Specific conductivity	The ability of water to conduct electricity. Conductivity increases with increasing concentrations of dissolved salts. Because conductivity varies with temperature, specific conductivity (conductivity standardized to 25 °C) is reported.
SSWQO	Site-specific water quality objective
SWE	Snow water equivalent
TDS	Total dissolved solids
TOC	Total organic carbon
Trophic Levels	Functional classification of organisms in an ecosystem according to feeding relationships. Primary producers constitute the first trophic level, and convert energy from the sun into food. All other trophic levels depend upon primary producers for their food. Secondary producers (or primary consumers) constitute the second trophic level, and tertiary producers (or secondary consumers) constitute the third trophic level. In a lake, phytoplankton constitute the first trophic level, zooplankton and some benthic organisms the second, and fish the third.
TRSP	Two Rock Sedimentation Pond “*The containment structure that is designed to contain the Minewater from the Sable pit during operation, drainage from the Waste Rock Storage Area, and the turbid water and solids fraction of the lake sediments after lake Dewatering and stripping*” as defined in the Class A Water Licence (W2012L2-0001).
US EPA	United States Environmental Protection Agency
Waste Rock	“*All unprocessed rock materials that are produced as a result of mining operations*” as defined in the Class A Water Licence (W2012L2-0001).
WLWB, the Board	Wek’èezhìi Land and Water Board, referred to as the Board within this report with the exception of reference citations.
WRSA	Waste Rock Storage Area “*The facilities where Waste Rock, Coarse Processed Kimberlite, and other materials as approved by the Board are deposited in accordance with this Licence*” as defined in the Class A Water Licence (W2012L2-0001).
Zooplankton	Zooplankton are small animals that live in the water column. They are secondary producers and feed mainly on phytoplankton.

Units of Measurement and Symbols

at	@
centimetre	cm
degree Celsius	°C
dry weight	dwt
equal to	=
kilometre	km
less than	<
milligrams per kilogram	mg/kg
milligrams per litre	mg/L
millimetre	mm
percent	%
wet weight	wwt

1. INTRODUCTION

1.1 Background

Many environmental monitoring programs are conducted at the Ekati Diamond Mine every year with an overarching goal of protecting land, air, water, and wildlife. Figure 1.1-1 shows all ongoing environmental plans and programs. The Aquatic Effects Monitoring Program (AEMP) at the Ekati Diamond Mine is a requirement specified in Dominion Diamond Mines ULC's (Dominion's) Class A Water Licence (W2012L2-0001). Sampling conducted for the 2019 AEMP was permitted through the Aurora Research Institute, Scientific Research Licence 16508, issued for the Ekati Diamond Mine for the collection of samples in 2019.

The AEMP is designed to detect changes in the aquatic ecosystem that may be caused by mine-related activities. The 2019 AEMP was conducted as specified in the document titled *Ekati Diamond Mine: Aquatic Effects Monitoring Program Design Plan for 2017 to 2019, Version 6.1* (ERM 2018a). An annual evaluation of effects is conducted for waterbodies in three watersheds: the Koala Watershed and Lac de Gras, the King-Cujo Watershed and Lac du Sauvage, and the Pigeon-Fay and Upper Exeter Watershed. In 2017, the evaluation of effects for the Pigeon-Fay and Upper Exeter Watershed was approved to occur once every three years (i.e., next evaluation in 2020), with the exception of five variables (potassium, nitrate-N, total molybdenum, total strontium, and phytoplankton density), which are required to be evaluated annually (WLWB 2017a).

Discharge from the Two Rock Sedimentation Pond (TRSP) was initiated in August 2018, thus 2019 is the first year the annual evaluation of effects has been conducted on data collected from the Horseshoe Watershed and Lower Exeter Lake. In 2019, sampling in the Horseshoe Watershed and Lower Exeter Lake was completed as specified in the document titled *Ekati Diamond Mine: Sable Aquatic Effects Monitoring Program Plan Version 1.3* (ERM 2018b). The Sable AEMP Design Plan was developed in accordance with Part J, Item 2 of Water Licence W2012L2-0001 for the Ekati Diamond Mine and the Board's 2017 Directive (WLWB 2017b). In addition, the Board directed Dominion to conduct additional sediment sampling in 2018 or 2019 in the Horseshoe Watershed and Lower Exeter Lake (WLWB 2017c); this sampling was completed in 2019. Detectable changes in sediment quality are not anticipated after the short duration of Discharge in 2018 (two to four weeks). Therefore, an evaluation of effects was not completed for Horseshoe Watershed and Lower Exeter Lake sediment quality in 2019 and sediment quality data from Horseshoe Watershed and Lower Exeter Lake will be first evaluated in 2020 to align with evaluations for other watersheds.

As completed in the past, the 2019 AEMP report includes a Summary Report, which provides an overall summary of the Evaluation of Effects. The main 2019 AEMP report is comprised of three parts:

- Part 1 – Evaluation of Effects: provides summaries of the methods used to evaluate change in the aquatic environment and the results of those assessments;
- Part 2 – Data Report: reports on the aquatic environment at the Ekati Diamond Mine in 2019, including the field methods, and graphical and tabular results for each of the aquatic environmental components (e.g., physical limnology); and
- Part 3 – Statistical Report: provides the detailed methods used to assess change in the aquatic environment and the detailed results of the statistical analyses reported in Part 1.

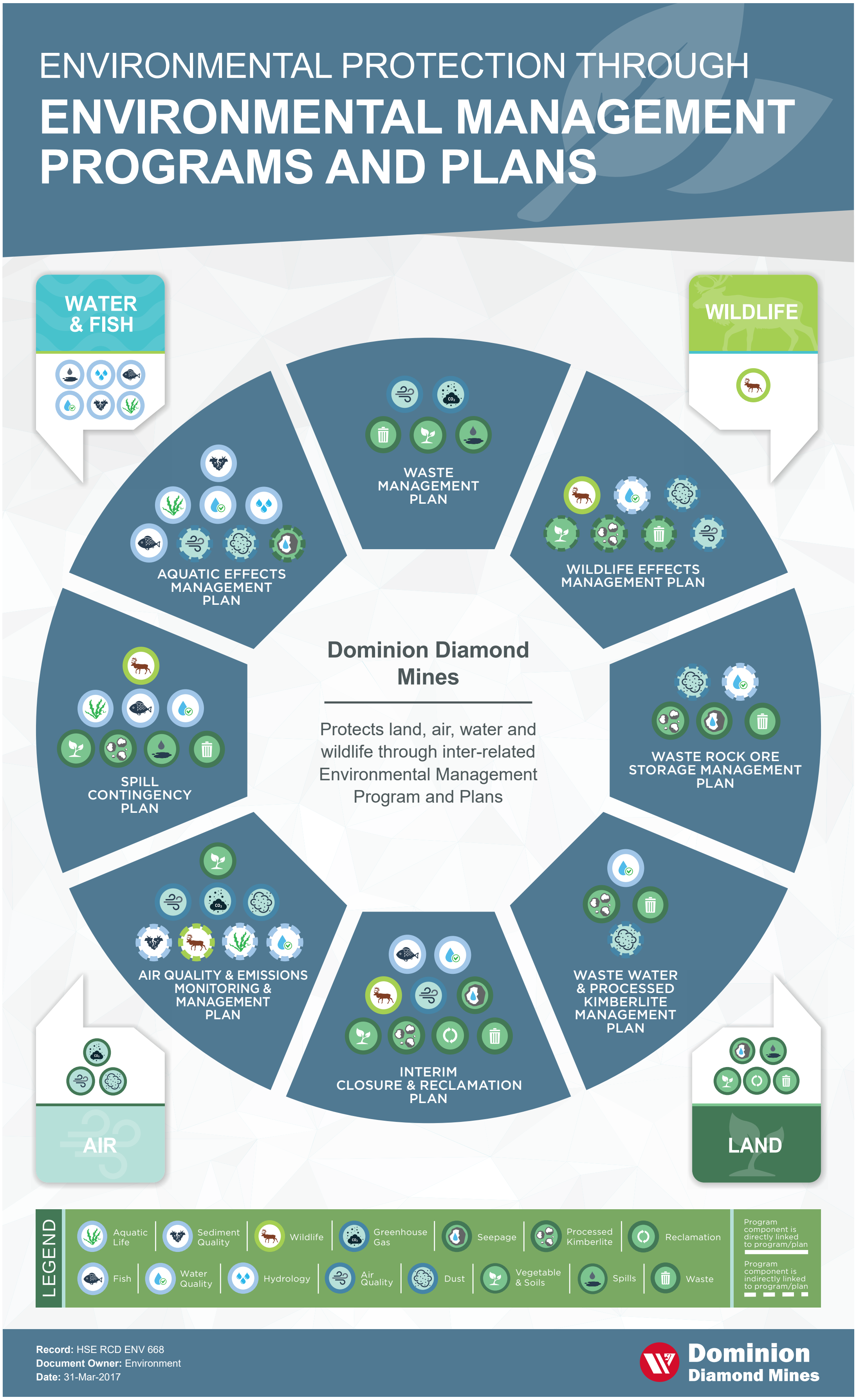


Figure 1.1-1: Environmental Protection through Environmental Management Programs and Plans

1.2 Framework for Aquatic Effects Monitoring

The AEMP is one of a number of monitoring and management plans for the Ekati Diamond Mine that employ an adaptive approach to identifying, understanding, and reducing the magnitude, frequency, and extent of the potential effects of mine-related activities on the aquatic environment. The overall objectives of the AEMP over the life of the mine are as follows:

- to determine the short- and long-term effects of the project on the Receiving Environment;
- to test the predictions made in the 1995 Environmental Impact Statement (BHP and Dia Met 1995) and Environment Assessment (BHP and Dia Met 2000) or in other submissions to the Board regarding the impacts of the project on the aquatic Receiving Environment;
- to assess the efficacy of mitigation measures that are used to minimize the effects of mine-related activities on the aquatic Receiving Environment; and
- to identify the need for additional mitigation measures to reduce or eliminate mine-related effects.

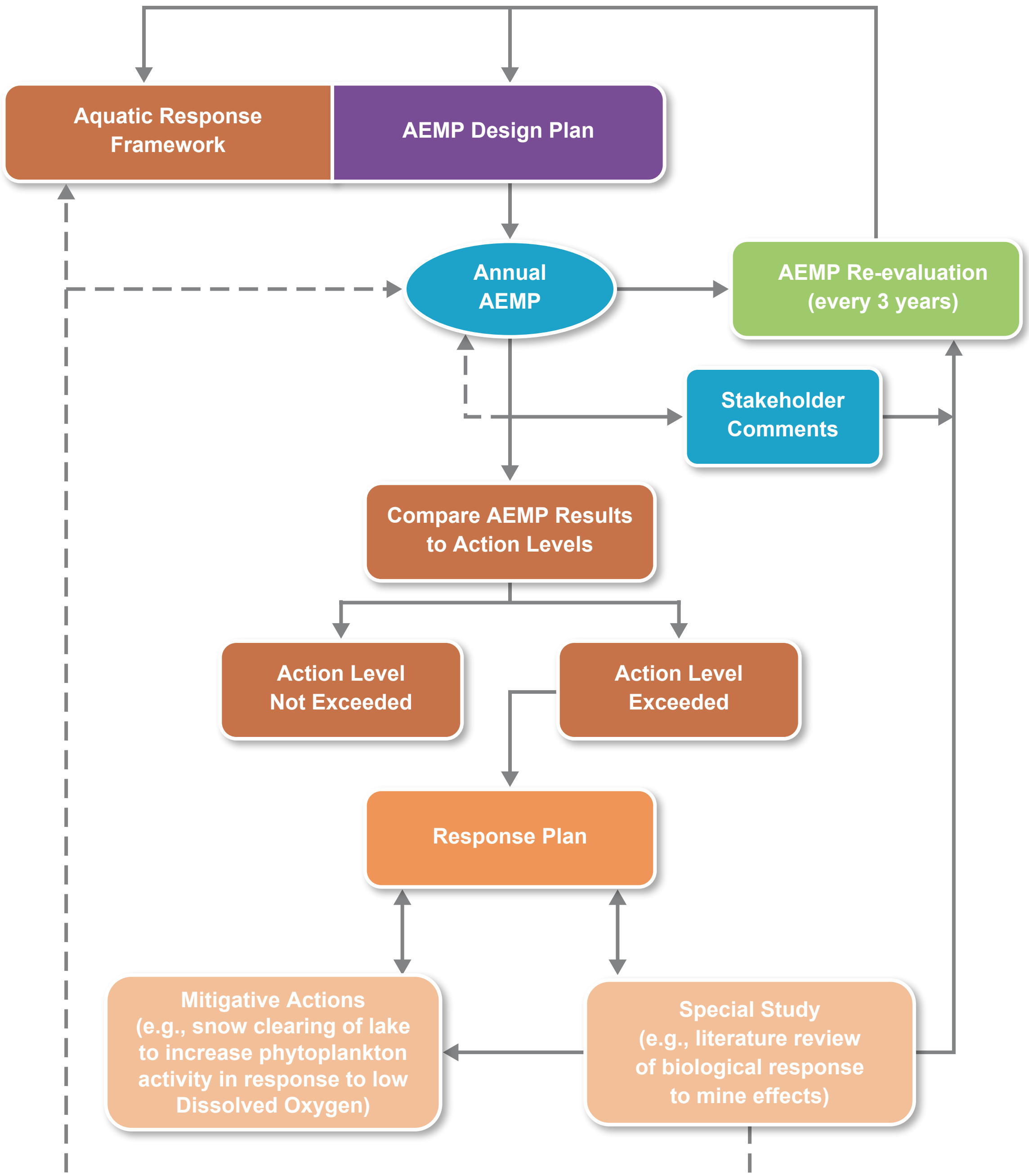
The overall framework for monitoring, evaluating, and adaptively managing potential aquatic effects at the Ekati Diamond Mine is presented in Figure 1.2-1. The primary objective of the annual AEMP is to act as an early warning system. The AEMP Design Plan describes the monitoring that is carried out with a focus on detecting change and assessing its magnitude and extent to determine whether observed changes may be related to mine-related effects. This is achieved through the evaluation of annual AEMP results, which relies on a hierarchy of steps described in the AEMP Evaluation Framework (see Section 2.2.1). In brief, the AEMP Evaluation Framework involves the following:

- data collection and screening;
- data analysis (e.g., graphical and/or statistical, comparison to benchmarks);
- assessment of whether a change has occurred; and
- determination of whether an observed change may be the result of a mine-related effect.

Results from the annual AEMP are then screened against Action Levels for water quality, plankton, and benthos variables defined in the *Aquatic Response Framework Version 3.0* (ARF; ERM 2018c). If the data exceed a defined Action Level (low Action Level – LAL, medium Action Level – MAL, high Action Level – HAL), a Response Plan is developed, if required (Figure 1.2-1). In some cases, a Response Plan is not required because there is already a Response Plan in place for the particular Action Level exceedance. Response Plans may include special studies aimed at understanding change that has been detected or mitigative actions aimed at reducing or eliminating effects. Results from the annual AEMP, comments received on the annual AEMP report, and the results of special studies feed into the three-year AEMP Re-evaluation, which provides an opportunity to assess the efficacy of the AEMP and adjust the AEMP Design Plan, if needed. A summary of Action Level exceedances identified to date, and relevant context, is provided in this Summary Report (see Appendix A).

1.3 Concordance with Water Licence W2012L2-0001 Criteria

Table 1.3-1 presents the concordance of the 2019 AEMP with Water Licence W2012L2-0001.



Note: Dashed lines indicate exceptional circumstances where immediate changes to the annual AEMP or Aquatic Response Framework are required.

Figure 1.2-1: Overall Framework for Monitoring Aquatic Effects for the Ekati Diamond Mine

Table 1.3-1: Aquatic Effects Monitoring Program Concordance with Water Licence W2012L2-0001

Water Licence W2012L2-0001 Criterion	Water Licence Section	AEMP Part[1]	AEMP Section
The Licensee shall implement an Aquatic Effects Monitoring Program (AEMP) that meets the following objectives: a) To determine the short- and long-term effects of the Project on the Receiving Environment;	Part J, Item 1(a)	Part 1	Sections 3 to 6
b) To test the predictions made in the Environmental Assessment (EA) or in other submissions to the Board regarding the impacts of the Project on the Receiving Environment;	Part J, Item 1(b)	Part 1	Sections 3 to 6
c) To assess the efficacy of mitigation measures that are used to minimize the effects of the Project on the Receiving Environment; and	Part J, Item 1(c)	Part 1 / Summary Report	Sections 3 to 6 / Appendix A
d) To identify the need for additional mitigation measures to reduce or eliminate Project-related effects.	Part J, Item 1(d)	Summary Report	Appendix A
The Licensee shall operate in accordance with the approved AEMP Design Plan.	Part J, Item 2	Parts 1 and 2	Sections 1 to 2
On or before March 31 each year, the Licensee shall submit an AEMP Annual Report to the Board for approval[2]. This report shall include information relating to data collected in the preceding calendar year and which satisfies the requirements of Schedule 8, Condition 3.	Part J, Item 6	All parts	All sections
The AEMP Annual Report referred to in Part J, Condition 6 shall include the following information: a) A summary of activities conducted under the Aquatic Effects Monitoring Program;	Schedule 8, Item 3(a)	Summary Report	Section 2
b) Tabular summaries of all data and information generated under the Aquatic Effects Monitoring Program in an electronic and printed format acceptable to the Board; and	Schedule 8, Item 3(b)	Part 2	Section 3, accompanying Excel workbook
c) An assessment of any identified environmental changes relative to baseline conditions that occurred as a result of the Project.	Schedule 8, Item 3(c)	Part 1	Sections 3 to 6

Note:

[1] Part 1 = Evaluation of Effects, Part 2 = Data Report, Part 3 = Statistical Report

[2] Extenuating circumstances detailed in communications to WLWB (WLWB 2020 and Dominion 2020) delayed the submission of the 2020 AEMP Annual Report for this reporting year.

2. METHODS

2.1 Sampling Design

The following components of the aquatic ecosystem were monitored in 2019:

- stream hydrology (June to September 2019);
- under-ice physical limnology (April 2019);
- open-water physical limnology (late July to August 2019);
- under-ice lake water quality (April 2019);
- open-water lake water quality (late July to August 2019);
- open-water stream water quality (June, July, August, and September 2019);
- phytoplankton (late July to August 2019);
- zooplankton (late July to August 2019);
- lake benthos (late July to August 2019); and
- stream benthos (August to early September 2019).

In addition, meteorological data were collected year-round at the Ekati Diamond Mine. Meteorological data collected during the 2019 AEMP reporting period (October 2018 and September 2019) are reported in the AEMP because they relate to hydrology at the site (see Section 3.1 of Part 2 – Data Report).

Lake sediment quality is monitored every three years, the next sampling is in 2020. However, the Board directed that sediment sampling be completed in Horseshoe Watershed lakes and Lower Exeter lake in 2019 (WLWB 2017c). These lakes were sampled from late July to August 2019.

Large-bodied and small-bodied fish are monitored every six and three years respectively. Fish were assessed in 2018 (large- and small-bodied), thus sampling did not occur in 2019.

Information on the sampling design and evaluation of effects methods is provided in Section 2 of Part 1 – Evaluation of Effects.

2.1.1 Sampling Locations

The 2019 AEMP lakes and streams are provided in Table 2.1-1 and shown in Figures 2.1-1 to 2.1-4. Bathymetric maps depicting the AEMP sampling locations within each lake are provided in Figures 2.1-5 through 2.1-25 of Part 2 – Data Report.

Most of the AEMP sampling locations within the Koala Watershed are located downstream of mine Discharge (Figure 2.1-2). Exceptions include Vulture Lake and Vulture-Polar Stream, which are internal reference sites located upstream of mine Discharge in the Koala Watershed. Grizzly Lake, the Lower Panda Diversion Channel (PDC), Kodiak Lake, and Kodiak-Little Stream are also located upstream of the Long Lake Containment Facility (LLCF), but are in close proximity to the mine, which results in the potential for effects from mine-related activities. Potential effects at these sites stem from roads and/or the airstrip, emissions, and potential spills. In addition, Kodiak Lake and Kodiak-Little Stream may be susceptible to potential effects associated with the weathering of the PDC, an artificial channel constructed to allow fish passage between North Panda and Kodiak Lake. Kodiak Lake and Kodiak-Little Stream are also susceptible to surface runoff from the vicinity of the ammonium nitrate (AN) building (situated near the eastern shore of Kodiak Lake). Downstream of the LLCF, all lakes and streams are susceptible to the quantity and quality of water Discharged from the LLCF as far as Lac de Gras, which receives water from the Koala Watershed at its northern end. In addition, Nema Lake and Nema-Martine Stream are located near the Fox Pit and are susceptible to Seepage from Fox Pit and its associated Waste Rock Storage Areas (WRSAs).

Table 2.1-1: 2019 AEMP Sampling Locations

Lake Sites	Stream Sites
Reference Watersheds	
Nanuq Lake	Nanuq Outflow
Counts Lake	Counts Outflow
Koala Watershed and Lac de Gras	
Vulture Lake (reference)	Vulture-Polar (reference)
Kodiak Lake	Lower PDC
Grizzly Lake	Kodiak-Little
1616-30 (LLCF)	1616-30 (LLCF)
Leslie Lake	Leslie-Moose
Moose Lake	Moose-Nero
Nema Lake	Nema-Martine
Slipper Lake	Slipper-Lac de Gras
Lac de Gras: S2, S3, S5, S6	
King-Cujo Watershed and Lac du Sauvage	
1616-43 (KPSF)	1616-43 (KPSF)
Cujo Lake	Cujo Outflow
Lac du Sauvage: LdS1, LdS2	Christine-Lac du Sauvage
Carrie Pond Watershed	
	Mossing Outflow
Pigeon-Fay and Upper Exeter Watershed	
Fay Bay	Pigeon Reach 7 (reference)
Upper Exeter Lake	Pigeon Reach 1
Horseshoe Watershed and Lower Exeter Lake	
Northeast Lake (reference)	Northeast Outflow (reference)
Ulu Lake	Ulu Outflow
0008-Sa3 (TRSP)	0008-Sa3 (TRSP)
Horseshoe Lake	Horseshoe Outflow
HWL2 Lake	HWL2 Outflow
Ross Lake	Ross Outflow
Logan Lake	Logan Outflow
Lower Exeter Lake	

Note: Not all components were monitored in each lake or stream (see Figures 2.1-1 to 2.1-4 or Part 2 – Data Report for details).

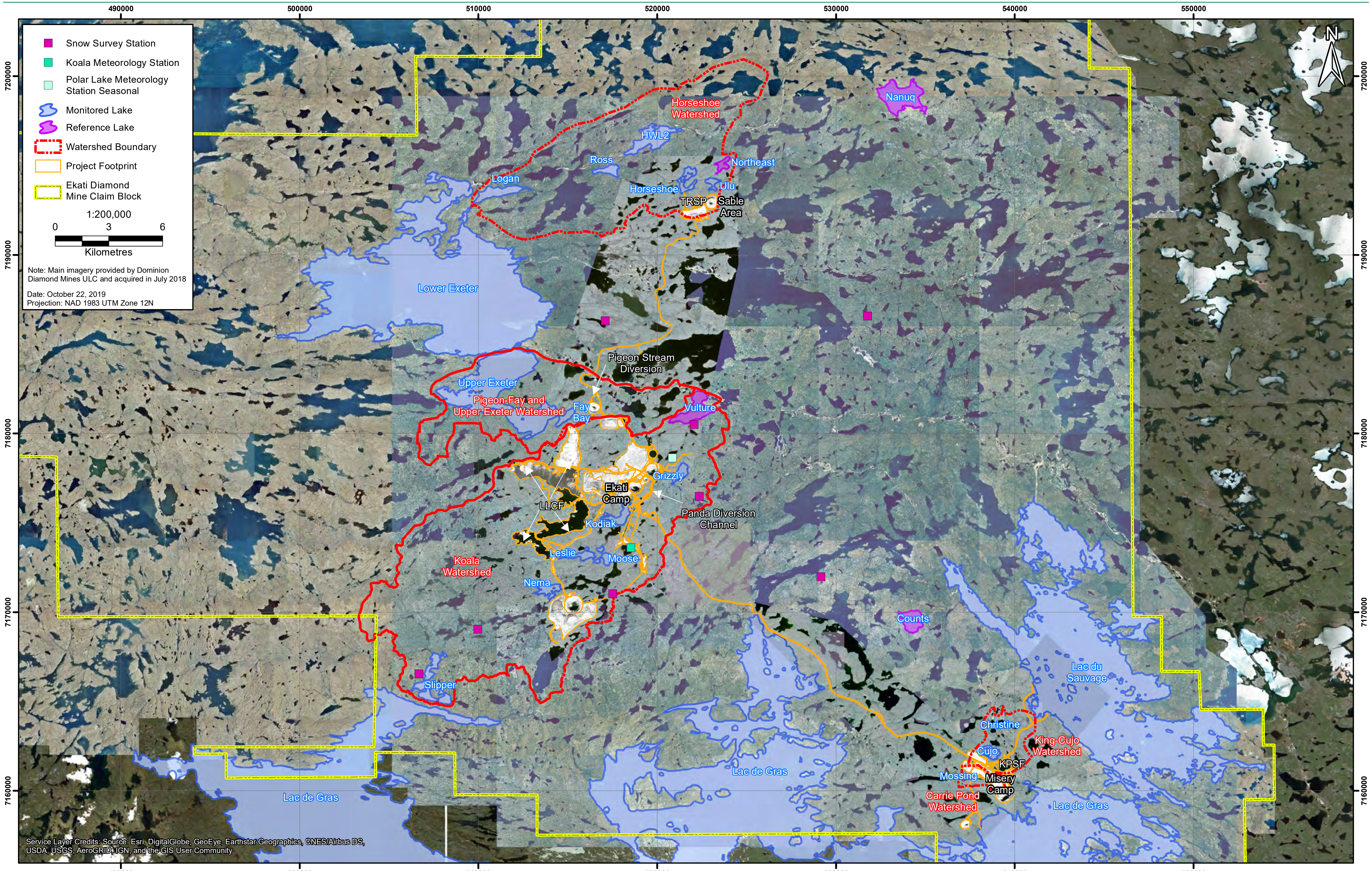


Figure 2.1-1: AEMP Sampling Area, 2019

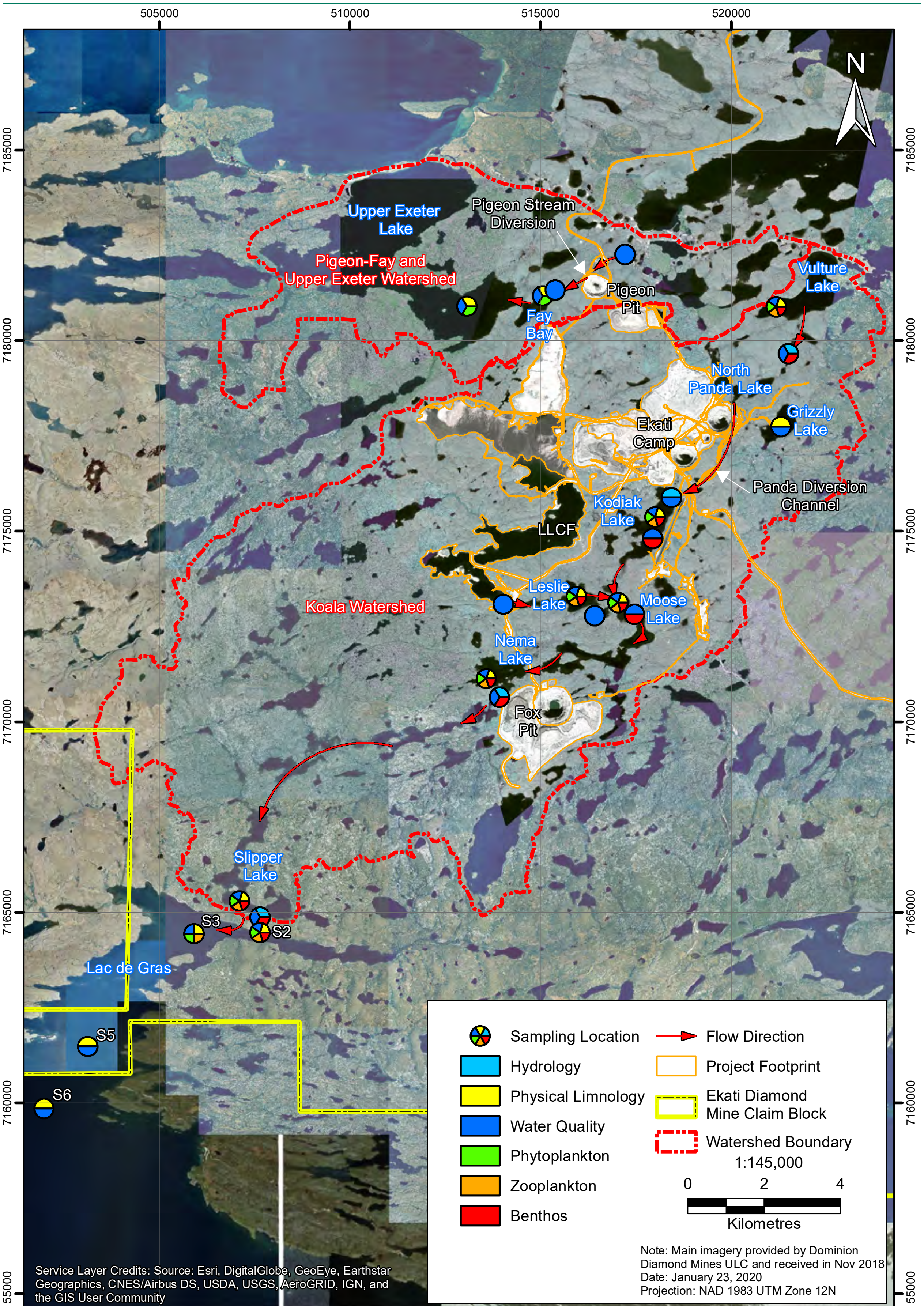


Figure 2.1-2: Koala Watershed, Pigeon-Fay and Upper Exeter Watershed, and Lac de Gras, 2019

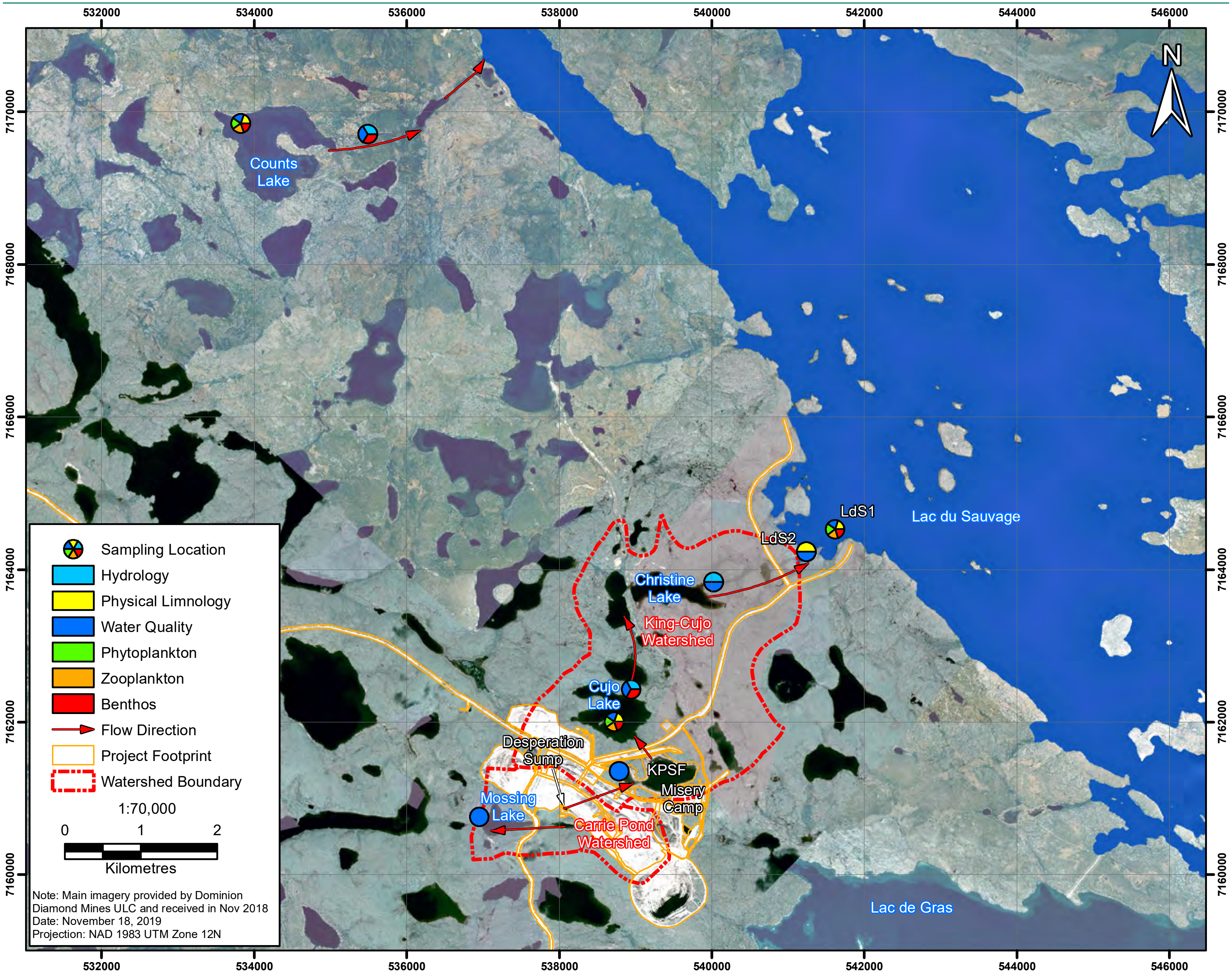


Figure 2.1-3: King-Cujo Watershed, Carrie Pond Watershed, Counts Lake, and Lac du Sauvage, 2019

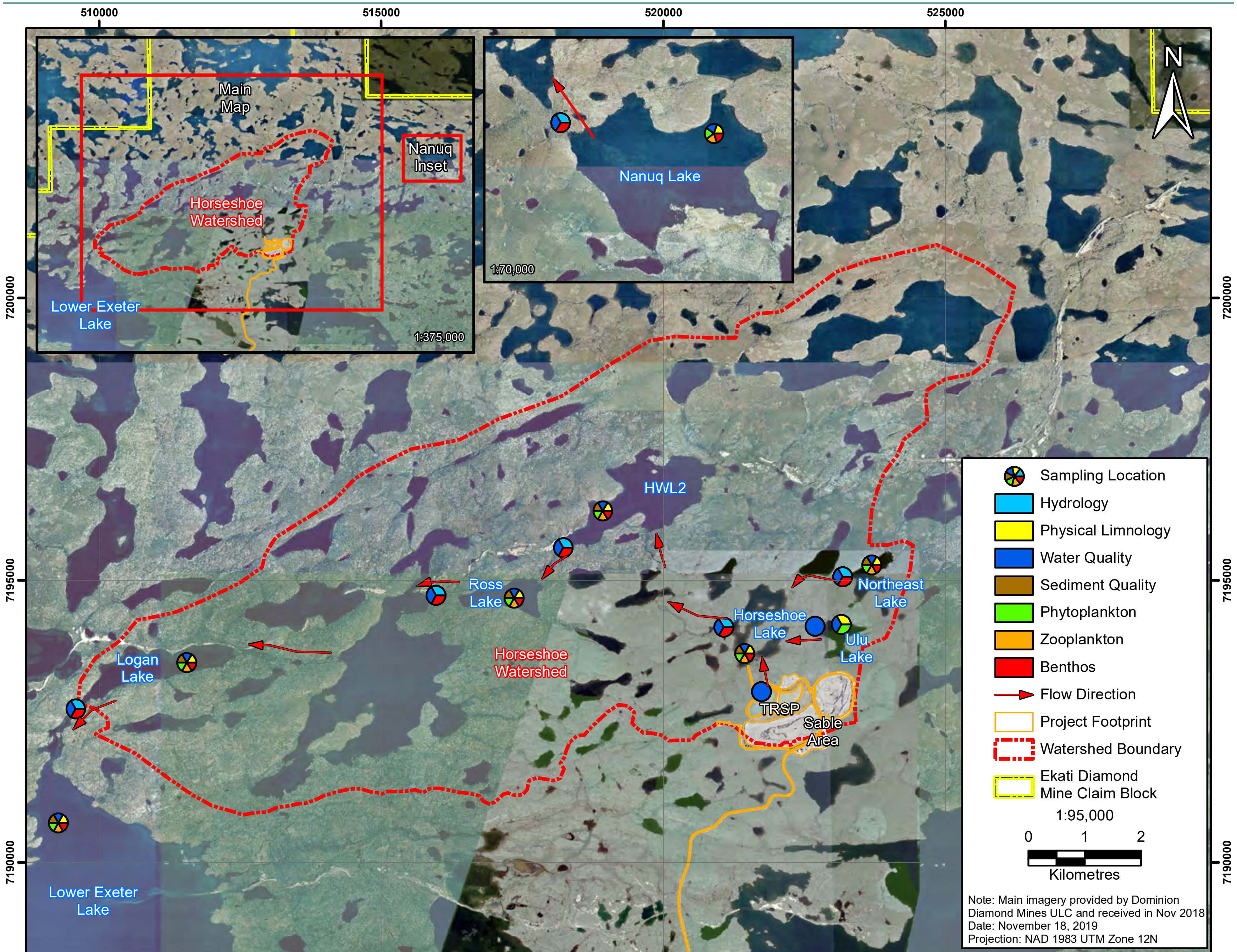


Figure 2.1-4: Horseshoe Watershed, Nanuq Lake, and Lower Exeter Lake, 2019

All AEMP sampling stations in the King-Cujo Watershed are located downstream of the King Pond Settling Facility (KPSF; Figure 2.1-3). Lac du Sauvage receives water from the King-Cujo Watershed along its western shore. In addition, Cujo Lake and Outflow are in close proximity to the mine (i.e., Misery Camp and Misery WRSA), which results in the potential for effects from mine-related activities. These AEMP lakes and streams are therefore potentially influenced by mining activities associated with the Misery Development.

The Carrie Pond Watershed includes one AEMP sampling station (i.e., Mossing Outflow). The main influence to Mossing Outflow was Desperation Pond, located upstream of Mossing Outflow (Figure 2.1-3). The majority of Desperation Pond was encapsulated within the WRSA and the area that remains is currently being utilized as a sump. Water from Desperation Sump is pumped to the KPSF on an as-needed basis but is no longer Discharged to the Receiving Environment. Mossing Outflow is monitored in the AEMP but not evaluated, see Part 2 – Data Report for the water quality in 2019.

All but one of the AEMP sampling stations in the Pigeon-Fay and Upper Exeter Watershed are located downstream of the Pigeon Stream Diversion (PSD; Figure 2.1-2). The exception is Pigeon Reach 7, an internal reference site located upstream of the PSD. The Pigeon-Fay and Upper Exeter Watersheds do not receive any Discharge from the Pigeon Development; Minewater and drainage from the WRSA is directed into the LLCF or Beartooth Pit. Thus, potential effects at these sites stem from the Construction and operation of the PSD and from Pigeon Development activities and roads.

The Horseshoe Watershed contains the Sable Pit, Sable South WRSA, and TRSP (Figure 2.1-4). Monitoring locations downstream of TRSP Discharge include Horseshoe Lake and Outflow, Horseshoe Watershed Lake 2 (HWL2) and Outflow, Ross Lake and Outflow, Logan Lake and Outflow, and Lower Exeter Lake. The current monitoring site in Horseshoe Lake is located in the southwestern basin where potential mine-related changes in water quality are expected to be greatest. Ulu Lake and Outflow are upstream of TRSP Discharge but are monitored because they are located within the drainage area of the Sable WRSAs and have the potential to be influenced by mining activity. Northeast Lake and Northeast Outflow are internal reference sites located upstream of mine Discharge in the Horseshoe Watershed.

The external reference lakes and streams (Nanuq and Counts lakes and their respective outflows) are located well away from any mine-related activities (Figures 2.1-3 and 2.1-4). Nanuq Lake is located in the northeast corner of the Ekati Diamond Mine claim block, approximately 11 kilometers (km) from the nearest possible mine influence (Sable Development). Counts Lake is located southeast of the Ekati Diamond Mine Main Camp, approximately halfway between the camp and Misery Pit about 5 km away from the nearest possible mine influence (Misery Road).

2.1.2 Sampling Frequency and Replication

Table 2.1-2 summarizes sampling components, frequency, and replication completed during the ice-covered and open-water seasons as part of the 2019 AEMP sampling program. See Figures 2.1-2 to 2.1-4 for lake-specific monitoring components.

2.1.3 Field Methods

A complete description of the 2019 field methods is provided in Part 2 – Data Report. The 2019 methods are comparable to historical methods and the 2019 datasets are compatible with the historical datasets for time-series effect analyses.

In 2019, Dominion personnel conducted the ice-covered season sampling for all watersheds with the support of ERM Consultants Canada Ltd. (ERM). Dominion completed the July, August, and September lake sampling of the Pigeon-Fay and Upper Exeter Watershed and the June and July stream water-quality sampling, as well as the majority of stream flow measurements throughout the hydrological monitoring season. An ERM scientist assisted by Dominion personnel conducted the freshest (June) hydrological monitoring, the August lake and stream sampling, and the September stream sampling.

Table 2.1-2: Summary of the 2019 AEMP Sampling Program

Monitoring	Seasonal Frequency	Replication and Depths at Each Lake/Stream per Sampling Event
Lakes		
Physical limnology	April (under-ice)	n=1 profile
	late July to early August (open-water)	n=1 profile; Secchi depth
	July and September (open-water)	Pigeon-Fay and Upper Exeter Watershed only n=1 profile, Secchi depth
Water quality	April (under-ice)	n=2 @ mid water column depth; n=2 @ 2 m from the bottom
	late July to early August (open-water)	n=2 @ 1 m below surface; n=2 @ mid water column depth Leslie and Moose lakes only n=2 @ 2m from the bottom
	July and September (open-water)	Pigeon-Fay and Upper Exeter Watershed only n=2 @ 1 m below surface; n=2 @ mid water column depth
Sediment Quality1	late July to early August	Horseshoe Watershed and Lower Exeter Lake only n=3 Ekman grabs @ mid-depth site (5 to 10 m) n=3 K-B cores @ mid-depth site (5 to 10 m)
Phytoplankton	late July to early August	n=3 @ 1 m for taxonomic enumeration; n=3 @ 1 m for biomass
Zooplankton	late July to early August	n=3 vertical hauls from 1 m above bottom to surface, with flowmeter for taxonomic enumeration; n=3 vertical hauls from 1 m above bottom to surface, with flowmeter for biomass
Benthos	late July to early August	n=3 @ mid-depth site (5–10 m)
Streams		
Water quality	June (freshet), July, August, September (fall high flows)	n=2
Benthos	August to September	n=5
Stream flow measurements (manual) and staff gauge survey	2 to 3 times during the freshet period; 4 times during the remainder of the open-water season	n=1
Hydrometric Stations (automated)	installation prior to freshet, data collection monthly	n=1
Stream cross section survey	during hydrometric station installation	n=1

Notes:
n = number of samples or measurements.
[1] *Ekman samples were collected for particle size distribution and core samples were collected for nutrient and metals analyses.*

2.2 Evaluation of Effects Methods

2.2.1 Evaluation Framework

Evaluation of the AEMP results was performed using a hierarchy of steps (Figure 2.2-1). Data were collected based on the *Ekati Diamond Mine: Aquatic Effects Monitoring Program Design Plan for 2017 to 2019, Version 6.1* (ERM 2018a) and the *Ekati Diamond Mine: Sable Aquatic Effects Monitoring Program Plan Version 1.3* (ERM 2018b). The methods and results of the 2019 AEMP sampling program are reported in Part 2 – Data Report.

Data collected as part of the 2019 AEMP were evaluated for quality. Any large dataset is likely to contain some outliers or questionable records caused by instrument failure, transcription errors, laboratory errors, etc. Thus, questionable data were identified and excluded prior to the evaluation of effects. However, all of the data collected as part of the 2019 sampling program are presented in Part 2 – Data Report. The finalized dataset was graphically and statistically analysed to detect potential mine-related effects. For data collected from sites in the Koala Watershed and Lac de Gras, and sites in the King-Cujo Watershed and Lac du Sauvage, regression modelling was used to detect any changes that might be occurring in lakes and streams through time and also to determine whether temporal patterns differed between monitored and reference sites. Different regression models were applied to different variables depending on the variable type and number of years of data that were available and, in the case of water quality, the proportion of data that were greater than the analytical detection limit (DL).

The Mossing Outflow site in the Carrie Pond Watershed was not evaluated for effects in 2019 as only seven years of data were available for that location. The appropriateness of including Mossing Outflow in the evaluation of effects was assessed as part of the 2015 AEMP Re-evaluation (ERM 2016a). It was concluded that insufficient data existed for Mossing Outflow to be included in the statistical analysis and a commitment was made to revisit the inclusion of Mossing Outflow in the AEMP evaluation of effects in the 2019 AEMP Re-evaluation. This recommendation was approved by the Board (WLWB 2017d). Data collected at Mossing Outflow in 2019 are presented in Part 2 – Data Report.

For sites in the Pigeon-Fay and Upper Exeter Watershed, Horseshoe Watershed, and Lower Exeter Lake, *before-after control-impact* (BACI) analysis was used to detect changes in the aquatic environment. The BACI analysis compared *before-after* trends apparent at monitored sites with that of the reference sites to determine if the trends were parallel and thus attributable to a natural process.

If statistical analyses were not possible because assumptions or data requirements were not satisfied, variables were subjected to graphical analysis (see Part 1 – Evaluation of Effects, Section 2.2.4). In such cases, data were examined for historical trends and spatial gradients.

The results of statistical and graphical analyses were then interpreted using best professional judgment. Graphical analysis was used to confirm and/or interpret conclusions reached by the statistical analysis. The result was an assessment of whether change had occurred and whether the change was 'significant', as defined by the statistical and/or graphical analyses.

Changes deemed significant were assessed to determine whether they were likely to be the result of mine-related activities, sampling activities, or natural variation. The identification of a change as a mine-related effect required the existence of plausible mechanisms that could link mine-related activities and change. For example, consider a situation where hypothetical water quality variable *y* has increased in a lake that is the third monitored lake downstream of a point source (e.g., the LLCF), but there has been no change in variable *y* in lakes that are closer to the point source. The lack of a clear spatial gradient (e.g., decreasing concentrations with increasing distance downstream of the point source) indicates that the observed change is unlikely related to the point source and thus, would not be considered a mine-related effect. Benchmarks and biological trends were important in interpreting the ecological significance of detected mine-related effects.

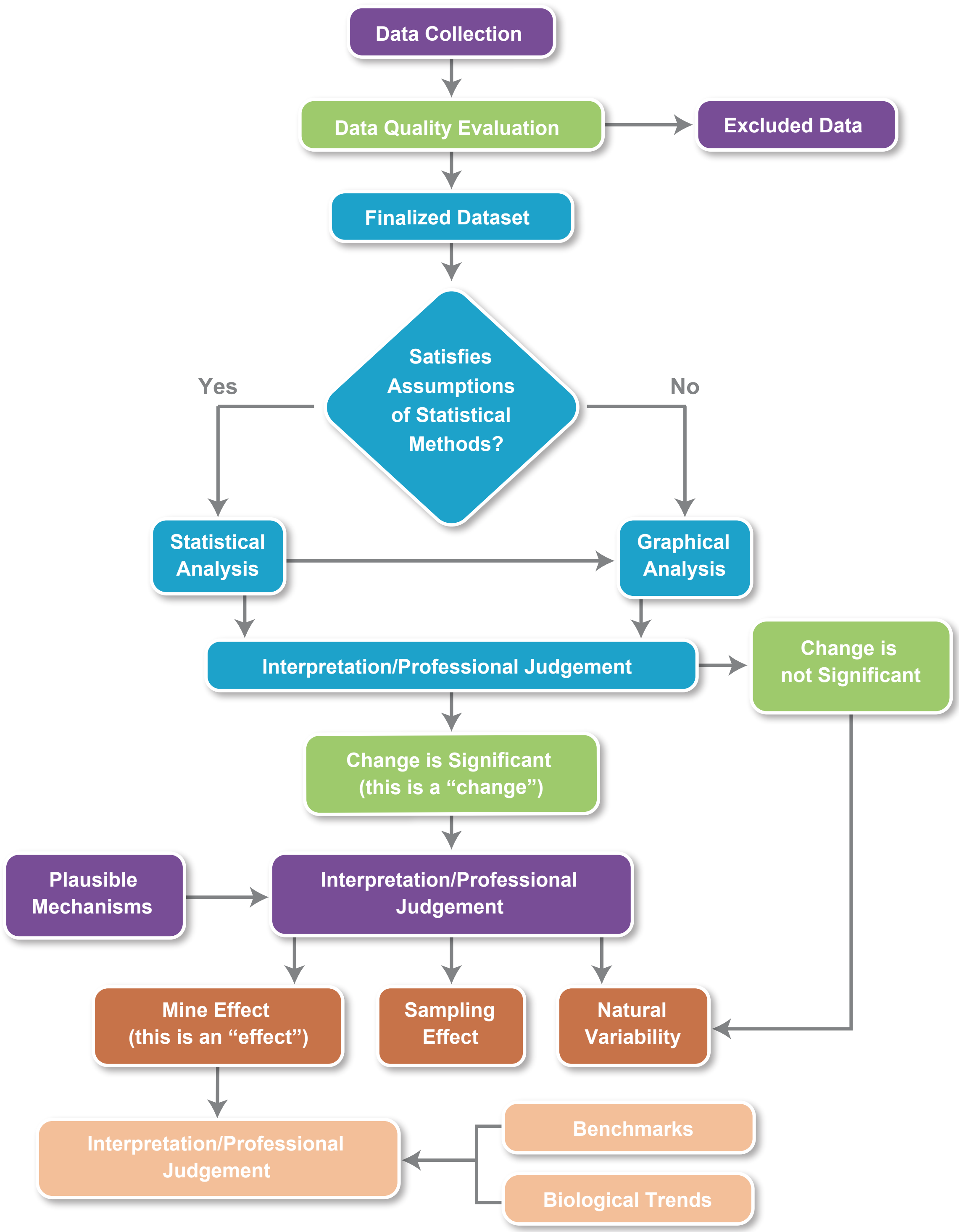


Figure 2.2-1: Evaluation Framework for the Ekati Diamond Mine AEMP

2.2.2 Variables Evaluated

The water quality, plankton, and benthos variables evaluated in the 2019 AEMP are those identified in the *Ekati Diamond Mine: Aquatic Effects Monitoring Program Design Plan for 2017 to 2019, Version 6.1* (ERM 2018a) and the *Ekati Diamond Mine: Sable Aquatic Effects Monitoring Program Plan Version 1.3* (ERM 2018b). Evaluated variables are presented in Table 2.2-1. The 2015 AEMP Re-evaluation (ERM 2016a) considered all water quality variables analysed at the laboratory for evaluation, but only variables that were increasing or showed signs of increase were selected for evaluation as part of the AEMP. Some increasing variables were not selected for evaluation because they were represented by other variables (e.g., total dissolved solids (TDS) were increasing but were considered to be included indirectly as chloride, nitrate, sulphate, and total potassium; ERM 2016a). However, observed data for all analysed water quality variables are presented in Appendix A of Part 1 – Evaluation of Effects.

Table 2.2-1: Physical Limnology, Water Quality, Phytoplankton, Zooplankton, and Benthos Variables Evaluated in 2019

Physical Limnology – Lakes	Water Quality – Lakes and Streams	Biological – Lakes and Streams
■ Under-ice temperature profile ■ Under-ice dissolved oxygen profile ■ Open-water temperature profiles[1] ■ Open-water dissolved oxygen profile[1] ■ Open-water specific conductivity profile ■ Open-water Secchi depth	**Physical/Ions** ■ pH ■ Total alkalinity ■ Water hardness ■ Chloride ■ Fluoride ■ Sulphate ■ Total suspended solids[2] **Nutrients** ■ Total ammonia-N ■ Nitrite-N ■ Nitrate-N[3] ■ Total phosphorus[4] ■ Total organic carbon **Metals** ■ Total antimony ■ Total arsenic ■ Total barium ■ Total boron ■ Total molybdenum[3] ■ Total nickel ■ Total potassium[3] ■ Total selenium ■ Total strontium[3] ■ Total uranium ■ Total zinc[2]	**Phytoplankton** ■ Chlorophyll *a* concentration ■ Total phytoplankton density[3] ■ Edible phytoplankton density ■ Non-edible phytoplankton density ■ Diversity indices for phytoplankton ■ Phytoplankton community composition[5] **Zooplankton[6]** ■ Total zooplankton biomass ■ Total zooplankton density ■ Rotifer density ■ Adult crustacean density ■ Diversity indices for zooplankton ■ Zooplankton community composition[5] **Lake Benthos[6]** ■ Benthos density ■ Diversity indices for benthic dipterans ■ Dipteran community composition[5] **Stream Benthos[7]** ■ Benthos density ■ Diversity indices for benthic dipterans ■ Dipteran community composition[5] ■ Diversity indices for benthic EPT taxa ■ EPT community composition[5]

Notes:

EPT = Ephemeroptera, Plecoptera, and Trichoptera.

[1] *Reference lakes and lakes of the Koala Watershed only.*

[2] *Reference lakes and streams and Horseshoe Watershed lakes and streams and Lower Exeter Lake only.*

[3] *Variable included in Pigeon-Fay and Upper Exeter Watershed evaluation in 2019.*

[4] *The terms total phosphorus and total phosphate-P are interchangeable for the purposes of the Ekati Diamond Mine AEMP. Previously the analytical laboratory reported the data as total phosphate-P and currently reports the data as total phosphorus though there has been no change to the analytical method through time.*

[5] *Community composition refers to the total and relative densities of major taxonomic groups.*

[6] *Reference lakes, lakes of the Koala Watershed, King-Cujo, and Horseshoe watersheds, Lac de Gras, Lac du Sauvage, and Lower Exeter Lake only.*

[7] *Reference streams and streams of the Koala, King-Cujo, and Horseshoe watersheds only.*

3. GENERAL CLIMATIC AND HYDROLOGICAL CONDITIONS IN 2019

3.1 Climatic Conditions

The meteorological monitoring program at the Ekati Diamond Mine in 2019 included the operation of the Koala automated meteorological station, which has been in continuous operation since 1993, and the micrometeorological station on Polar Lake (Figure 2.1-1). The Polar Lake station was in operation from July 15 to September 20, 2019 during most of the open-water season to provide data to estimate open-water evaporation. In addition, snow surveys were completed between March 27 and April 3, 2019 at seven locations within the Ekati Diamond Mine claim block; five of the snow monitoring sites were within the Koala Watershed (Figure 2.1-1). See Part 2 - Data Report (Sections 2.2 and 3.1) for a detailed account of meteorological monitoring methods and results obtained as part of the 2019 AEMP.

The 12-month (October 2018 to September 2019) mean air temperature was -9.4 °C at the Koala station (Table 3.1-2 in Part 2 – Data Report). This is 0.1 °C cooler than the 2018/2019 12-month mean for the Kugluktuk Airport station and 0.9 °C warmer than the Kugluktuk Climate Normal data available from 1981 to 2010. Mean monthly temperatures in 2019 at the Koala station ranged from -29.8 °C in January to 11.4 °C in July. The maximum air temperature was 19.7 °C on July 21, 2019 and the lowest air temperature was -39.1.4 °C on February 1, 2019, not accounting for the perceived humidex or wind chill. In the Mackenzie District region (which includes the Ekati Diamond Mine), mean temperature departures in three of four seasons (fall, winter, and spring) ranged from 0.6°C below to 4.0 °C above normal and ranked from 3rd to 52nd warmest season in the past 72 years (Table 3.1-4 in Part 2 – Data Report). The summer and fall 2019 season Mackenzie District data were unavailable at the time of writing.

From the available October 2018 to September 2019 precipitation data, a total of 271.7 mm of precipitation (adjusted for wind undercatch) was recorded at the Koala meteorological station (Table 3.1-7 in Part 2 – Data Report).

The snow survey conducted at the seven sampling sites around the Ekati Diamond Mine claim block in late March to early April 2019 yielded a snowpack mean snow water equivalent (SWE) value of 97.3 mm and mean depth of 41.2 cm (Table 3.1-5 in Part 2 – Data Report). A substantial portion of the snow pack is lost to sublimation, evaporation, and wind redistribution. The SWE value of 97.3 mm represents the mean amount of water available for snow melt runoff if melting were to occur in April.

Wind speed and direction data collected from the Koala station indicated that the prevailing wind direction during the snow-cover period (October 2018 to May 2019) was from the northwest with a secondary component from the east-southeast (Figure 3.1-1 in Part 2 – Data Report). During the snow-free period (June to September), the prevailing winds were again from the northwest with a secondary component from the east-northeast (Figure 3.1-1 in Part 2 – Data Report). The mean wind speed was 4.7 m/s during the snow-cover period, and 5.5 m/s during the snow-free period. Calm conditions (hourly mean wind speeds of < 0.5 m/s) occurred 3.2% of the time during the snow-cover period, and less than 1% during the snow-free period. The maximum observed gust wind speed was 23 m/s on April 15, 2019. Taking into account missing data, wind patterns were generally similar to those of previous years.

The Polar Lake micrometeorological station operated from July 15 to September 20, 2019. The high latitude and continental climate of the Ekati Diamond Mine area combine to produce long, sunny days providing abundant energy to drive evaporation during the summer season. Using the Penman equation for the months of July to September 2019, the open-water evaporation at the Polar Lake station was 210 mm. Evaporation calculated using the Priestly-Taylor method resulted in 202 mm for the same time period. Both values use gap-fill estimates for months without complete data. See Section 2.2.2 of Part 2 – Data Report.

3.2 Hydrological Conditions

Streamflow monitoring was undertaken in 2019 at four streams within the Koala Watershed (Vulture Polar [internal reference], Lower PDC, Nema-Martine, and Slipper-Lac de Gras), four streams in the Horseshoe Watershed (Northeast, Horseshoe, Ross, and Logan outflows), and two streams within the King-Cujo Watershed (Cujo Outflow and Christine-Lac du Sauvage), along with one stream within a reference watershed (Counts Outflow; Figures 2.1-2 to 2.1-4). Automated hydrometric monitoring stations were installed between June 1 and June 18, 2019, and operated until early September (September 2 to 8), when stations were demobilized for winter. See Part 2 – Data Report (Sections 2.3 and 3.2) for a description of hydrological monitoring completed as part of the 2019 AEMP.

The hydrologic year in the Ekati Diamond Mine area is defined by the onset of freezing conditions. The 2019 hydrologic year began late September 2018 and ended in early October 2019. Temperatures fluctuated around freezing levels in late May and early June before consistently maintaining a mean daily temperature above 0 °C beginning June 10, 2019. Long days in mid-June provide increased amounts of solar energy to generate snow melt runoff, while the frozen ground inhibited infiltration. The majority of snowmelt and runoff occurred in the third and fourth week of June 2019 (see Figures 3.2-1 to 3.2-11 in Part 2 – Data Report).

Freshet peak flows occurred in mid to late June with the exception of Counts Outflow, which peaked in early-July. Approximately 25% of total runoff for the year occurred in June (see Appendix C of Part 1 – Evaluation of Effects). Winter freeze up is expected to have occurred at most monitored streams by September 30, and no later than October 8 in larger streams (Slipper-Lac de Gras, Ross Outflow, and Logan Outflow) based on a review of available air temperature records.

During the hydrologic year, 271.7 mm of observed precipitation fell in the Ekati Diamond Mine area (Section 3.1), which is well below the normal value of 345 mm. Total runoff in 2019 (January to December) varied from 38.8 mm at station Horseshoe Outflow to 169.8 mm at Lower PDC. Maximum daily flow varied from 0.06 m^3/s at Cujo Outflow to 4.04 m^3/s at Slipper-Lac de Gras.

4. SUMMARY OF EVALUATION OF EFFECTS FOR THE KOALA WATERSHED AND LAC DE GRAS

Figures 4-1a and 4-1b summarize the evaluation of effects for the Koala Watershed and Lac de Gras. See Section 3 of Part 1 – Evaluation of Effects for a detailed account of the direction and magnitude of change for each variable. For a discussion of statistical and graphical analyses that were used to assist in interpreting results for each of the variables, see Section 2.2 of Part 1 – Evaluation of Effects.

A historical mine-related effect was detected for under-ice temperatures in Leslie, Moose, and Nema Lakes in 2019. Under-ice temperatures were generally cooler from 2008 to 2018 compared to data collected between 1998 and 2006, but in 2019 under-ice temperatures were warmer and similar to temperatures observed between 1998 and 2006. The change in the under-ice temperature profiles downstream of the LLCF in Leslie, Moose, and Nema lakes may be a result of mine-related changes in water quality (e.g., an increase in TDS), however, since the trend in temperatures observed between 2008 and 2018 was not observed in 2019, a historical effect was concluded in 2019. Similarly, a historical mine-related effect was detected for under-ice temperature and dissolved oxygen (DO) concentrations in Kodiak Lake as observations in 2019 likely reflect natural under-ice conditions. No mine-related effects for under-ice temperature or DO concentrations were detected for Grizzly Lake and no mine-related effects for DO concentrations were detected for lakes downstream of the LLCF.

Potential historical effects for both open-water season temperature and DO concentrations were concluded for Leslie and Moose lakes in 2019. Potential historical effects were concluded because thermal stratification was not observed in Leslie and Moose lakes in 2019 but this was potentially related to the absence of Discharge from the LLCF in 2018 followed by a lower than average annual Discharge volume in 2019. No mine-related effects were detected for open-water season temperature or DO concentrations in Grizzly, Kodiak, Nema, or Slipper lakes or Lac de Gras. DO concentrations were above the CCME guideline throughout the water column at all monitored and reference lakes during the open-water season in 2019.

Open-water specific conductivity profiles were uniform throughout the water column in all lakes in 2019. A bottom water sample will continue to be collected from Leslie and Moose lakes in addition to surface and mid-depth samples. The 2019 analysis suggests that additional sampling at deep-depth is not necessary for other monitored or reference lakes.

There was no evidence of a consistent directional trend in Secchi depth over time in any of the monitored lakes. Thus, no mine-related effects were detected with respect to open-water Secchi depth in monitored lakes of the Koala Watershed or Lac de Gras.

Twenty-one water quality variables were evaluated in the 2019 AEMP for the Koala Watershed and Lac de Gras. Of these, the concentrations of 18 variables have increased in lakes or streams in the Koala Watershed or Lac de Gras as a result of mine-related activities (Figure 4-1a):

- pH (laboratory-measured; downstream to Lac de Gras site S3);
- total alkalinity (downstream to Lac de Gras site S2);
- water hardness (downstream to Lac de Gras site S3);
- chloride (downstream to Lac de Gras site S3);
- sulphate (downstream to Lac de Gras site S3; Lower PDC; Kodiak Lake; Kodiak-Little);
- total ammonia-N (Leslie Lake; Moose and Nema lakes during the ice-covered season only);
- nitrite-N (downstream to Moose-Nero Stream; Nema Lake during ice-covered season only);

LLCF → Downstream

	Grizzly Lake	Lower PDC	Kodiak Lake	Kodiak-Little Stream	Leslie Lake	Leslie-Moose Stream	Moose Lake	Moose-Nero Stream	Nema Lake	Nema-Martine Stream	Slipper Lake	Slipper-Lac de Gras Stream	Lac de Gras S2	Lac de Gras S3	Lac de Gras S5	Lac de Gras S6
Physical Limnology																
Under-ice temperature	Green	—	Grey	—	Grey	—	Grey	—	Grey	—	Green	—	Green	Green	Green	Green
Under-ice dissolved oxygen	Green ⊕	—	Grey ⊕	—	Green ⊕	—	Green ⊕	—	Green ⊕	—	Green	—	Green	Green	Green	Green
Open-water temperature	Green	—	Green	—	Grey/Yellow	—	Grey/Yellow	—	Green	—	Green	—	Green	Green	Green	Green
Open-water dissolved oxygen	Green	—	Green	—	Grey	—	Grey	—	Green	—	Green	—	Green	Green	Green	Green
Open-water Secchi depth	Green	—	Green	—	Green	—	Green	—	Green	—	Green	—	Green	Green	Green	Green
Water Quality																
pH	Green	Green	Green	Green	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Green	Green
Total alkalinity	Green	Green	Green	Green	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red	Green	Green	Green
Water hardness	Green	Green	Green	Green	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red	Red	Green	Green
Chloride	Green	Green	Green	Green	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Green	Green
Fluoride	Green	Green	Green	Green	Yellow	Yellow	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green
Sulphate	Green	Red	Red	Red	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red	Red	Red	Green	Green
Total ammonia-N	Green	Green	Green	Green	Red/Orange	Green	Red/Orange	Green	Red/Orange	Green	Grey	Green	Green	Green	Green	Green
Nitrite-N	Green	Green	Green	Green	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Green	Green	Green	Green	Green	Green	Green
Nitrate-N	Green	Green	Green	Green	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Grey	Grey	Grey	Green	Green	Green	Green	Green
Total phosphorus	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Total organic carbon	Green	Green	Green	Green	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green
Total antimony	Green	Green	Green	Green	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Green	Green	Green	Green	Green	Green
Total arsenic	Green	Green	Green	Green	Red	Red	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green
Total barium	Green	Green	Green	Green	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Green	Green	Green
Total boron	Green	Green	Green	Green	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red	Green	Green	Green	Green
Total molybdenum	Green	Green	Green	Green	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Green	Green
Total nickel	Green	Green	Red	Green	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Green	Green	Green	Green
Total potassium	Green	Green	Green	Green	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Green	Green
Total selenium	Green	Green	Green	Green	Red	Red	Red	Red	Green	Green	Green	Green	Green	Green	Green	Green
Total strontium	Green	Green	Green	Green	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Red/Orange	Green	Green
Total uranium	Green	Green	Green	Green	Red	Red	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green

Legend:

- Green: *No mine-related change detected.*
- Yellow: *Potential mine-related change detected (potential effect).*
- Orange: *Change shows signs of stabilization or decline in recent years.*
- Red: *Mine-related change detected (mine effect).*
- Grey: *Historical mine-related change that is no longer considered a current effect (historical effect).*
- ⊕ *Water quality benchmark exceeded by lake mean or CCME dissolved oxygen guideline exceeded at any depth but similar observations at reference lake.*
- ⦸ *Water quality benchmark exceeded by lake mean or CCME dissolved oxygen guideline exceeded at any depth.*
- — *Not sampled.*

Note: See Section 3 of Part 1 - Evaluation of Effects for direction, magnitude, and seasonality of change.

Figure 4-1a: Summary of Mine-related Changes in the Physical Limnology and Water Quality Variables Evaluated for the Koala Watershed and Lac de Gras, 2019

	Grizzly Lake	Lower PDC	Kodiak Lake	Kodiak-Little Stream	Leslie Lake	Leslie-Moose Stream	Moose Lake	Moose-Nero Stream	Nema Lake	Nema-Martine Stream	Slipper Lake	Slipper-Lac de Gras Stream	Lac de Gras S2	Lac de Gras S3	Lac de Gras S5	Lac de Gras S6
Phytoplankton																
Chlorophyll *a*	No change	—	⊕	—	⊕	—	⊕	—	⊕	—	⊕	—	⊕	No change	—	—
Total density	No change	—	⊕	—	⊕	—	⊕	—	⊕	—	⊕	—	No change	No change	—	—
Edible density	No change	—	No change	—	No change	—	No change	—	No change	—	No change	—	No change	No change	—	—
Non-edible density	No change	—	No change	—	No change	—	No change	—	Potential effect	—	No change	—	No change	No change	—	—
Diversity	No change	—	No change	—	No change	—	No change	—	No change	—	No change	—	No change	No change	—	—
Community composition	No change	—	No change	—	Mine effect / Stabilization	—	Mine effect / Stabilization	—	Mine effect / Stabilization	—	Mine effect / Stabilization	—	Mine effect / Stabilization	No change	—	—
Zooplankton																
Total biomass	No change	—	No change	—	No change	—	No change	—	No change	—	No change	—	No change	No change	—	—
Total density	No change	—	No change	—	No change	—	No change	—	No change	—	No change	—	No change	No change	—	—
Rotifer density	No change	—	No change	—	Potential effect	—	No change	—	No change	—	No change	—	No change	No change	—	—
Adult crustacean density	No change	—	No change	—	No change	—	No change	—	No change	—	No change	—	No change	No change	—	—
Diversity	No change	—	No change	—	No change	—	No change	—	No change	—	No change	—	No change	No change	—	—
Community composition	No change	—	No change	—	Mine effect / Stabilization	—	Mine effect / Stabilization	—	Mine effect / Stabilization	—	No change	—	No change	No change	—	—
Lake Benthos																
Total density	—	—	No change	—	No change	—	No change	—	No change	—	No change	—	No change	—	—	—
Dipteran diversity	—	—	No change	—	No change	—	No change	—	No change	—	No change	—	No change	—	—	—
Dipteran community composition	—	—	No change	—	No change	—	No change	—	No change	—	No change	—	No change	—	—	—
Stream Benthos																
Total density	—	—	—	Historical effect	—	—	—	No change	—	No change	—	⊘	—	—	—	—
Dipteran diversity	—	—	—	No change	—	—	—	No change	—	No change	—	No change	—	—	—	—
Dipteran community composition	—	—	—	No change	—	—	—	No change	—	No change	—	No change	—	—	—	—
EPT taxa diversity	—	—	—	No change	—	—	—	No change	—	No change	—	No change	—	—	—	—
EPT taxa community composition	—	—	—	No change	—	—	—	No change	—	No change	—	No change	—	—	—	—

LLCF → *Downstream*

Legend:

- (green) *No mine-related change detected.*
- (yellow) *Potential mine-related change detected (potential effect).*
- (orange) *Change shows signs of stabilization or possible shift towards baseline in recent years.*
- (red) *Mine-related change detected (mine effect).*
- (grey) *Historical mine-related change that is no longer considered a current effect (historical effect).*
- ⊕ *Mean biomass or density was not within the biology benchmark, however similar observations at reference site.*
- ⊘ *Mean biomass or density was not within the biology benchmark.*
- — *Not sampled.*

Notes: See Section 3 of Part 1 - Evaluation of Effects for direction and magnitude of change.
EPT = Ephemoptera, Plecoptera, Trichoptera

Figure 4-1b: Summary of Mine-related Changes in the Biological Variables Evaluated for the Koala Watershed and Lac de Gras, 2019

- nitrate-N (downstream to Moose-Nero Stream);
- total antimony (downstream to Nema-Martine Stream);
- total arsenic (downstream to Slipper Lake);
- total barium (downstream to Lac de Gras site S2);
- total boron (downstream to Slipper-Lac de Gras Stream);
- total molybdenum (downstream to Lac de Gras site S3);
- total nickel (downstream to Slipper-Lac de Gras Stream);
- total potassium (downstream to Lac de Gras site S3);
- total selenium (downstream to Moose-Nero Stream);
- total strontium (downstream to Lac de Gras site S3); and,
- total uranium (downstream to Slipper Lake).

In addition, potential mine-related effects were detected for fluoride in lakes downstream to Nema Lake (ice-covered season only) and total organic carbon (TOC) downstream to Slipper Lake. Historical effects were determined for total ammonia-N in Slipper Lake, and nitrate-N in Nema Lake, Nema-Martine Stream, and Slipper Lake.

Although concentrations of many water quality variables have stabilised or decreased at some sites downstream of the LLCF in recent years, concentrations generally remain above baseline or reference concentrations for most sites. The extent to which concentrations have increased generally decreases with downstream distance from the LLCF. Observed trends were similar during the ice-covered and open-water seasons, though concentrations were sometimes greater during the ice-covered season as a consequence of solute exclusion during ice-formation. In reference lakes, concentrations of water quality variables have generally been low and stable through time. Together, the evidence suggests that the observed changes in concentrations in the 18 water quality variables identified in Figure 4-1a in lakes and streams that are downstream of the LLCF are mine-related effects that stem from the Discharge of water from the LLCF into the Receiving Environment under Water Licence W2012L2-0001. In monitored lakes and streams that are not downstream of the LLCF (i.e., Grizzly Lake, the Lower PDC, Kodiak Lake, and Kodiak-Little Stream) only two variables increased through time: sulphate (Lower PDC, Kodiak Lake, and Kodiak-Little Stream) and total nickel (Kodiak Lake). The cause of changes in sulphate and total nickel concentrations at sites not downstream of the LLCF are not clear, but may be an effect of mine-related activities at the main camp.

The following water quality Action Levels were exceeded during the 2019 ice-covered season:

- chloride LAL in Leslie Lake; and
- total potassium MAL in Leslie Lake.

Response Plans have been proposed or implemented to address the exceeded Action Levels (see further description of Response Plans in Appendix A.2).

The extent to which changes in water or sediment quality might result in changes in biological communities is a function of both the relative competitive abilities of different species under different environmental conditions (i.e., their ability to acquire resources, relative to the other species present) and each species' ability to physically tolerate changes in the concentrations of water quality variables. Thus, water quality data were compared to the water quality benchmarks (see Section 2.2.6 of Part 1 – Evaluation of Effects). In cases where a mean concentration of all sampling depths was lower than the water quality benchmark, mean deep-depth water quality data were compared to water quality benchmarks separately. This was done to fulfill a commitment made in response to stakeholder comments on the ARF that was based on the concern that benchmarks could be exceeded at depth if stratification was present in the water column. The mean concentrations for all evaluated variables were below benchmark values for lake-means and deep-depth means in all monitored lakes in 2019. Thus, despite increases in 18 evaluated water quality variables downstream of the LLCF and one water quality variable in the Lower PDC and Kodiak-Little Stream, the comparison of observed water quality data to benchmark values suggests that toxicological effects as a result of the observed concentrations of the evaluated water quality variables and nutrient enrichment type effects as a result of changes in total phosphorus in the Koala Watershed and Lac de Gras are not expected. However, results suggest that changes could occur in biological communities downstream of the LLCF as far as site S3 in Lac de Gras based on relative competitive abilities of different species under different environmental conditions. Changes in biological communities may also result from changes in the taxonomic composition or the nutritional quality of organisms on which higher trophic levels feed.

Results of the most recent sediment quality analyses in the Koala Watershed and Lac de Gras (i.e., in 2017; ERM 2018d) suggest that concentrations of four evaluated sediment quality variables have increased downstream of the LLCF (antimony, molybdenum, selenium, and strontium). The extent to which concentrations have changed through time generally decreases with downstream distance from the LLCF. Based on available literature, it is unlikely that adverse effects to aquatic life would occur because of the observed increases in sediment concentrations of antimony, molybdenum, and strontium in monitored lakes downstream of the LLCF in 2017 (ERM 2018d). Mean concentrations were less than the most relevant available toxicity thresholds for antimony and molybdenum. No relevant toxicity thresholds were available for strontium; however, mean strontium concentrations in lakes downstream of the LLCF were lower than the mean across 2,737 sediment samples collected in a variety of freshwater bodies across the United States of America (ERM 2018d). The mean concentration of selenium in Leslie Lake sediments (mean = 2.03 mg/kg dry weight) exceeded the BC Ministry of Environment and Climate Change Strategy (BC MOECCS) sediment alert concentration of 2.0 mg/kg (dry weight). However, the BC MOECCS sediment alert concentration is not well supported by toxicological evidence and is not the most appropriate ‘threshold’ available to assess the potential for adverse effects in the aquatic Receiving Environment. Thus, Action Levels for selenium are based on the recently updated US EPA (2016) selenium water quality and fish tissue criteria, which represent the current state of science for selenium toxicity to the most sensitive aquatic receptors (i.e., fish). AEMP water quality data for the Koala Watershed are thus compared to the US EPA selenium criteria for the purposes of this report (see Section 2.2.6.1 of Part 1 – Evaluation of Effects).

A total of 12 plankton variables and eight benthos variables were evaluated for potential mine-related effects in the 2019 AEMP for the Koala Watershed and Lac de Gras.

Two mine-related changes in plankton variables were observed:

- altered taxonomic composition of the phytoplankton community in lakes downstream of the LLCF as far as site S2 in Lac de Gras (possible shift back towards baseline community composition in recent years); and
- altered taxonomic composition of the zooplankton community in Leslie, Moose, and Nema lakes (stabilisation of trends in recent years).

Two potential mine-related changes in plankton variables were also identified:

- decrease in non-edible phytoplankton densities in Nema Lake; and
- decrease in rotifer densities in Leslie Lake.

In addition, one historical mine-related change was also identified:

- historically high stream benthos densities in Kodiak-Little Stream.

Potentially mine-related changes will continue to be monitored as part of the annual AEMP to assess whether they are mine-related.

Concentrations of nutrients are among the water quality variables that have changed through time in the Koala Watershed and Lac de Gras and changes in nutrients can have an effect on the composition of biological communities that are not related to toxic effects. The ratio of available nutrients in the Koala Watershed has shifted through time as nitrogen levels have increased. The results of the 2012 and 2015 AEMP re-evaluations, suggested that observed changes in biological community composition at the Ekati Diamond Mine likely resulted from inter-specific differences in the competitive ability of different taxonomic groups under changing quantities or ratios of macronutrients like nitrogen, rather than elemental toxicity (Rescan 2012a; ERM 2016a). Because the trends in the evaluated water quality variables in 2019 are generally consistent with those observed in the 2011 to 2018 AEMPs (Rescan 2012b, 2013a; ERM Rescan 2014; ERM 2015, 2016b, 2017a, 2018d, 2019c) and no benchmark exceedances occurred that would suggest potential toxicological effects, it is expected that the relative availability of macronutrients could continue to be the dominant driver of potential change in biological communities downstream of the LLCF.

No mine-related effects or potential mine-related effects were detected for lake or stream benthos in the Koala Watershed or Lac de Gras. However, a decrease in benthos density was observed in Kodiak-Little Stream. This decrease was considered a historical effect because there was potential for effects in Kodiak-Little Stream during early years due to the Construction and flushing of the PDC and the Discharge of treated Sewage effluent from April 1997 to January 1999 (Rescan 2003). Additionally, the only water quality variable that was found to have increased through time in Kodiak-Little Stream in 2019 is sulphate; however, sulphate concentrations have remained below the benchmark value.

Both zooplankton and benthos provide important sources of food for many species of fish. Thus, changes in zooplankton or benthos communities could have important consequences for fish, especially if preferred prey items are replaced with non-preferred ones. A mine-related effect was detected for taxonomic composition of the zooplankton community in Leslie, Moose, and Nema lakes, where changes were identified in the total and/or relative densities of cladocerans, calanoid copepods, copepod nauplii, and rotifers. These taxa, with the exception of rotifers, all belong to the subphylum Crustacea (phylum Arthropoda). Based on stomach content analysis, Crustacea dominated the diet of Round Whitefish in most years and variation in the proportion of crustaceans in Round Whitefish diet did not appear to vary with trends in zooplankton community composition (ERM 2019a). Fish diet was analysed at a higher taxonomic level than analysis of zooplankton and benthos, therefore the proportions of the diet comprising Crustacea from different taxa were not compared. However, mine-related effects on absolute and relative densities of zooplankton taxonomic groups did not appear to have an effect on the total proportion of Crustacea in Round Whitefish diet prey choices (ERM 2019a). Consistent trends in other biological response variables that may be influenced by a shift in diet such as length, weight, condition, and age of Round Whitefish were not observed among reference and monitored lakes, nor were there any emerging spatial trends in these variables which suggests there was no biological effect of changes in the total and/or relative densities of crustacean prey sources (ERM 2019a). A lack of changes in Round Whitefish diet or biological responses despite changes identified in the zooplankton community in Leslie, Moose, and Nema lakes may be the result of the opportunistic feeding behaviour of Round Whitefish where fish move among habitats to maximize feeding opportunities (Scott and Crossman 1973). Changes observed in the zooplankton community are based on analyses of samples from a specific site within each lake while fish are active feeders with diets that reflect spatial and temporal variation in prey. Slimy Sculpin (the other fish species for which diet was evaluated using stomach contents; ERM 2019a) are benthivorous and, therefore, Slimy Sculpin diet is not expected to be influenced by changes in zooplankton community composition.

The 2019 biological data are compared to Action Levels in Appendix A of this report.

5. SUMMARY OF EVALUATION OF EFFECTS FOR THE KING-CUJO WATERSHED AND LAC DU SAUVAGE

Figures 5-1a and 5-1b summarize the evaluation of effects for the King-Cujo Watershed and Lac du Sauvage. See Section 4 of Part 1 – Evaluation of Effects for a detailed account of the direction and magnitude of change for each variable. For a discussion of statistical and graphical analyses that were used to assist in interpreting results for each of the variables, see Section 2.2 of Part 1 – Evaluation of Effects.

Under-ice temperature and DO concentrations in Cujo Lake and Lac du Sauvage site LdS1 were within the range of historical variation. The DO concentration in Cujo Lake was below the CCME guideline at depths below 3.4 m in 2019. This is consistent with historical DO profiles in Cujo Lake in which DO concentrations were often below the guideline throughout the entire depth profile. DO concentrations were also below the CCME guideline at lower depths in Counts and Nanuq lakes (reference lakes) in 2019. No mine-related effects were detected in Cujo Lake or site LdS1 in Lac du Sauvage. Although Action Level exceedances for under-ice DO concentrations in Cujo Lake have been observed during some historical years, no exceedance was observed in 2019.

Open-water specific conductivity in Cujo Lake and sites in Lac du Sauvage were uniform throughout the water column during all monitoring years. This analysis suggests that additional bottom water sampling is not necessary for monitored sites in the King-Cujo Watershed and Lac du Sauvage.

There was no evidence of a consistent directional trend in Secchi depth over time at either Cujo Lake or Lac du Sauvage site LdS1. Therefore, no mine-related effects were detected with respect to open-water Secchi depth in monitored lakes of the King-Cujo Watershed or Lac du Sauvage.

A total of 21 water quality variables were evaluated for lakes and streams in the King-Cujo Watershed and Lac du Sauvage in the 2019 AEMP. Of these, concentrations of 17 variables are currently elevated in monitored sites downstream of the KPSF as a result of the mine:

- pH (downstream to Christine-Lac du Sauvage Stream);
- total alkalinity (downstream to Christine-Lac du Sauvage Stream);
- water hardness (downstream to Christine-Lac du Sauvage Stream and potentially to LdS2 in Lac du Sauvage);
- chloride (downstream to Christine-Lac due Sauvage Stream);
- fluoride (downstream to Christine-Lac du Sauvage Stream);
- sulphate (downstream to Christine-Lac du Sauvage Stream and potentially to LdS2 in Lac du Sauvage);
- total ammonia-N (Cujo Lake ice-covered season only);
- nitrate-N (Cujo Lake (open-water season only), Cujo Outflow);
- total phosphorus (Cujo Lake open-water season only);
- total arsenic (Cujo Lake ice-covered season only);
- total barium (downstream to Christine-Lac du Sauvage Stream);
- total boron (downstream to Cujo Outflow)
- total molybdenum (downstream to Christine-Lac du Sauvage Stream);
- total nickel (downstream to Cujo Outflow);
- total potassium (downstream to Christine-Lac du Sauvage Stream);
- total strontium (downstream to Christine-Lac du Sauvage Stream); and
- total uranium (downstream to Cujo Outflow).

	Downstream → KPSF ↓ Cujo Lake	Cujo Outflow	Christine -Lac du Sauvage Stream	Lac du-Sauvage LdS2	Lac du-Sauvage LdS1
Physical Limnology					
Under-ice temperature	green	—	—	—	green
Under-ice dissolved oxygen	⊕	—	—	—	green
Open-water Secchi depth	green	—	—	green	green
Water Quality					
pH	red	red	red	green	green
Total alkalinity	red	red	red	green	green
Water hardness	orange/red	orange/red	red	yellow	green
Chloride	red	red	red	green	green
Fluoride	red	red	red	green	green
Sulphate	orange/red	orange/red	red	yellow	green
Total ammonia-N	orange/red	green	green	green	green
Nitrite-N	grey	grey	green	green	green
Nitrate-N	orange/red	orange/red	green	green	green
Total phosphorus	⦸	green	green	green	green
Total organic carbon	yellow	yellow	yellow	green	green
Total antimony	green	green	green	green	green
Total arsenic	red	green	green	green	green
Total barium	red	red	red	green	green
Total boron	orange/red	orange/red	green	green	green
Total molybdenum	orange/red	orange/red	red	green	green
Total nickel	red	red	green	green	green
Total potassium	red	red	red	green	green
Total selenium	grey	grey	green	green	green
Total strontium	orange/red	orange/red	red	green	green
Total uranium	red	red	green	green	green

Legend:

- (green) *No mine-related change detected.*
- (yellow) *Potential mine-related change detected (potential effect).*
- (orange) *Change shows signs of stabilization or decline in recent years.*
- (red) *Mine-related change detected (mine effect).*
- (grey) *Historical mine-related change that is no longer considered a current effect (historical effect).*
- ⊕ *Water quality benchmark or CCME dissolved oxygen guideline exceeded by lake mean but similar observations at reference lake.*
- ⦸ *Mean biomass or density was not within the biology benchmark.*
- — *Not sampled.*

Note: See Section 4 of Part 1 - Evaluation of Effects for direction, magnitude, and seasonality of change.

Figure 5-1a: Summary of Mine-related Changes in the Physical Limnology and Water Quality Variables Evaluated for the King-Cujo Watershed and Lac du Sauvage, 2019

	KPSF → (Downstream) Cujo Lake	Cujo Outflow	Christine-Lac du Sauvage Stream	Lac du Sauvage LdS2	Lac du Sauvage LdS1
Phytoplankton					
Chlorophyll *a*	Red ⊕	—	—	—	Green
Total density	Red ⊕	—	—	—	Green
Edible density	Red	—	—	—	Green
Non-edible density	Green	—	—	—	Green
Diversity	Green	—	—	—	Green
Community composition	Yellow	—	—	—	Green
Zooplankton					
Total biomass	Yellow ⊕	—	—	—	Green
Total density	Green	—	—	—	Green
Rotifer density	Green	—	—	—	Green
Adult crustacean density	Green	—	—	—	Green
Diversity	Green	—	—	—	Green
Community composition	Green	—	—	—	Green
Lake Benthos					
Total density	Red/Orange ⊘	—	—	—	Green
Dipteran diversity	Green	—	—	—	Green
Dipteran community composition	Green	—	—	—	Green
Stream Benthos					
Total density	—	Green ⊘	—	—	—
Dipteran diversity	—	Green	—	—	—
Dipteran community composition	—	Green	—	—	—
EPT taxa diversity	—	Green	—	—	—
EPT taxa community composition	—	Green	—	—	—

Legend:

- Green: *No mine-related change detected.*
- Yellow: *Potential mine-related change detected (potential effects).*
- Orange: *Change shows signs of stabilization or possible shift towards baseline in recent years.*
- Red: *Mine-related change detected (mine effect).*
- ⊕ *Mean biomass or density was not within the biology benchmark, however similar observations at reference site.*
- ⊘ *Mean biomass or density was not within the biology benchmark.*
- — *Not sampled.*

Notes: See Section 4 of Part 1 - Evaluation of Effects for direction and magnitude of change.
EPT = Ephemoptera, Plecoptera, Trichoptera

Figure 5-1b: Summary of Mine-related Changes in the Biological Variables Evaluated for the King-Cujo Watershed and Lac du Sauvage, 2019

Water hardness and concentrations of sulphate, total ammonia-N, nitrate-N, total boron, total molybdenum, and total strontium also showed signs of stabilisation or decline in Cujo Lake and Cujo Outflow since 2016 or 2017, though concentrations remain above baseline or reference concentrations in 2019.

In addition, a potential effect was detected for TOC downstream to Christine-Lac du Sauvage Stream.

Historical increases in: nitrite-N and total selenium in Cujo Lake and Cujo Outflow since 2016 were likely a result of the pumping of water from the Misery Pit and Desperation Sump into the KPSF in 2015 and subsequent Discharge to Cujo Lake; concentrations measured in 2017 and 2018 showed a decreasing trend and in 2019 concentrations were within baseline and/or historical ranges.

Overall, the extent to which concentrations of water quality variables have changed through time generally decreases with downstream distance from the KPSF. Patterns were similar during the ice-covered and open-water seasons, though concentrations were sometimes elevated during the ice-covered season, relative to the open-water season, because of solute exclusion during ice-formation. In reference lakes, concentrations have generally been low and stable through time. Together, the evidence suggests that the observed changes in concentrations of the 17 variables identified in Figure 5-1a are mine-related effects from the Discharge of water from the KPSF into the Receiving Environment under Water Licence W2012L2-0001.

Mean total phosphorus concentrations were greater than the lake-specific total phosphorus benchmark in Cujo Lake during the open-water season in 2019 and since 2016. The 2018 LAL exceedance for total phosphorus in Cujo Lake was confirmed during the 2019 open-water season through the collection of monthly samples according to the Total Phosphorus Response Plan, Version 1.3 (ERM 2018e). The 2019 open-water season (June to October) mean for total phosphorus in Cujo Lake exceeded the LAL benchmark and triggered the MAL in Cujo Lake; Version 2.0 of the Total Phosphorus Response Plan is currently being developed.

The extent to which changes in water or sediment quality might result in changes in biological communities is a function of both the relative competitive abilities of different species under different environmental conditions (i.e., their ability to acquire resources, relative to the other species present) and each species' ability to physically tolerate changes in the concentrations of water quality variables. Thus, water quality data were compared to the water quality benchmarks (see Section 2.2.6.1 of Part 1 – Evaluation of Effects). In cases where a mean concentration from all sampling depths was lower than the water quality benchmark, mean deep-depth water quality data were compared to water quality benchmarks separately. This was done to fulfill a commitment made in response to stakeholder comments on the ARF that were based on the concern that benchmarks could be exceeded at depth if stratification was present in the water column. Water quality benchmarks based on toxicological thresholds were not exceeded for any of the evaluated water quality variables, though the total phosphorus benchmark was exceeded in Cujo Lake. The comparison of water quality data to benchmark values suggests that toxicological effects as a result of concentrations of the evaluated water quality variables in the King-Cujo Watershed and Lac du Sauvage are unlikely to be expected. However, results suggest that changes could occur in biological communities downstream of the KPSF as far as Christine-Lac du Sauvage Stream based on relative competitive abilities of different species under different environmental conditions, and that there is a potential for nutrient enrichment type effects based on the exceedance of the total phosphorus benchmark. Changes in biological communities may also result from changes in the taxonomic composition or the nutritional quality of organisms on which higher trophic levels feed.

Results of the most recent sediment quality analyses in the King-Cujo Watershed and Lac du Sauvage (i.e., in 2017; ERM 2018d) suggest that concentrations of four evaluated sediment quality variables have increased in Cujo Lake: molybdenum and uranium as a result of Discharge from the KPSF, and selenium and strontium possibly as a result of natural variability. However, based on available literature, it was concluded to be unlikely that adverse effects to aquatic life would occur because of the observed increases in sediment concentrations of these four sediment quality variables in Cujo Lake (ERM 2018d). Mean concentrations were less than the most relevant available toxicity thresholds for molybdenum and uranium and the BC MOECCS sediment alert concentration for selenium. No relevant toxicity thresholds were available for strontium; however, the mean strontium concentration in Cujo Lake was lower than the mean across 2,737 sediment samples collected in a variety of freshwater bodies across the United States of America (ERM 2018d).

A total of 12 plankton variables and eight benthos variables were evaluated for potential mine-related effects in the 2019 AEMP for the King-Cujo Watershed and Lac du Sauvage.

Four mine-related changes in plankton and benthos variables were observed:

- an increase in chlorophyll *a* in Cujo Lake;
- an increase in total phytoplankton density in Cujo Lake;
- an increase in edible phytoplankton density in Cujo Lake; and
- an increase in lake benthos density in Cujo Lake (stabilised since 2003).

Two potential mine-related changes in plankton variables were also identified:

- altered taxonomic composition of the phytoplankton community in Cujo Lake; and
- increase in zooplankton biomass in Cujo Lake.

Though no mine-related effects were detected with respect to zooplankton diversity or community composition of major taxonomic groups, a close examination of zooplankton species compositions suggested the cladoceran *H. gibberum* has been largely absent from Cujo Lake since 2002. A similar trend was observed in lakes downstream of the LLCF. The presence of cladoceran *H. gibberum* is known to be indicative of low pH and calcium levels (Hamilton 1958). Thus, the absence of this species from lakes immediately downstream of the KPSF is likely related to the observed increase in pH and calcium concentrations.

The increase in chlorophyll *a,* and total and edible phytoplankton densities in Cujo Lake may be related to the increase in total phosphorus that was observed in Cujo Lake since 2016. The cause of the increase in lake benthos density is not known but the trend has been stable since 2003.

The 2019 biological data are compared to Action Levels in Appendix A of this report.

6. SUMMARY OF EVALUATION OF EFFECTS FOR THE PIGEON-FAY AND UPPER EXETER WATERSHED

Figure 6-1 summarizes the evaluation of effects for the Pigeon-Fay and Upper Exeter Watershed. The evaluation of effects for the Pigeon-Fay and Upper Exeter Watershed lake and stream monitoring variables occurs once every three years, with the exception of potassium, nitrate-N, total molybdenum, total strontium, and phytoplankton density, which are evaluated annually (WLWB 2017a). The next full evaluation of effects will be completed in 2020. See Section 5 of Part 1 – Evaluation of Effects for a detailed account of the results and graphical representations of historical data that were used to interpret the statistical results for the Pigeon-Fay and Upper Exeter Watershed. For a discussion of statistical and graphical analyses that were used to assist in interpreting results for each of the evaluated variables, see Section 2.2 of Part 1 – Evaluation of Effects.

Open-water specific conductivity in Fay Bay and Upper Exeter Lake was uniform throughout the water column in 2019. This suggests that additional bottom water sampling is not necessary for monitored sites in the Pigeon-Fay and Upper Exeter Watershed.

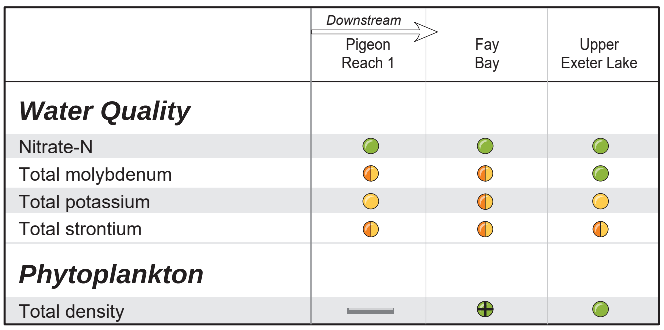
Three of four of the evaluated water quality variables have changed through time at monitored sites:

- total molybdenum (Pigeon Reach 1; Fay Bay);
- total potassium (Pigeon Reach 1; Fay Bay; open-water season only in Upper Exeter Lake); and
- total strontium (Pigeon Reach 1; Fay Bay; open-water season only in Upper Exeter Lake).

These changes were considered potential mine-related effects and in general, the increases observed in the Pigeon-Fay and Upper Exeter Lake Watershed have been relatively small. The increases observed in Fay Bay and Upper Exeter Lake were likely related to the unplanned release of FPK in May 2008 (Rescan 2011). The general pattern that was observed for water quality variables that increased in Fay Bay and/or Upper Exeter Lake was an increase in 2008 followed by a decrease in concentrations, although 2019 concentrations remained higher than concentrations observed during baseline years. Increases observed in Pigeon Reach 1 may be related to mine activities or Construction and weathering of the PSD. No water quality Action Level exceedances were identified for the Pigeon Fay and Upper Exeter Watershed in 2019.

The extent to which changes in water or sediment quality might result in changes in biological communities is a function of both the relative competitive abilities of different species under different environmental conditions (i.e., their ability to acquire resources, relative to the other species present) and each species' ability to physically tolerate changes in the concentrations of elements and molecules (toxicity). Thus, water quality data were compared to the water quality benchmarks (see Section 2.2.6 of Part 1 – Evaluation of Effects). In cases where a mean concentration from all sampling depths was lower than the water quality benchmark, mean deep-depth water quality data were compared to water quality benchmarks separately. This was done to fulfill a commitment made in response to stakeholder comments on the ARF that were based on the concern that benchmarks could be exceeded at depth if stratification was present in the water column. All lake-mean and deep-depth mean concentrations of the evaluated water quality variables were below their respective benchmark values in 2019 in the Pigeon-Fay and Upper Exeter Watershed. Thus, despite increases in three evaluated water quality variables, observed concentrations were below benchmark values and below concentrations at which toxicological effects might be expected. Similarly, the 2017 sediment analysis for the Pigeon-Fay and Upper Exeter Watershed did not identify any changes in sediment quality that were related to the mine, thus no mine-related changes in biological communities were expected based on the 2017 sediment quality results (ERM 2018d).

No mine-related effects were detected with respect to phytoplankton density in the Pigeon-Fay and Upper Exeter Watershed. The 2019 biological data are compared to Action Levels in Appendix A of this report.



Legend:

- *No mine-related change detected.*
- *Potential mine-related change detected (potential effect).*
- *Change shows signs of stabilization or decline in recent years.*
- *Historical mine-related change that is no longer considered a current effect (historical effect).*
- *Water quality benchmark exceeded by lake mean, CCME dissolved oxygen guideline exceeded at any depth, or biology benchmark outside the benchmark range but similar observations at reference site.*
- *Not sampled.*

Note: See Section 5 of Part 1 - Evaluation of Effects for direction, magnitude, and seasonality of change.

Figure 6-1: Summary of Mine-related Changes in the Water Quality and Biological Variables Evaluated for the Pigeon-Fay and Upper Exeter Watershed, 2019

7. SUMMARY OF EVALUATION OF EFFECTS FOR THE HORSESHOE WATERSHED AND LOWER EXETER LAKE

Figures 7-1a and 7-1b summarize the evaluation of effects for the Horseshoe Watershed and Lower Exeter Lake. See Section 6 of Part 1 – Evaluation of Effects for a detailed account of the direction and magnitude of change for each variable. For a discussion of statistical and graphical analyses that were used to assist in interpreting results for each of the variables, see Section 2.2 of Part 1 – Evaluation of Effects.

Under-ice temperatures in 2019 were either within the historical range for each lake or greater than temperatures measured historically; greater temperatures were observed at both reference (Counts and Northeast) and monitored (Ulu, HWL2, and Ross) lakes. Under-ice DO concentrations in 2019 were similar to baseline DO concentrations in all monitored lakes and within the historical ranges for reference lakes. DO concentrations in all monitored lakes, except Lower Exeter Lake, were below the CCME guideline at depth in 2019. This is consistent with baseline DO profiles for each lake. DO concentrations were also below the CCME guideline at depth in three of the reference lakes (Counts, Nanuq, and Northeast) in 2019. No mine-related effects for under-ice temperature or DO concentrations were detected for Horseshoe Watershed lakes or Lower Exeter Lake.

Open-water specific conductivity was uniform throughout the water column in all monitored and reference lakes in 2019 (the first monitoring year after baseline). This suggests that additional bottom water sampling is not necessary for monitored or reference sites in the Horseshoe Watershed and Lower Exeter Lake.

Open-water Secchi depths in 2019 were within the baseline range in all monitored lakes. Therefore, no mine-related effects were detected with respect to open-water Secchi depth in monitored lakes of the Horseshoe Watershed or Lower Exeter Lake.

A total of 23 water quality variables were evaluated for lakes and streams in the Horseshoe Watershed and Lower Exeter Lake in the 2019 AEMP. Of these, concentrations of only one variable, total potassium, is currently elevated in Horseshoe Lake as a result of the mine. Although there has only been a single year of post-baseline monitoring, the evidence suggests that the observed changes in concentrations of total potassium are mine-related effects from the Discharge of water from the TRSP into the Receiving Environment under Water Licence W2012L2-0001. In addition, potential mine-related effects were detected in Horseshoe Lake for fluoride, sulphate, and nitrate-N (ice-covered season). Additional sampling years are required to confirm whether the observed differences in these variables were due to Discharge from the TRSP or natural variability. No mine-related effects were detected for lakes or streams not downstream of the TRSP (i.e., Ulu Lake and Ulu Outflow). Overall, the observed changes to concentrations of water quality variables downstream of the TRSP were small relative to baseline concentrations and changes were limited to Horseshoe Lake, the first lake downstream of the TRSP.

The extent to which changes in water quality might result in changes in biological communities is a function of both the relative competitive abilities of different species under different environmental conditions (i.e., their ability to acquire resources, relative to the other species present) and each species' ability to physically tolerate changes in the concentrations of water quality variables (toxicity). Thus, water quality data were compared to the water quality benchmarks (see Section 2.2.6 of Part 1 – Evaluation of Effects). In cases where a mean concentration from all sampling depths was lower than the water quality benchmark, mean deep-depth water quality data were compared to water quality benchmarks separately. This was done to fulfill a commitment made in response to stakeholder comments on the ARF that were based on the concern that benchmarks could be exceeded at depth if stratification was present in the water column. Water quality benchmarks based on toxicological thresholds were not exceeded for any of the evaluated water quality variables. However, the mean total phosphorus concentration was greater than the lake-specific total phosphorus benchmark in Horseshoe Lake during the open-water season in 2019. It could not be confirmed whether the elevated total phosphorus concentration observed in Horseshoe Lake in 2019 was a trend or was due to natural variability; therefore, the LAL was not triggered.

TRSP → *Downstream* (from Ulu Outflow to Horseshoe Lake onward)

	Ulu Lake	Ulu Outflow	Horseshoe Lake	Horseshoe Outflow	HWL2 Lake	HWL2 Outflow	Ross Lake	Ross Outflow	Logan Lake	Logan Outflow	Lower Exeter Lake
Physical Limnology											
Under-ice temperature	🟢	—	🟢	—	🟢	—	🟢	—	🟢	—	🟢
Under-ice dissolved oxygen	⊕	—	⊕	—	⊕	—	⊕	—	⊕	—	🟢
Open-water Secchi depth	🟢	—	🟢	—	🟢	—	🟢	—	🟢	—	🟢
Water Quality											
pH	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	⊘
Total alkalinity	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Water hardness	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Chloride	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Fluoride	🟢	🟢	🟡	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Sulphate	🟢	🟢	🟡	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Total suspended soilds	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Total ammonia-N	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Nitrite-N	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Nitrate-N	🟢	🟢	🟡	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Total phosphorus	🟢	🟢	⊘	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Total organic carbon	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Total antimony	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Total arsenic	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Total barium	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Total boron	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Total molybdenum	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Total nickel	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Total Potassium	🟢	🟢	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Total selenium	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Total strontium	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Total uranium	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Total zinc	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢

Legend:

- 🟢 *No mine-related change detected.*
- 🟡 *Potential mine-related change detected (potential effect).*
- 🔴 *Mine-related change detected (mine effect).*
- ⊕ *Water quality benchmark exceeded by lake mean or CCME dissolved oxygen guideline exceeded at any depth but similar observations at reference lake.*
- ⊘ *Water quality benchmark exceeded by lake mean or CCME dissolved oxygen guideline exceeded at any depth.*
- — *Not sampled.*

Note: See Section 6 of Part 1 - Evaluation of Effects for direction, magnitude, and seasonality of change.

Figure 7-1a: Summary of Mine-related Changes in the Physical Limnology and Water Quality Variables Evaluated for the Horseshoe Watershed and Lower Exeter Lake, 2019

TRSP → Downstream

	Ulu Lake	Ulu Outflow	Horseshoe Lake	Horseshoe Outflow	HWL2 Lake	HWL2 Outflow	Ross Lake	Ross Outflow	Logan Lake	Logan Outflow	Lower Exeter Lake
Phytoplankton											
Chlorophyll *a*	⊕	—	●	—	●	—	●	—	●	—	●
Total density	⊕	—	⊕	—	●	—	●	—	●	—	●
Edible density	●	—	●	—	●	—	●	—	●	—	●
Non-edible density	●	—	●	—	●	—	●	—	●	—	●
Diversity	●	—	●	—	●	—	●	—	●	—	●
Community composition	●	—	●	—	●	—	●	—	●	—	●
Zooplankton											
Total biomass	—	—	●	—	●	—	●	—	●	—	●
Total density	—	—	●	—	●	—	●	—	●	—	●
Rotifer density	—	—	●	—	●	—	●	—	●	—	●
Adult crustacean density	—	—	●	—	●	—	●	—	●	—	●
Diversity	—	—	●	—	●	—	●	—	●	—	●
Community composition	—	—	●	—	●	—	●	—	●	—	●
Lake Benthos											
Total density	—	—	●	—	●	—	●	—	●	—	●
Dipteran diversity	—	—	●	—	●	—	●	—	●	—	●
Dipteran community composition	—	—	●	—	●	—	●	—	●	—	●
Stream Benthos											
Total density	—	—	—	●	—	●	—	●	—	●	—
Dipteran diversity	—	—	—	●	—	●	—	●	—	●	—
Dipteran community composition	—	—	—	●	—	●	—	●	—	●	—
EPT taxa diversity	—	—	—	●	—	●	—	●	—	●	—
EPT taxa community composition	—	—	—	●	—	●	—	●	—	●	—

Legend:

- ● *No mine-related change detected.*
- ● *Potential mine-related change detected (potential effect).*
- ● (red) *Mine-related change detected (mine effect).*
- ⊕ *Water quality benchmark exceeded by lake mean or CCME dissolved oxygen guideline exceeded at any depth but similar observations at reference lake.*
- ⊘ *Water quality benchmark exceeded by lake mean or CCME dissolved oxygen guideline exceeded at any depth.*
- — *Not sampled.*

Notes: See Section 6 of Part 1 - Evaluation of Effects for direction and magnitude of change.
EPT = Ephemoptera, Plecoptera, Trichoptera

Figure 7-1b: Summary of Mine-related Changes in the Biological Variables Evaluated for the Horseshoe Watershed and Lower Exeter Lake, 2019

The comparison of water quality data to benchmark values suggests that toxicological effects as a result of concentrations of the evaluated water quality variables in the Horseshoe Watershed and Lower Exeter Lake are unlikely to be expected. However, results suggest that changes could occur in biological communities in Horseshoe Lake based on relative competitive abilities of different species under different environmental conditions, and that there is a potential for nutrient enrichment type effects based on the exceedance of the total phosphorus benchmark. Changes in biological communities may also result from changes in the taxonomic composition or the nutritional quality of organisms on which higher trophic levels feed.

Generally, lake sediment quality is monitored and evaluated every three years. Sediment quality data were collected in the Horseshoe Watershed and Lower Exeter Lake in 2019 and the data is presented in presented in Part 2 – Data Report. However, sediment quality was not evaluated in the 2019 AEMP because detectable changes in sediment quality were not anticipated after the short duration of Discharge from TRSP into Horseshoe Lake in 2018 (two to four weeks). Therefore, sediment quality in the Horseshoe Watershed and Lower Exeter Lake will first be evaluated as part of the 2020 AEMP.

A total of 12 plankton variables and eight benthos variables were evaluated for potential mine-related effects in the 2019 AEMP for the Horseshoe Watershed and Lower Exeter Lake. No mine-related changes in plankton and benthos variables were observed in the monitored lakes relative to the reference lakes when comparing the *before* and *after* periods.

The 2019 biological data are compared to Action Levels in Appendix A of this report.

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APPENDIX A AQUATIC RESPONSE FRAMEWORK REPORTING

Appendix A: Aquatic Response Framework Reporting

A.1 Action Level Exceedances

The 2019 AEMP water quality data were compared to ARF Action Levels following receipt of the final ice-covered and open-water season laboratory data files in the spring and fall of 2019. Comparisons were completed according to the criteria outlined in the ARF, Version 3.0 (ERM 2018c) and the Board was subsequently notified of any identified Action Level exceedances. The 2019 biological data are compared to Action Levels for the first time in this report. Section A.1 presents a summary of the comparison of both the 2019 AEMP water quality (Section A.1.1) and biological (Section A.1.2) data to ARF Action Levels.

A.1.1 Water Quality Variables

To exceed the LAL for water quality, two conditions (conditions 1 and 2) are required to be met for near-field sampling locations as defined in the ARF. If condition 1 was met for a near-field sampling location and sampling period, the assessment of observed 2019 data against condition 2 was presented for that sampling location because it is required to determine whether the LAL was exceeded. If condition 1 was not met (i.e., 'none' indicated in Table A.1-1) for a particular near-field sampling location and sampling period (under-ice [April] or open-water [August]) the assessment of observed 2019 data relative to condition 2 was not presented and the LAL was not exceeded (i.e., '-' indicated in Table A.1-1). Dissolved Oxygen is the one exception for which only condition 1 or condition 2 is required to be met (not both), depending on the condition relevant to the specific waterbody (see ARF version 3.0 for details).

If a LAL was exceeded for a near-field sampling location (Table A.1-1), the variable was also compared to approved MALs and HALs. MALs and HALs have been approved for all variables that exceeded water quality Action Levels in 2019.

In 2019, Action Level exceedances were identified for three water quality variables:

- Chloride
    - Leslie Lake: LAL (April, under-ice)
- Potassium
    - Leslie Lake: MAL (April, under-ice)
- Total phosphorus
    - Cujo Lake: MAL (August, open-water)

The MAL was exceeded in April 2018 for chloride in Leslie Lake (ERM 2019a). In 2019, chloride concentrations decreased and the LAL was exceeded in April because concentrations were above 50% of the water quality benchmark (compared to greater than 70% in 2018 when the MAL was exceeded). Similarly, the total potassium HAL was exceeded in April 2018 in Leslie Lake (ERM 2019a), in 2019 concentrations decreased and the MAL was exceeded in April because concentrations were above 70% of the water quality benchmark (compared to greater than 90% in 2018 when the HAL was exceeded).

The LAL was exceeded for total phosphorus in Cujo Lake during the 2017 and 2018 open-water seasons. As per the Response Plan for total phosphorus (Version 1.3, ERM 2018e), monthly sampling was conducted during the open-water season of 2019. The LAL was exceeded based on the 2019 open-water season mean total phosphorus concentration in Cujo Lake, which triggered the MAL because it was the third consecutive open-water season when the LAL was exceeded (see ERM 2018e). As part of the re-evaluation of the ARF in the 2019 AEMP Re-Evaluation, it was recommended that total phosphorus exceedances be reported in the annual AEMP with the biological variables. This notification timing allows for any necessary statistical analyses to be completed, as well as examination of relevant biological data (e.g., plankton community) to assist in effects determination. See the re-evaluation of the ARF in the 2019 AEMP Re-Evaluation (ERM 2019e) for a more detailed discussion.

Between 2015 and 2017, LAL exceedances for water quality variables had also been identified for nitrate-N, nitrite-N, and total selenium but no Action Level exceedances were identified for these variables in 2018 or 2019. Approved Response Plans in various stages of development and approval are in place for these variables as well as the variables that triggered Response Plans in 2019. A summary of each Response Plan is provided in Section A.2 below.

A.1.2 Biological Variables

To exceed the LAL for plankton and benthos variables two conditions (conditions 1 and 2) are required to be met for near-field sampling locations defined in the ARF. If condition 1 was met for a near-field sampling location and sampling period, the assessment of observed 2019 data against condition 2 was presented for that sampling location because it is required to determine whether the LAL was exceeded. If condition 1 was not met (i.e., ‘none’ indicated in Table A.1-2) for a particular near-field sampling location, the assessment of observed 2019 data relative to condition 2 was not presented and the LAL was not exceeded (i.e., ‘-’ indicated in Table A.1-2). If a LAL was exceeded for a near-field sampling location, the variable was also compared to approved MALs and HALs.

In 2019, Action Level exceedances were identified for three biological variables (Table A.1-2):

- Phytoplankton biomass (as chlorophyll *a*)
    - Cujo Lake: LAL
- Phytoplankton community composition
    - Leslie and Moose lakes: LAL
- Zooplankton community composition
    - Leslie and Moose lakes: LAL

Thus, observations for these lakes were also compared to the approved MAL for phytoplankton and zooplankton community composition (ERM 2017b; Section 3.2.3). No mine-related declines were detected for edible phytoplankton density or adult crustacean zooplankton density for Kodiak, Leslie, or Moose lakes in 2019, thus the MAL for community composition was not exceeded.

The phytoplankton biomass LAL exceedance in Cujo Lake is a result of elevated chlorophyll *a* concentrations since 2017, which could be a consequence of a mine-related effect related to elevated nitrogen and/or phosphorus concentrations in the lake (see Section 4.2.3 in Part 1 – Evaluation of Effects). Elevated nitrite-N and nitrate-N were observed in Cujo Lake in 2016 as a result of the pumping of water from the Misery Pit and Desperation Sump into the KPSF in 2015 and subsequent Discharge to Cujo Lake, though concentrations measured in 2018 and 2019 were lower suggesting a stabilizing or decreasing trend in trend in nitrogen. Mean total phosphorus concentrations have been greater than the lake-specific total phosphorus benchmark in Cujo Lake during the open-water season since 2016 (see Part 1 – Evaluation of Effects). Total phosphorus is generally considered to be the primary nutrient responsible for nutrient enrichment-type effects (e.g., increased phytoplankton biomass) and reducing phosphorus inputs to aquatic environments is recognized as the most effective means of reversing nutrient enrichment-type effects (Schindler et al. 2012). Total phosphorus concentrations remain elevated in Cujo Lake while nitrite-N and nitrate-N concentrations have recently decreased suggesting that total phosphorus is the main contributor to the observed increases in phytoplankton biomass (as chlorophyll *a*).

Therefore, it is appropriate to address the phytoplankton biomass (as chlorophyll *a*) LAL exceedance in Cujo Lake as part of the total phosphorus Response Plan, which is currently being updated (see Section A.2.4 for details). Further, Discharge from the KPSF is not planned for the next three years, which will eliminate the primary mine-related source of total phosphorus to Cujo Lake. A phytoplankton biomass (as chlorophyll *a*) Response Plan is not warranted at this time, rather, the updated version of the total phosphorus Response Plan will be revised to reflect the phytoplankton biomass (as chlorophyll *a*) Action Level exceedance.

An approved Response Plan is already in place for plankton and benthos community composition (ERM 2017b) because the same exceedances were identified since 2016. The Board has previously acknowledged that revisions to an existing Response Plan may not be necessary each time an Action Level is exceeded, given appropriate rationale (WLWB 2017d). The approved Response Plan indicates that results of the 2015 and 2016 AEMPs and the Aquatic Ecology Synthesis (AES) study completed in 2016 suggest that there may be a stabilization of the changes observed in the plankton communities downstream of the LLCF. The 2017, 2018, and 2019 AEMPs presented similar conclusions (see Section 4 and ERM 2018d, 2019a). Thus, the results do not provide evidence to suggest that the risk of effects on the aquatic ecosystem have increased since the Response Plan for plankton and benthos community composition was initially approved. The approved Response Plan also indicates that the strongest evidence suggests that changes in the biological communities at the Ekati Diamond Mine are related to changes in macronutrients. The ongoing actions proposed in the Plankton and Benthos Community Composition Response Plan were the development of the Nitrogen and Total Phosphorus Response Plans. The 2019 AEMP demonstrates that concentrations of nitrite-N and nitrate-N have stabilized or declined downstream of the LLCF in recent years. No mine-related effects were identified for total phosphorus concentrations downstream of the LLCF in 2019. Together, the evidence suggests that the current Response Plan for plankton and benthos community composition is functioning as intended and concentrations of macronutrients, the suspected root-cause of the changes to the plankton communities, are being managed. An updated Response Plan for plankton and benthos community composition is not warranted at this time.

The LAL for fish variables is exceeded when a mine-related effect is concluded in a monitored large-bodied fish species for a near-field lake as defined in the ARF (ERM 2018c). LALs were exceeded in 2018 for three fish tissue metals: mercury, selenium, and uranium. The LAL for mercury was exceeded in both the Koala and King-Cujo watersheds based on the conclusion of a mine-related effect on mercury concentration in Round Whitefish muscle tissue in Kodiak, Leslie, Moose, and Cujo lakes and in liver tissue in Kodiak, Moose, and Cujo lakes. The LAL for selenium was exceeded in the Koala Watershed based on the conclusion of a mine-related effect on selenium concentration in Lake Trout muscle and Round Whitefish muscle and liver tissues in Leslie and Moose lakes and was exceeded in the King-Cujo Watershed based on conclusion of mine-related effect on selenium concentration in Round Whitefish muscle and liver tissues in Cujo Lake. Finally, the LAL for uranium was exceeded in the King-Cujo Watershed based on the conclusion of a mine-related effect on uranium concentration in Round Whitefish liver tissues in Cujo Lake.

Based on 2012 monitoring data, LAL exceedances were identified for fish variables (antimony, molybdenum, selenium, and uranium concentrations and EROD activity) and a Fish Response Plan was developed for these fish variables (Version 1.2, submitted June 2018). A new version of the Fish Response Plan, based on the 2018 LAL exceedances, was submitted in October 2019 (Version 2.0, awaiting review and approval). A summary of the Fish Response Plan Version 2.0 is provided in Section A.2 below. The need for updates to the Fish Response Plan based on the 2018 LAL will depend on the Board's review and response to Version 2.0.

Table A.1-1: Comparison of 2019 AEMP Water Quality Data to ARF Low Action Levels, Ice-covered (April) and Open-water (August) Seasons

Variable	Koala Watershed		King-Cujo Watershed		Pigeon-Fay and Upper Exeter Watershed		Horseshoe Watershed		Low Action Level Exceeded
	Condition 1	Condition 2	Condition 1	Condition 2	Condition 1	Condition 2	Condition 1	Condition 2	
DO[1]	None		None		None		None		No
pH	None	-	None	-	None	-	None	-	No
Chloride	Leslie (April)	Leslie (April)	None	-	None	-	None	-	Leslie (April)
Fluoride	None	-	None	-	None	-	None	-	No
Sulphate	None	-	None	-	None	-	None	-	No
Total suspended solids	None	-	None	-	None	-	None	-	No
Total ammonia-N	None	-	None	-	None	-	None	-	No
Nitrate-N	None	-	None	-	None	-	None	-	No
Nitrite-N	None	-	None	-	None	-	None	-	No
Total phosphorus	None	-	Cujo (August)	Cujo (August)	None	-	Horseshoe (August)	None	Cujo, (August)
Total aluminum	None	-	None	-	None	-	None	-	No
Total antimony	None	-	None	-	None	-	None	-	No
Total arsenic	None	-	None	-	None	-	None	-	No
Total barium	None	-	None	-	None	-	None	-	No
Total boron	None	-	None	-	None	-	None	-	No
Total cadmium	None	-	None	-	None	-	None	-	No
Total chromium	None	-	None	-	None	-	None	-	No
Total copper	Kodiak (April and August), Nema and Slipper (August)	None	None	-	None	-	None	-	No

Variable	Koala Watershed		King-Cujo Watershed		Pigeon-Fay and Upper Exeter Watershed		Horseshoe Watershed		Low Action Level Exceeded
	Condition 1	Condition 2	Condition 1	Condition 2	Condition 1	Condition 2	Condition 1	Condition 2	
Total lead	None	-	None	-	None	-	None	-	No
Total manganese	None	-	None	-	None	-	None	-	No
Total molybdenum	None	-	None	-	None	-	None	-	No
Total nickel	None	-	None	-	None	-	None	-	No
Total potassium	Leslie (April)	Leslie (April)	None	-	None	-	None	-	Leslie (April)
Total selenium	None	-	None	-	None	-	None	-	No
Total strontium	None	-	None	-	None	-	None	-	No
Total uranium	None	-	None	-	None	-	None	-	No
Total vanadium	None	-	None	-	None	-	None	-	No
Total zinc	None	-	None	-	None	-	None	-	No

Notes:

'None' indicates that condition 1 was not met at any near-field sampling location during either the ice-covered or open-water season of 2019 or that condition 2 was not met for the near-field sampling location and sampling period for which condition 1 was met.

Dashes indicate that comparison of observed data to this condition is not presented because it is not necessary given that condition 1 was not met.

[1] For DO only condition 1 or condition 2 is required to be met (not both), depending on the condition relevant to the specific waterbody (see ARF version 3.0 for details).

Table A.1-2: Comparison of 2019 AEMP Plankton and Benthos Data to ARF Low Action Levels

Biological Variable	Variable Group	Koala Watershed		King-Cujo Watershed		Pigeon-Fay and Upper Exeter Watershed		Horseshoe Watershed		Low Action Level Exceeded
		Condition 1	Condition 2	Condition 1	Condition 2	Condition 1	Condition 2	Condition 1	Condition 2	
Phytoplankton										
Biomass (as chlorophyll *a*)	General	Kodiak, Leslie	None	Cujo	Cujo	NA	NA	None	-	Yes (Cujo)
Density	General	Leslie	None	Cujo	None	None	-	None	-	No
Community composition	Community	Leslie, Moose	Leslie, Moose	Cujo	None	NA	NA	None	-	Yes (Leslie, Moose)
Zooplankton										
Biomass	General	None	-	None	-	NA	NA	None	-	No
Density	General	None	-	Cujo	None	NA	NA	None	-	No
Community composition	Community	Leslie, Moose	Leslie, Moose	None	-	NA	NA	None	-	Yes (Leslie, Moose)
Lake Benthos										
Density	General	Moose, S2	None	Cujo	None	NA	NA	None	-	No
Dipteran community composition	Community	None	-	None	-	NA	NA	None	-	No
Stream Benthos										
Density	General	Kodiak-Little, Moose-Nero	None	Cujo	None	NA	NA	None	-	No

Notes:

NA = not applicable.

'None' indicates that condition 1 was not met at any near-field sampling location in 2019 or that condition 2 was not met for the near-field sampling location and sampling period for which condition 1 was met.

Dashes (-) indicate that comparison of observed data to this condition is not presented because it is not necessary given that condition 1 was not met.

A.2 Summary of Response Plans

A high-level summary of existing Response Plans is provided in Table A.2-1. Further information on each Response Plan is provided in Sections A.2-1 to A.2-8 and in the individual Response Plan documents.

A.2.1 Dissolved Oxygen

Version 1.0 of the under-ice DO Response Plan, submitted in April 2016, was required because the LAL defined in the ARF for under-ice DO was exceeded in Cujo Lake in April 2015. Version 1.0 proposed that under-ice DO in Cujo Lake continue to be monitored bi-weekly during late winter (February through April) because more frequent collection of under-ice profiles would allow for a better understanding of the duration of hypoxic conditions during the ice-covered season and the potential ecological risk of the observed DO concentrations. As part of this recommendation it was stated that the mitigation strategy of clearing the snow from the ice surface, which had been performed annually since 2010, would be continued at least until more was known about the cause(s) of the low DO concentration in Cujo Lake. Version 1.0 also proposed that a desktop study be undertaken to investigate whether low DO concentrations in Cujo Lake were occurring naturally or as a result of mine-related activities. The Board provided their Decision on Version 1.0 on July 25, 2016. In their Decision the Board supported the actions proposed in the Response Plan and indicated that approval would be considered after receipt of Version 1.1, which was to include definitions for a MAL and HAL as well as any other relevant updates (to be submitted by December 31, 2016).

Version 1.1 of the under-ice DO Response Plan was submitted in December 2016 to address the objectives stated in Version 1.1 and the Board Decision, as well as to address additional LAL exceedances in Leslie and Kodiak lakes in April 2016. The results of the desktop study proposed in Version 1.0 were presented. The study found that lake morphology and ice-cover phenology drivers may be combining with increases in organic matter in the sediments and stable but elevated organic matter concentrations in the water column to result in the observed DO conditions in Cujo Lake. Version 1.1 concluded that lake morphology and ice-cover phenology drivers likely also resulted in the LAL exceedances in Leslie and Kodiak lakes in 2016. Version 1.1 included the commitment to continue bi-weekly monitoring of under-ice DO in Cujo Lake and it was recommended that mitigation of low under-ice DO concentrations be continued annually through clearing of snow from the ice surface if the results of the bi-weekly monitoring indicate that whole-lake under-ice DO concentrations were expected or observed to drop below 6.5 mg/L. The Board provided their Decision on Version 1.1 on July 20, 2017. The Board did not approve Version 1.1, indicating that there were outstanding concerns with the proposed Action Levels. The Board directed the submission of Version 1.2 within 90 days of the Directive and required Version 1.2 to include revised Action Levels and proposed mitigations appropriate to address the under-ice DO concentrations observed in 2017 (the Board was notified on June 30, 2017 that the proposed MAL had been exceeded in Cujo Lake in April 2017).

Dominion submitted Version 1.2 of the under-ice DO Response Plan in October 2017. Version 1.2 was written to address the April 2017 Action Level exceedance in Cujo Lake. A plan to monitor the effectiveness of aeration as a mitigation technique for low DO and revised MAL and HAL definitions were proposed. Version 1.2 was approved by the Board on April 30, 2018. The Directive indicated that Dominion was to include a discussion of the ecological implications of low DO to overwintering benthic invertebrates and provide clarification on statements pertaining to adaptation of fish to low DO conditions in the next submission of the Response Plan. Additionally, the Board approved of Dominion's plan to monitor the effectiveness of aeration as a mitigation technique for low DO and required that the proposed follow-up memorandum be submitted by September 30, 2018. The Board also required that the memorandum include a discussion of snow clearing as a mitigation technique. A memorandum summarizing the 2018 and historical mitigation and monitoring results was submitted to the Board as directed. The memorandum described that historical results indicated some effectiveness of both snow clearing and surface aeration as mitigation strategies but that the success could not be quantified using available data. The memorandum provided recommendations for the 2019 mitigation and monitoring program and included the commitment to submit a follow-up memorandum describing the 2019 results. The Board approved of Dominion's plans in a Decision letter provided on January 24, 2019, and indicated that the follow-up memorandum could be submitted in conjunction with the 2019 AEMP. The *2019 Cujo Lake Aeration Strategy Follow-up* memorandum was submitted in conjunction with the 2019 AEMP.

A.2.2 Chloride

Version 1.0 of the Chloride Response Plan, submitted in April 2016, was required because the LAL was exceeded for chloride in Leslie Lake during the ice-covered season of 2015. Version 1.0 proposed continued monitoring and evaluation of chloride under the AEMP and an update to the Koala Watershed water quality model to address the LAL exceedance and to provide a more current assessment of risk from future mine-related changes in chloride concentrations. A MAL was also proposed. The Board provided their Decision on Version 1.0 on July 25, 2016. In their Decision, the Board indicated that approval of the Response Plan would be considered after receipt of a Version 1.1 that included a HAL and any other relevant updates. The Board required that Version 1.1 be submitted by December 31, 2016.

Version 1.1 of the Chloride Response Plan was submitted by December 31, 2016, as directed by the Board. Version 1.1 indicated that the LAL had not been exceeded since the ice-covered season of 2015 and concluded that the potential for toxicological effects from changes in chloride concentrations was negligible because the LAL exceedance was modestly greater than the 50% benchmark derived from the site-specific water quality objective (SSWQO) for chloride (i.e., a difference of 0.17 mg/L) and the observed chloride concentration in Leslie Lake was lower than acute and chronic toxicological thresholds for aquatic life. In addition, the updated water quality modelling results indicated that adverse effects to aquatic life, wildlife, and humans are not anticipated as a result of predicted future chloride concentrations downstream of the LLCF. Thus, Version 1.1 recommended that chloride continue to be monitored and evaluated in the AEMP but no additional actions were proposed. Version 1.1 also included proposed MAL and HAL definitions. Dominion subsequently submitted notification to the Board on June 30, 2017 that chloride concentrations in Leslie Lake exceeded the LAL in April 2017. Dominion proposed that because the Chloride Response Plan was currently under review and that only the LAL had been exceeded, no update to the Response Plan was required. Version 1.1 was approved by the Board on July 20, 2017.

Chloride concentrations in near-field lakes downstream of the LLCF increased between the ice-covered seasons of 2017 and 2018, resulting in a MAL exceedance in Leslie Lake, and a LAL exceedance in Moose Lake in April 2018. Version 1.2 was submitted in August 2018 to address the LAL and MAL exceedances in Leslie and Moose lakes in 2017 and 2018. The Board provided their Decision on Version 1.2 on April 2, 2019. In their Decision, the Board indicated that Version 1.2 should have been submitted as Version 2.0 and directed Dominion to submit Version 2.1 with a discussion of sources of chloride loadings, a loading time-series, and a discussion of potential mitigation options to reduce loadings.

Version 2.1 was submitted on July 19, 2019, and included the requested data and predictions on loading source and quantity as loading concentrations. The main source of chloride loads to the LLCF and the Receiving Environment was underground Minewater and future chloride loading to the Receiving Environment was predicted to be substantially reduced. Version 2.1 recommended that ongoing monitoring programs (e.g., AEMP), water quality modelling, and water management were suitable to address the MAL exceedance. Chloride concentrations have subsequently decreased in Leslie and Moose lakes, and only a LAL exceedance occurred in Leslie Lake in 2019 (April). Version 2.1 was approved by the Board on October 21, 2019.

Table A.2-1: Summary of Existing Response Plans

Variable	Current Version and Submission Date	Status	Next Steps
DO	Version 1.2, October 2017 (ERM 2017c)	Approved with additional direction for the next version	Continue to monitor and evaluate DO in the AEMP, submit 2019 follow-up memorandum in conjunction with the 2019 AEMP, submit updated version as needed if Action Level is exceeded.
Chloride	Version 2.1, July 2019 (ERM 2019b)	Approved	Continue to monitor and evaluate chloride in the AEMP, submit updated version as needed if Action Level is exceeded.
Nitrogen	Version 2.2, June 2017 (ERM 2017d)	Approved	Continue to monitor and evaluate nitrate-N, nitrite-N, and ammonia-N in the AEMP, submit updated version as needed if Action Level is exceeded.
Total phosphorus	Version 1.3, August 2018 (ERM 2018e)	Approved with additional direction for next version. Version 2.0 is being developed to address a MAL exceedance in Cujo Lake	Continue to monitor and evaluate total phosphorus in the AEMP, conduct additional monitoring in Cujo Lake during the open-water season of 2020, submit updated version by November 16, 2020.
Total potassium	Version 3.0, August 2019 (ERM 2019c)	Approved	Continue to monitor and evaluate potassium in the AEMP, submit updated version as needed if Action Level is exceeded. Monitor potassium more frequently in Leslie and Moose lakes during the 2020 ice-covered season. Complete additional toxicity testing and a sodium-potassium investigation if the HAL is exceeded.
Total selenium	Version 1.2, April 2018 (ERM 2018f)	Approved	Continue to monitor and evaluate total selenium in the AEMP, submit updated version as needed if Action Level is exceeded.
Plankton and benthos community composition	Version 1.1, March 2017 (ERM 2017b)	Approved	Continue to monitor and evaluate plankton and benthos community composition in the AEMP, submit updated version as needed if an Action Level is exceeded.
Fish	Version 2.0, October 2019 (ERM 2019d)	Version 2.0 awaiting review and Board approval	Continue to monitor and evaluate large-bodied fish as outlined in the AEMP Design Plan; submit updated version as needed if an Action Level is exceeded.

A.2.3 Nitrogen

A formal Nitrogen Response Plan has been in place since December 2013 (Version 1.0 followed by Version 1.1 in July 2014) as a requirement of Water Licence W2012L2-0001. An additional update was presented in the 2014 AEMP report. In their Decision on the 2014 AEMP, the Board concluded that all previous Directives on the Nitrogen Response Plan were satisfied but required continued reporting on the effectiveness of actions in its AEMP annual reports. The annual AEMP reports include the effectiveness of actions through the evaluation of effects for total ammonia-N, nitrite-N, and nitrate N (also see Part 1 – Evaluation of Effects, Section 3.2.3.10).

Version 2.0 of the Nitrogen Response Plan, submitted in August 2016, was the first version of the Response Plan to be submitted under the approved ARF. Version 2.0 was written to address a LAL exceedance for nitrate-N in Cujo Lake in April 2016; however, that report was not posted by the Board for stakeholder review. Version 2.1 was subsequently submitted in October 2016 to address a LAL exceedance for nitrite-N in Cujo Lake in August 2016. Version 2.1 indicated that the increase in nitrate and nitrite concentrations observed in Cujo Lake were the result of the Discharge of water containing elevated concentrations of nitrate and nitrite from the KPSF into Cujo Lake during the open-water season of 2016. The nitrate and nitrite concentrations present in KPSF Discharge water were elevated as a result of the pumping of water from the Misery Pit and Desperation Sump into the KPSF in 2015. Neither eutrophication nor toxicological effects to aquatic life or wildlife were anticipated as a result of the increased concentrations of nitrate and nitrite present in Cujo Lake during 2016. The observed under-ice nitrate concentration was greater than the Health Canada drinking water guideline for humans; however, during the following open-water season the nitrate concentration was below the guideline. Toxicological effects to humans were not anticipated. Actions proposed in the Response Plan included the continued monitoring and evaluation of nitrate and nitrite as part of the annual AEMP, the continuation of existing nitrogen management practices, and an examination of the water quality benchmark for nitrite. MAL and HAL for nitrate were also proposed but setting Action Levels for nitrite was deferred to Version 2.2 as a result of the recommended nitrite benchmark review. Version 2.2 was proposed to be submitted on June 30, 2017. The Board provided a Decision on Version 2.1 on January 17, 2017. The Board supported the proposed MAL and HAL definitions for nitrate and the actions proposed to investigate the LAL exceedance for nitrite. The Board required a proposed MAL and HAL for nitrite in Version 2.2 and all relevant information from previous versions of the Response Plan in the update. The Board also directed the comparison of annual water quality results to predicted water quality trends for all water quality variables that have exceeded an Action Level as part of its AEMP annual report. This comparison to predicted water quality (based on the results of the 2017 Koala Watershed Water Quality Model update; ERM 2017e) is presented in Appendix B.

Version 2.2 of the Nitrogen Response Plan was submitted to the Board in June 2017. Version 2.2 presented a review of the benchmark for nitrite but no change to the benchmark was recommended. Ongoing response actions were updated to address Board concerns and MAL and HAL for nitrite were proposed. Version 2.2 was approved by the Board on January 25, 2018.

A.2.4 Total Phosphorus

Version 1.0 of the Total Phosphorus Response Plan was submitted in April 2016 to address a LAL exceedance for under-ice total phosphorus concentrations in Moose Lake in April 2015. Version 1.0 indicated that the potential for ecological effects from changes in total phosphorus concentrations was minimal because the LAL exceedance occurred during under-ice conditions when stimulation of primary producer growth is unlikely and because phosphorus is not considered toxic to aquatic life. Continued monitoring and evaluation of total phosphorus in the annual AEMP, an update to the Koala Watershed water quality prediction model, and an AES study, which would look at the potential role of phosphorus in structuring the plankton community composition at the Ekati Diamond Mine, were proposed to address the LAL exceedances. In addition, a MAL was proposed. The Board provided a Decision on Version 1.0 on July 25, 2016. The Board did not approve Version 1.0 and directed that Version 1.1 be provided by December 31, 2016. The Board required that Version 1.1 include both MAL and HAL definitions as well as any other relevant updates.

Version 1.1 of the Total Phosphorus Response Plan was submitted in December 2016. The LAL for total phosphorus was not exceeded during the open-water season of 2015 or the ice-covered or open-water seasons of 2016. In addition, the results of the updated water quality modelling work and the AES study suggested that the potential for future ecological effects from total phosphorus concentrations in the Receiving Environment downstream of the LLCF was low. Therefore, Version 1.1 recommended that total phosphorus continue to be monitored and evaluated as part of the AEMP but no additional actions were proposed. Version 1.1 also included proposed MAL and HAL. The Board provided their Decision on Version 1.1 on July 20, 2017. Version 1.1 was not approved because of outstanding concerns associated with the proposed Action Levels. The Board required that Version 1.2 be submitted with revised Action Levels, taking into consideration seasonal trends, and a discussion of management actions that would be considered or implemented in response to a MAL exceedance.

Version 1.2 of the Total Phosphorus Response Plan was submitted to the Board in October 2017. Version 1.2 was written to address a LAL exceedance in Leslie Lake in April 2017 and to address the Board Directives on Version 1.1. It was unclear whether the LAL exceedance observed in Leslie Lake in April 2017 was as a result of mine-related effects or natural variability and the potential for ecological effects was concluded to be minimal. The ongoing response actions were updated and potential actions that may be appropriate in the event of a MAL exceedance were identified, as required by the Board. Revised MAL and HAL, with rationale considering seasonal trends, were proposed. The Board provided their Decision on Version 1.2 on April 30, 2018. The Board did not approve Version 1.2 and directed Dominion to provide Version 1.3 by August 31, 2018 with the Board Directives addressed. The Board approved the MAL proposed in Version 1.2.

Version 1.3 of the Total Phosphorus Response Plan was submitted in August 2018. In this version, an analysis of the probability of exceeding 50% and 100% benchmark thresholds and details on the additional monitoring proposed to confirm MAL and HAL exceedances were included. In addition, this version included clarification on the rationale for the MAL. The Board approved Version 1.3 on April 2, 2019 and directed that the next version include a discussion of the probability of the open-water season average (i.e., in addition to the August average) naturally exceeding the HAL.

During the 2019 open-water season, monthly water quality samples were collected in Cujo Lake and the total phosphorus MAL was exceeded based on the open-water season average. Dominion requested and was granted an extension on submission of Version 2.0 until November 16, 2020. The extension will allow for the findings of the AEMP Re-evaluation, AEMP statistics, biological data, and an additional season of monthly open-water monitoring data to be incorporated into Version 2.0. In addition, there was no Discharge from the KPSF in 2019 and Discharge is not expected for the next three years, thereby eliminating the primary mine-related source of total phosphorus to the Receiving Environment. Version 2.0 is currently being developed for submission on November 16, 2020.

A.2.5 Potassium

The initial development of the Potassium Response Plan was a requirement specified in the Board Decision on the 2013 AEMP. The ARF was still under review by the Board at that time, therefore there was no formal system in place to require the development of a Response Plan. Version 1.0 was submitted to the Board on March 31, 2015. Version 1.0 identified two response actions required to develop improved understanding of the risks associated with potassium in the Receiving Environment downstream of the LLCF: 1) an updated water quality prediction and 2) a review of the potassium

SSWQO. Version 1.0 indicated that the results of these two actions would be available by July 31, 2015 and that Version 1.1 would be submitted November 30, 2015 provided the ARF was approved at least two months prior. The Board reviewed Version 1.0 and provided its Directive and Reasons for Decision on June 29, 2015. The Board supported the proposed actions but did not approve Version 1.0 because the Response Plan was not in compliance with Water Licence criteria due to missing components; some of the Water Licence criteria for Response Plans could not be met because the ARF had not yet been approved. A revised potassium SSWQO report and a memorandum presenting updated water quality predictions for potassium were provided to the Board on July 31, 2015. During the public review it was identified that the potassium SSWQO calculation should be revised from 70 mg/L to 64 mg/L (due to a rounding error), and the Board accepted the proposed SSWQO of 64 mg/L. The Board also required Dominion to revisit its modelled potassium predictions because peak under-ice concentrations were under-predicted by the model. Dominion was required to submit an updated revised SSWQO for potassium and updated water quality predictions as appendices to Version 1.1 by June 30, 2016.

Version 1.1 of the Potassium Response Plan including the revised SSWQO and updated water quality predictions was submitted in July 2016 following a request for an extended deadline. Version 1.2 was submitted in October 2016, to address LAL exceedances in Leslie and Moose lakes during the open-water season of 2016. Version 1.1 was not posted by the Board for stakeholder comment before Version 1.2 was submitted; therefore, only Version 1.2 was made available for stakeholder review. Both versions 1.1 and 1.2 included proposed MAL and HAL definitions and recommended two additional actions to address the LAL exceedances: 1) continued monitoring and evaluation of potassium under the AEMP and 2) the comparison of observed 2016 and winter 2017 potassium concentrations to predictions in the refined Koala Watershed water quality model to evaluate how predictions compare to actual observations. Version 1.2 concluded that both the observed and model-predicted future potassium concentrations in lakes downstream of the LLCF were less than the SSWQO of 64 mg/L and did not present an ecological risk to aquatic organisms or a concern for drinking water for humans or wildlife. The Board provided their Decision on Version 1.2 on January 17, 2017. In their Decision the Board indicated support for the actions proposed to investigate the LAL exceedances and the proposed MAL and HAL definitions but did not approve the Response Plan. Instead they required Version 1.3 to be submitted by June 30, 2017. The Board required that Dominion include mitigation options for potassium if measured concentrations in 2016 and 2017 (under-ice) exceeded the predicted range of concentrations downstream of the LLCF. The Board also directed Dominion to compare annual water quality results to predicted water quality trends for all water quality variables that have exceeded an Action Level as part of its AEMP annual report. An update to the Koala Watershed Water Quality Model was completed in December 2017 (ERM 2017e). Observed concentrations were compared to predictions for a number of water quality variables. Appendix B provides the results for water quality variables that have exceeded an Action Level, including a comparison to percentage of benchmarks.

On May 19, 2017, Dominion notified the Board of a MAL exceedance in Leslie Lake during April 2017 and requested an extension to the deadline for Version 1.3 to provide sufficient time to address both the Directive and Reasons for Decision on Version 1.2 and the newly identified MAL exceedance. The Board approved a submission deadline for Version 1.3 on August 9, 2017.

Version 1.3 of the Potassium Response Plan was submitted in August 2017. Version 1.3 identified that observed potassium concentration in lakes downstream of the LLCF (Leslie, Moose, Nema, and Slipper lakes) were greater than predicted by the model during the open-water season of 2016 and ice-covered season of 2017 (with the exception of 2017 under-ice concentrations in Moose Lake). Thus, Version 1.3 summarized a number of actions that had already been initiated to address the observed potassium concentrations (e.g., optimization of LLCF Discharge and an investigation of cause) and identified potential mitigation options and contingency measures that could be investigated further once a more in-depth understanding of the source(s) and mechanism(s) of change were obtained. Version 1.3 also indicated that a progress report with the results of the investigation of cause, the effectiveness of actions implemented in 2017, and an evaluation of the potential mitigation and contingency options identified would be provided by April 30, 2018. A modification of the HAL was also proposed to conform to Board direction on HALs in Dominion's other water quality Response Plans. The Board provided their Decision on Version 1.3 on January 25, 2018. Version 1.3 was approved with additional direction. The Board required that a Version 1.4, including a revised HAL at 90% of the benchmark, be submitted for a conformity check. Version 1.4 was submitted on May 1, 2018 and was approved by the Board on June 18, 2018 with Directives to be completed in Version 2.0. To fulfill a commitment made in Version 1.3, Dominion provided a report detailing the progress made with respect to the management and mitigation of potassium in water downstream of the LLCF on April 30, 2018 (ERM 2018g).

In April 2018, Dominion identified a HAL exceedance in Leslie Lake and a MAL in Moose Lake in addition to a LAL exceedance in Cujo Lake for the first time. Therefore, Version 2.0 was submitted on October 3, 2018 in accordance with the Board's Decision on Version 1.4 and to address the observed 2018 under-ice Action Level exceedances. Mitigation for the HAL exceedance observed in April 2018 had already been initiated through the delay of the LLCF Discharge during the 2018 open-water season, which resulted in only the LAL being exceeded in Leslie Lake during the open-water season. Proposed response actions included the potassium toxicity testing (as defined though the Water Licence amendment process) and more frequent under-ice water quality sampling through the 2018/2019 winter period in Leslie and Moose lakes. Version 2.0 also included the following Board Directives:

- an update to discussion of management/mitigation options available;
- an update to potential actions that could be taken in response to MAL and HAL exceedances;
- a description of an investigation to explore the effect of sodium on potassium toxicity;
- a discussion of how the potassium toxicity study (W2012L2-0001 Part H, Condition 37) and the sodium-potassium toxicity investigation will be incorporated into response planning; and
- the commitment to update water quality modelling with the upcoming Water Licence renewal.

The Board provided their Directive and Reasons for Decision on Version 2.0 of the Plan on February 11, 2019. The Board approved Version 2.0 but required that Version 2.1 be submitted with directed revisions by March 13, 2019. Dominion completed the revisions that included the addition of a fourth test species in the investigation to explore the effect of sodium on potassium toxicity and submitted Version 2.1 on March 12, 2019. The Board approved Version 2.1 on October 21, 2019, and provided additional direction regarding monitoring and loading data to be included in subsequent versions.

Total potassium concentrations decreased considerably from 60.6 mg/L in April 2018 to 49.2 mg/L in April 2019, resulting in a MAL exceedance in Leslie Lake only. On August 30, 2019, Dominion submitted Version 3.0 which was developed to describe the appropriate response to the current potassium concentrations. Successful mitigation for the HAL exceedance observed in April 2018 was implemented through the delay of the LLCF Discharge during the 2018 open-water season. Version 3.0 included proposed response actions specific to MAL and HAL exceedances: Dominion clarified that the potassium toxicity study and sodium-potassium investigation was appropriate for a HAL. The Board approved Version 3.0 on December 19, 2019.

A.2.6 Selenium

Version 1.0 of the Selenium Response Plan was submitted in August 2015 to address a LAL exceedance for under-ice selenium concentration in Cujo Lake in 2016. The increase in selenium concentrations observed in Cujo Lake under-ice was the result of the Discharge of water containing elevated concentrations of selenium from the KPSF into Cujo Lake during the open-water season of 2016. The selenium concentrations present in KPSF Discharge water were elevated as a result of the pumping of water from the Misery Pit and Desperation Sump into the KPSF in 2015. Toxicological effects to aquatic life, wildlife, or humans were not anticipated as a result of the increased concentrations of selenium observed in Cujo Lake during the winter of 2016. Version 1.0 proposed continued monitoring and evaluation of selenium as part of the AEMP and a literature review on selenium toxicity, as previously proposed in the Fish Response Plan (see Section A.2.8), to address the LAL exceedance. An interim MAL was proposed until the literature review on selenium toxicology could be completed. It was recommended that a HAL be established based on the results of the literature review. Version 1.1 was proposed to be submitted June 16, 2017. The Board provided their Decision on Version 1.0 of the Response Plan on January 17, 2017. The Board did not approve the Response Plan but supported the proposed studies to address the LAL exceedances and agreed to the proposed timeframe for submission of Version 1.1. The Board did not approve the use of the interim MAL proposed for selenium and required that Version 1.1 define MAL and HAL. The Board also required that a ‘source control’ action be added to Version 1.1 and directed the comparison of annual water quality results to predicted water quality trends for all water quality variables that have exceeded an Action Level as part of its AEMP annual report. This comparison to predicted water quality (based on the results of the 2017 Koala Watershed Water Quality Model update; ERM 2017e) is presented in Appendix B.

Version 1.1 of the Selenium Response Plan was submitted to the Board in June 2017. The US EPA water quality criterion for selenium for lentic environments was proposed as the new selenium benchmark and revised Action Levels were proposed. Version 1.1 also identified a number of ongoing selenium control and management measures that were not identified in Version 1.0. The Board approved Version 1.1 with additional direction on January 25, 2018. The Board required Dominion to submit Version 1.2 for a conformity check and indicated it should include a commitment to complete a literature review of selenium joint action toxicity if a MAL is exceeded. Version 1.2 was submitted in April 2018 and approved by the Board on August 27, 2018.

A.2.7 Plankton and Benthos Community Composition

Version 1.0 of the Plankton and Benthos Community Composition Response Plan was submitted in April 2016 to address LAL exceedances for phytoplankton, zooplankton, and benthos community composition in the Koala Watershed and for benthos in the King-Cujo Watershed. The Response Plan indicated that the strongest evidence suggested that the changes were related to increasing concentrations of some water quality variables, including macronutrients, but that trophic interactions may also factor into the changes. Version 1.0 proposed two desktop studies to investigate the changes: 1) the AES study to improve understanding of the changes in plankton communities and the drivers of those changes and 2) a canonical correspondence analysis that would investigate the relationship between benthos and sediment communities. Version 1.0 also proposed the Response Plans for nitrogen and total phosphorus as actions to address the LAL exceedance given that the strongest evidence pointed to macronutrients as a likely source of the change. A MAL was also proposed. The Board provided their Decision on Version 1.0 on July 25, 2016. The Board did not approve Version 1.0 and directed Dominion to provide Version 1.1 by December 31, 2016. The Board required that Version 1.1 include both MAL and HAL definitions as well as any other relevant updates. Dominion subsequently requested and was granted an extension request to three weeks after Decision on the 2015 AEMP Re-evaluation so that Version 1.1 and proposed Action Levels could align with the revised AEMP. The Decision on the 2015 AEMP Re-evaluation was received on February 27, 2017.

Version 1.1 of the Plankton and Benthos Community Composition Response Plan was submitted in March 2017. Version 1.1 indicated that the LAL exceedances identified in 2015 for phytoplankton in Leslie, Moose, and Kodiak lakes, and zooplankton in Leslie and Moose lakes were also present in 2016 but that the changes in benthos communities were unlikely related to the mine and therefore were no longer considered to have exceeded the LAL. Version 1.1 indicated that the results of the 2015 and 2016 AEMPs and the AES study completed in 2016 suggest that there may be a stabilization of the changes observed in the plankton communities downstream of the LLCF. Therefore, it was recommended that plankton and benthos communities continue to be monitored and evaluated in the annual AEMP. Both MAL and HAL definitions were proposed. Version 1.1 was approved by the Board on July 20, 2017.

A.2.8 Fish

Version 1.0 of the Fish Response Plan was submitted in April 2016 to address LAL exceedances for four tissue metals (i.e., antimony, molybdenum, selenium, and uranium) and EROD activity, an indicator of exposure to PAHs, in Lake Trout and/or Round Whitefish in the 2012 AEMP. The Response Plan proposed two actions to address these exceedances: 1) review of and reporting on the relevant fish toxicology literature (including consumption guidelines) for antimony, molybdenum, selenium, uranium, and EROD activity and 2) investigating individual juvenile fish growth rates from otoliths. The Response Plan did not include proposed MAL or HAL because information from the proposed actions was expected to support the development of appropriate Action Levels. The Board provided their Decision on Version 1.0 on July 25, 2016. The Board did not approve the Plan but supported the proposed studies to address the LAL exceedances and agreed to the proposed submission date of April 30, 2017 for Version 1.1. The Board also required that both MAL and HAL be included in Version 1.1. A late notification was submitted on April 28, 2017 indicating that Version 1.1 would be submitted by May 31, 2017 because more time was needed to develop a robust plan.

Version 1.1 of the Fish Response Plan was submitted in May 2017. Version 1.1 was extensively updated from Version 1.0. It incorporated the results of the literature review and the AES juvenile fish growth study proposed as actions in Version 1.0. This new information was used to develop proposed revised LALs for fish variables as well as MAL and HAL definitions for selenium in fish tissues. Version 1.1 also incorporated the investigation of the relationship between DO and parasitism in fish that was directed by the Board in their Directive and Reasons for Decision on the 2015 AEMP. The Board provided their Decision on Version 1.1 on January 25, 2018. Version 1.1 was not approved due to outstanding concerns over the proposed Action Levels. The Board directed that Version 1.2 was required no later than June 25, 2018 (five months from date of Directive).

Version 1.2 of the Fish Response Plan was submitted in June 2018. This version included a detailed description of the interconnectivity of the Action Levels and Response Plans for abiotic and biotic variables and the multiple layers of environmental protection provided by this approach. The revised LAL from Version 1.1 was removed and the approved LAL as stated in ARF Version 3.0 was included with a proposed framework for responding to LALs triggered by fish variables. MAL and HAL for selenium in fish tissues were revisited as directed by the Board. The Board provided their Decision on Version 1.2 on April 24, 2019. Version 1.2 was not approved due to outstanding concerns over the proposed response actions to a LAL exceedance and the proposed MAL and HAL for selenium in fish tissues. The Board also established the MAL and HAL to be implemented by Dominion for selenium in fish tissues. The Board directed a revised Fish Response Plan be submitted no later than July 23, 2019. Dominion requested an extension to the submission deadline until October 31, 2019 both to address the Board's direction, account for new Action Levels established by the Board, and to incorporate MAL exceedances based on the 2018 AEMP results. The Board first approved this request on June 13, 2019 and re-stated this approval on August 23, 2019.

A revised Fish Response Plan Version 2.0 was submitted in October 2019, reflecting the Action Level exceedances that have occurred since submission of Version 1.2. Version 2.0 included rationale for the conclusion of no LAL exceedance for antimony, molybdenum, and EROD activity, and updates related to the current exceedances of selenium, mercury, and uranium. MAL and HALs for selenium in fish tissues have been included as established by the Board in its Reasons for Decision on Version 1.2, but are being revisited as part of the re-evaluation of the ARF in the 2019 AEMP Re-Evaluation. MAL and HALs for mercury in fish tissues have been proposed in Version 2.0. In the re-evaluation of the ARF as part of the 2019 AEMP Re-evaluation, Dominion indicated that uranium in fish tissues was not required as a Response Framework variable and MAL and HALs for uranium in fish tissues were not proposed. Version 2.0 of the Fish Response Plan, as well as the 2019 AEMP Re-Evaluation, including re-evaluation of the ARF, are currently being reviewed and await approval.

A.3 Review of Aquatic Response Framework Variables

The ARF, Version 3.0 includes the commitment to assess water quality, stream benthos, and fish variables for inclusion within the ARF annually in the AEMP report (see Sections 3.1.1 and 3.2.1 of ERM 2018c).

The ARF states that water quality variables can be added to the ARF variables list on an annual basis for one of three reasons:

- it has been added as an EQC for Discharge to Leslie Lake, Cujo Lake, Carrie Pond, or Horseshoe Lake;
- a new mine-related effect or increasing trend has been identified; or
- the water quality model predicts an increase in a variable that was not previously predicted.

EQCs for new variables have not been added to Water Licence W2012-L2-0001 and water quality model predictions have not been updated since the last update to the ARF. In addition, no new mine-related effects or increasing trends were identified in the 2019 AEMP for water quality variables (see historical data for all water quality variables in Appendix A of Part 1 – Evaluation of Effects) and no new mine-related effects or increasing trends were identified in the 2017 AEMP for sediment quality variables (see historical data for all sediment quality variables in Appendix B of Part 1 – Evaluation of Effects in the 2017 AEMP; ERM 2018d) that are not already on the ARF variables list. Thus, no changes to the ARF water quality variables are required. However, the ARF Re-evaluation in the 2019 AEMP Re-evaluation recommended that total manganese be removed from the ARF variable list because current water quality modelling for the Koala Watershed (ERM 2017e) indicates that maximum total manganese concentrations were predicted to occur in either 2018 or 2019 in Leslie, Moose, Nema, and Slipper lakes and predicted concentrations decrease thereafter. In addition, the predicted total manganese concentrations peak at 1 to 2% of the approved hardness-dependent water quality benchmark (ERM 2017e, ERM 2018c). The 2019 AEMP Re-evaluation, including re-evaluation of the ARF, is currently being reviewed and awaits approval.

For stream benthos variables the ARF states that stream benthos diversity and community composition variables can be added to the ARF variables on an annual basis if a new mine-related effect is identified in one of these variables. No new mine-related effects for stream benthos diversity or community composition variables were identified in 2019, thus no changes to the ARF variables list for stream benthos is required.

A.4 New Aquatic Response Framework Components

The ARF indicated that new components of the framework would be tracked in the AEMP Summary Report on an annual basis, the reason being so that the ARF does not have to be continuously updated and can be updated on a three-year basis in conjunction with the AEMP Re-evaluation. The ARF, Version 3.0 (ERM 2018c) was submitted for approval in June 2018. Version 3.0 includes all changes to the ARF that have been approved since the approval of Version 2.0. No changes to the ARF have been made since the submission of the ARF Version 3.0. Changes to the ARF were recommend through the re-evaluation of the ARF (see ERM 2019e) which is currently being reviewed as part of the 2019 AEMP Re-evaluation and awaits approval.

APPENDIX B COMPARISONS OF OBSERVED AND PREDICTED WATER QUALITY DATA FOR RESPONSE PLAN VARIABLES

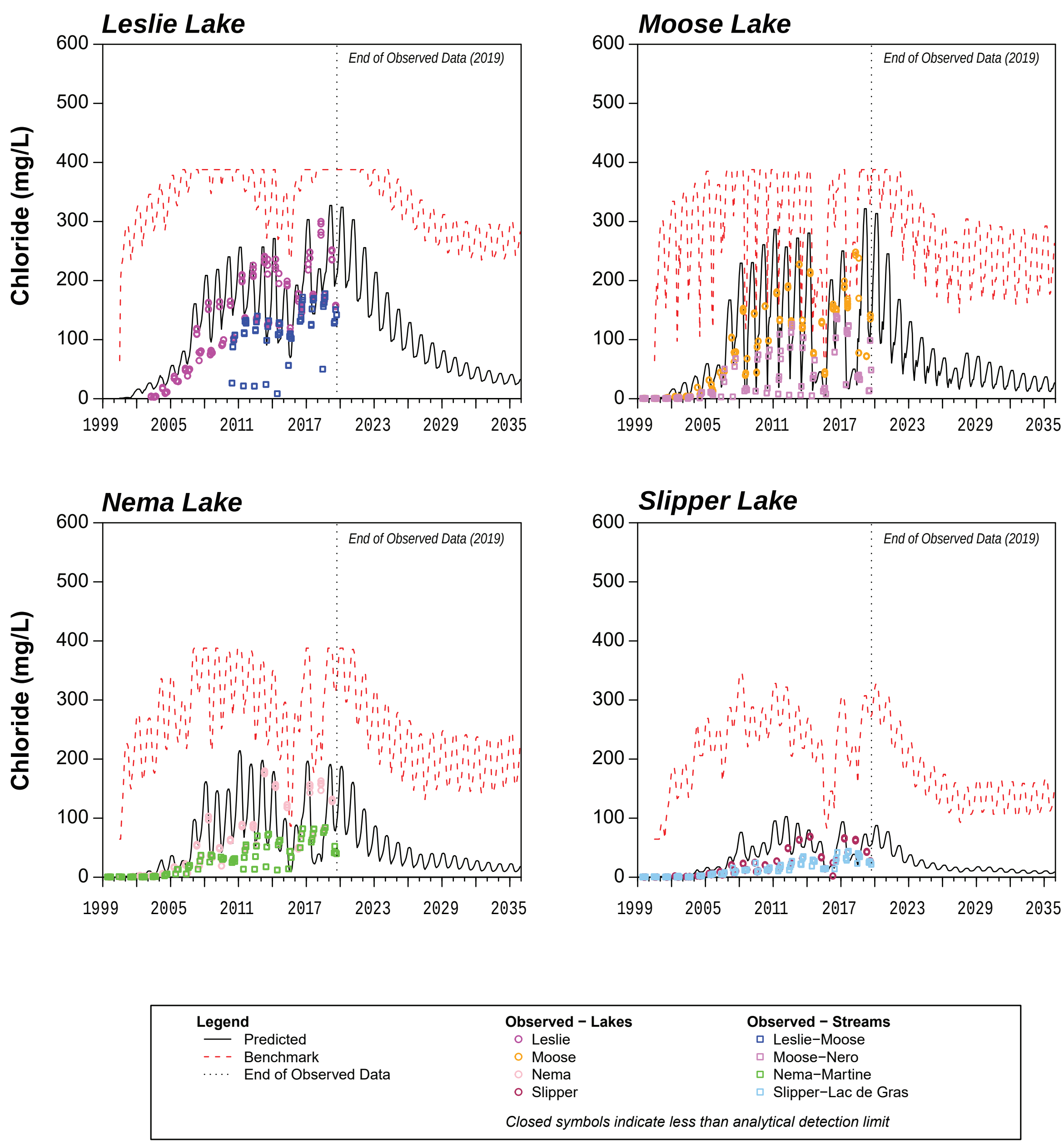

Figure B1: Observed and Predicted Chloride Concentrations for Lakes Downstream of the LLCF

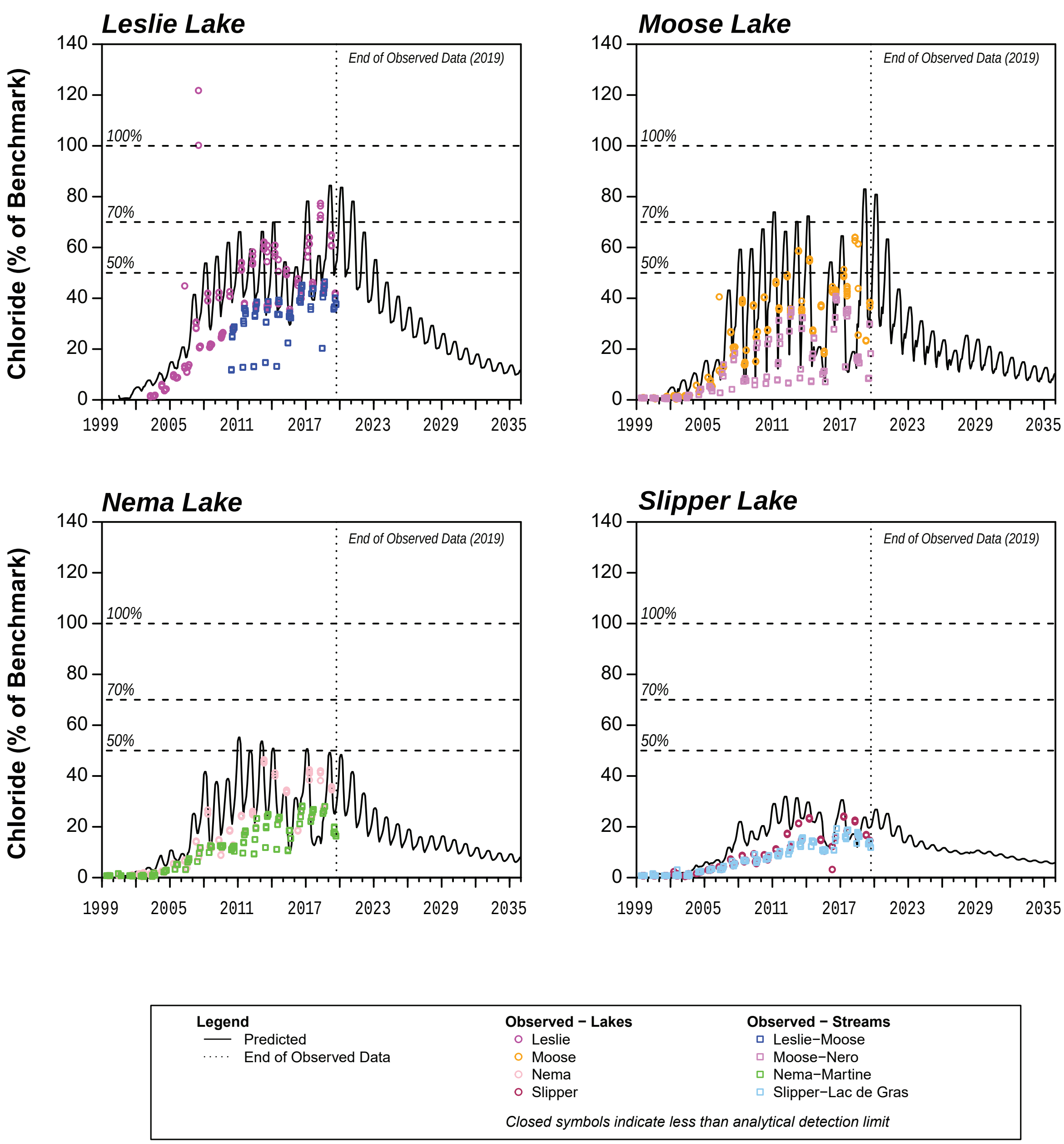

Figure B2: Observed and Predicted Chloride Concentrations for Lakes Downstream of the LLCF as Percentage of Benchmark

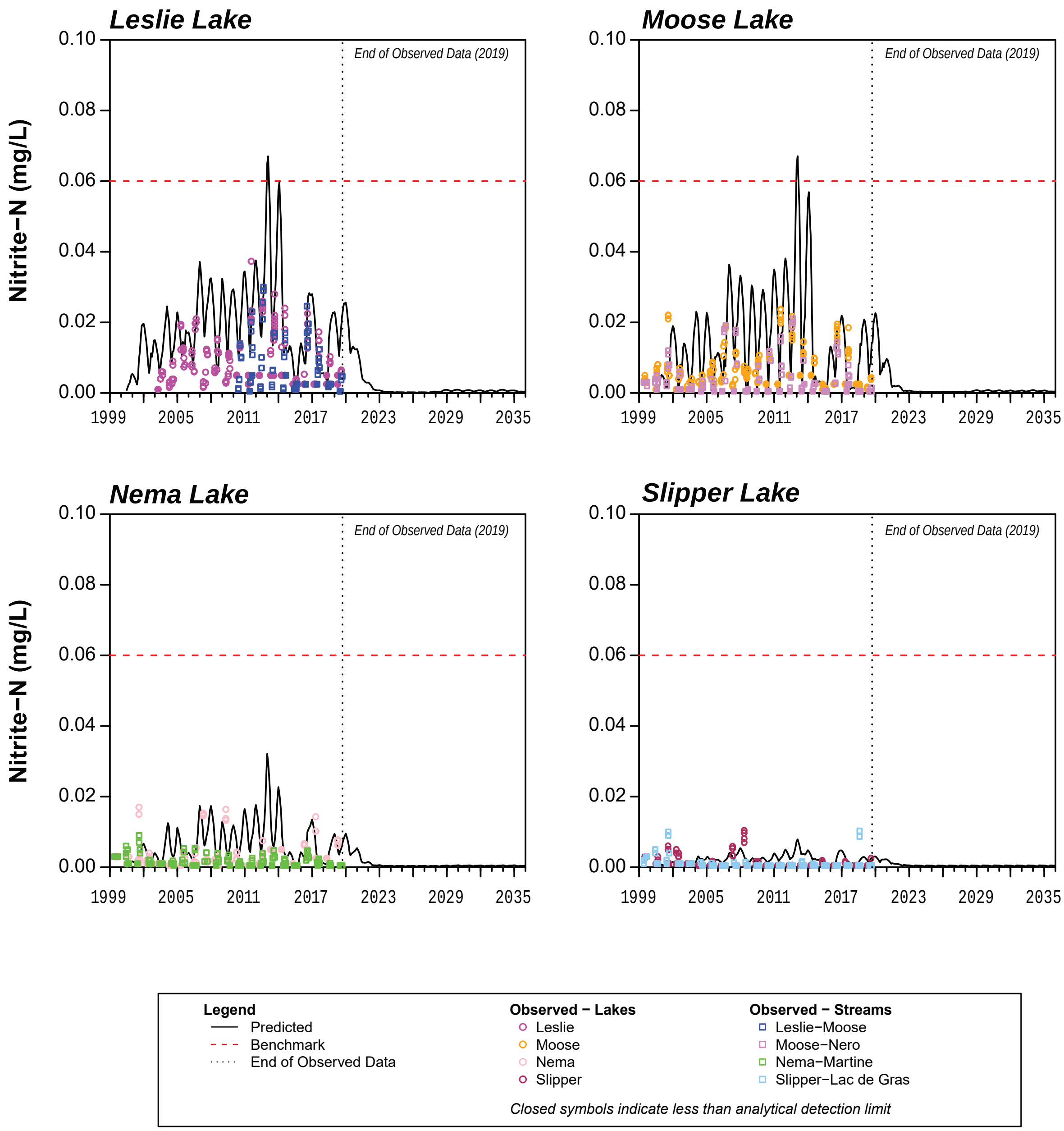

Figure B3: Observed and Predicted Nitrite-N Concentrations for Lakes Downstream of the LLCF

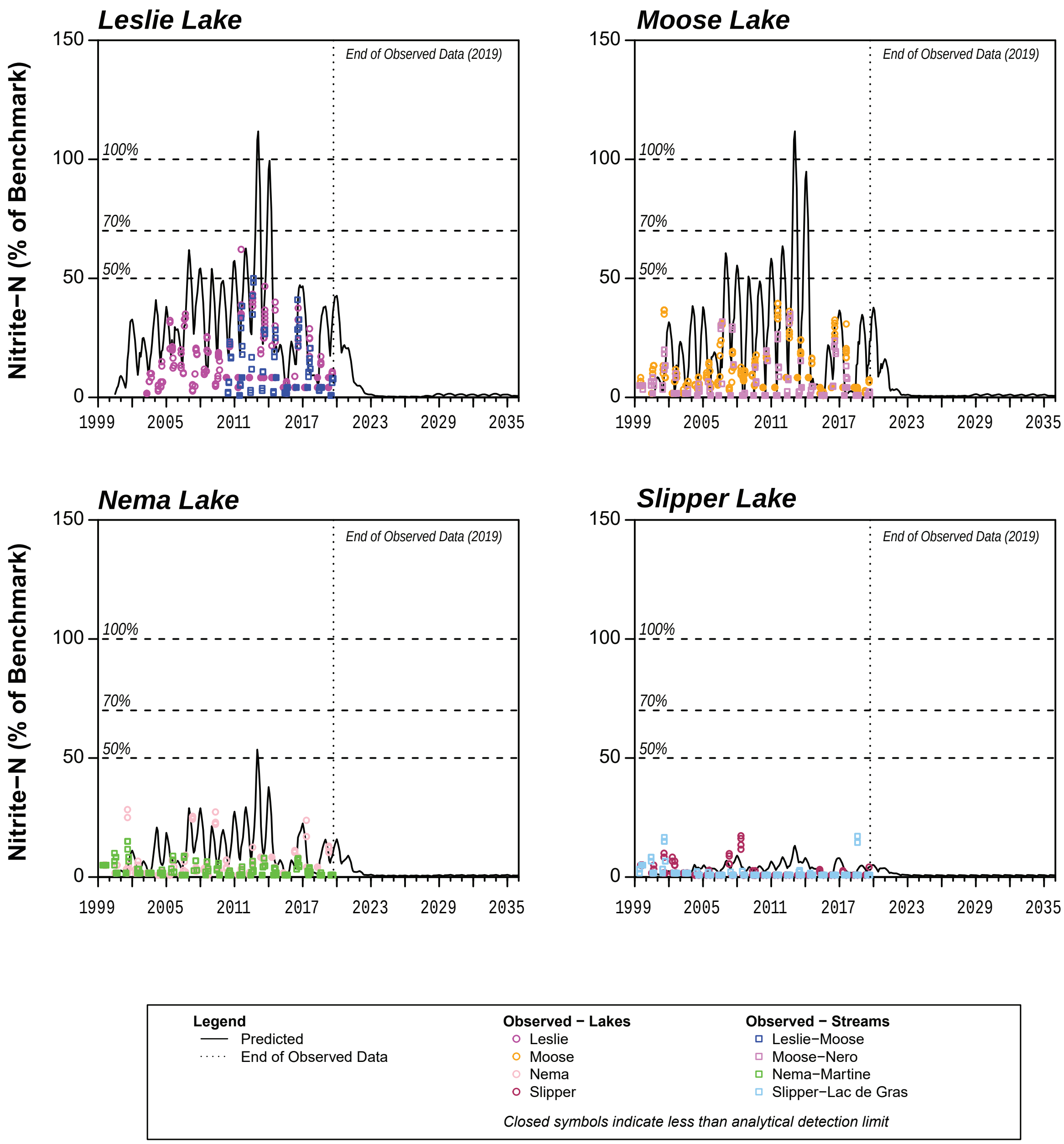

Figure B4: Observed and Predicted Nitrite-N Concentrations for Lakes Downstream of the LLCF as Percentage of Benchmark

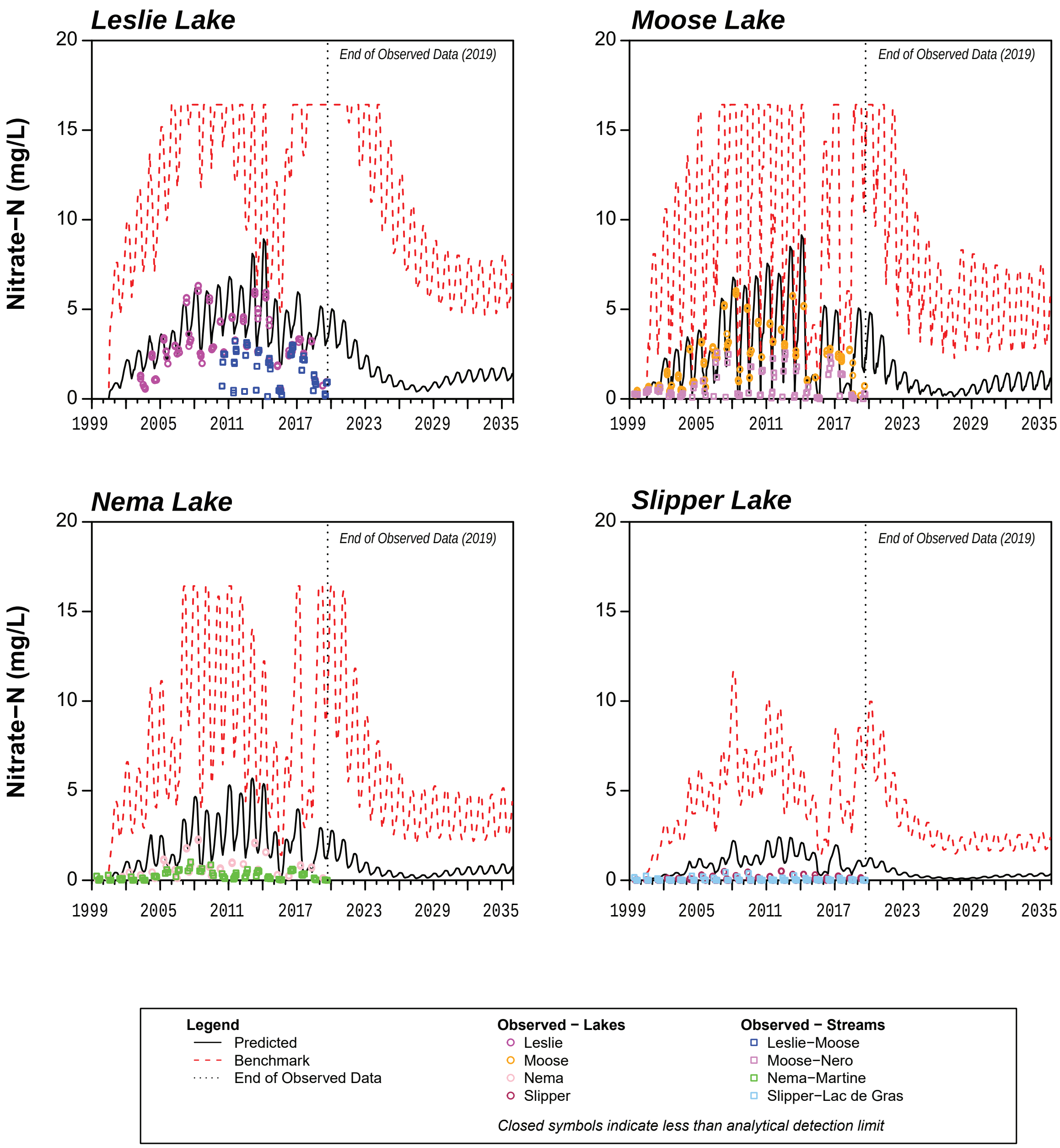

Figure B5: Observed and Predicted Nitrate-N Concentrations for Lakes Downstream of the LLCF

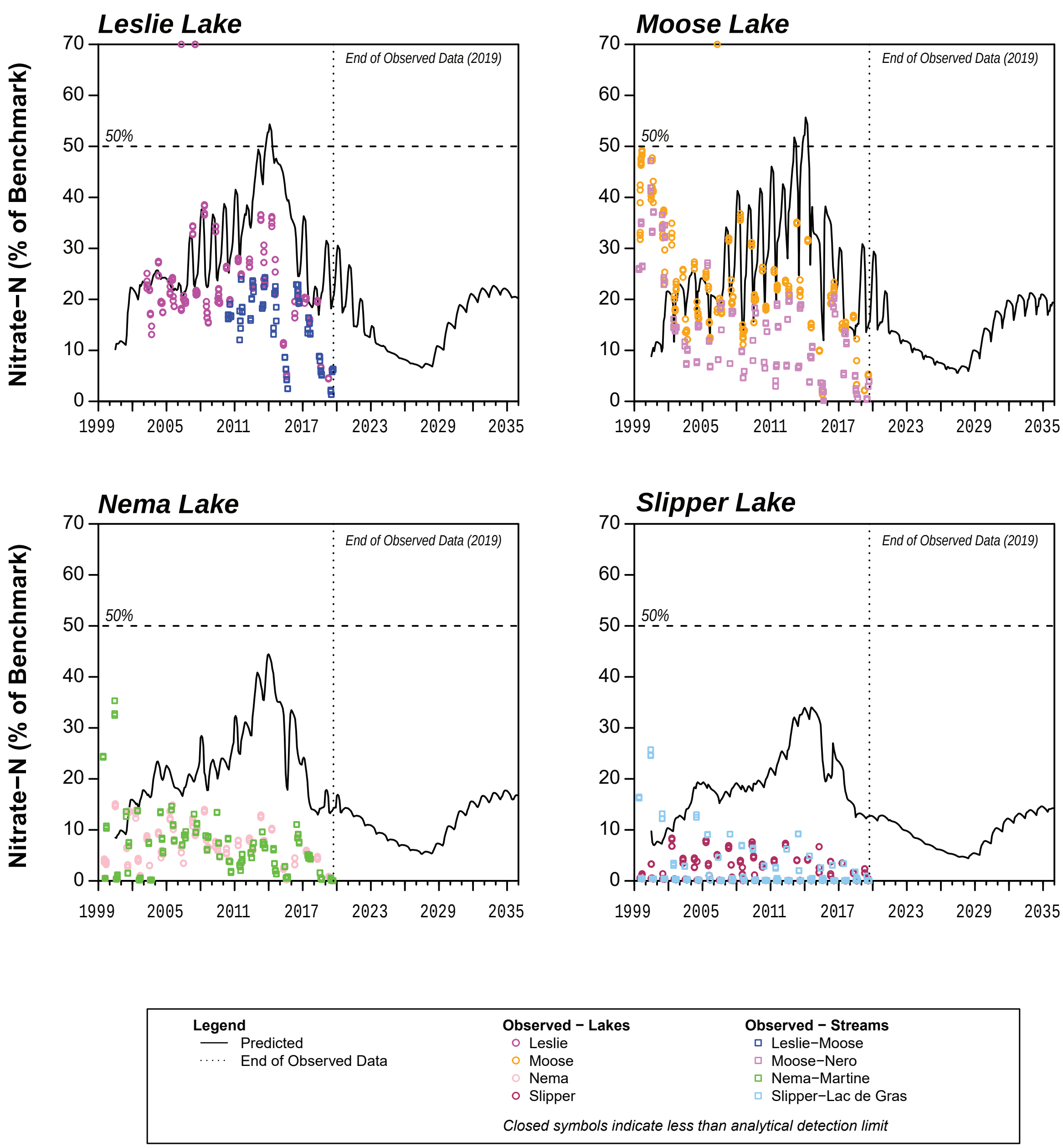

Figure B6: Observed and Predicted Nitrate-N Concentrations for Lakes Downstream of the LLCF as Percentage of Benchmark

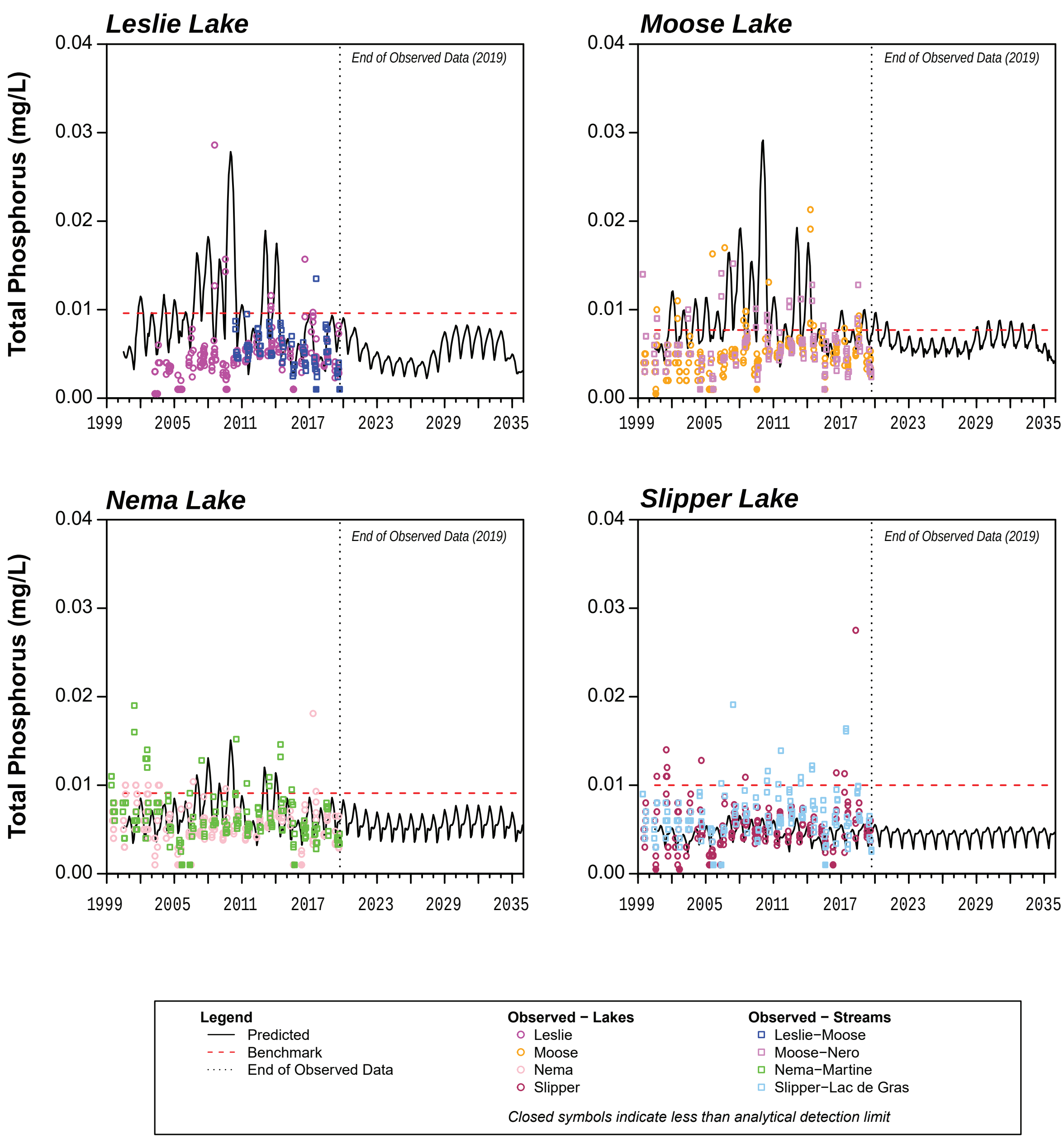

Figure B7: Observed and Predicted Total Phosphorus Concentrations for Lakes Downstream of the LLCF

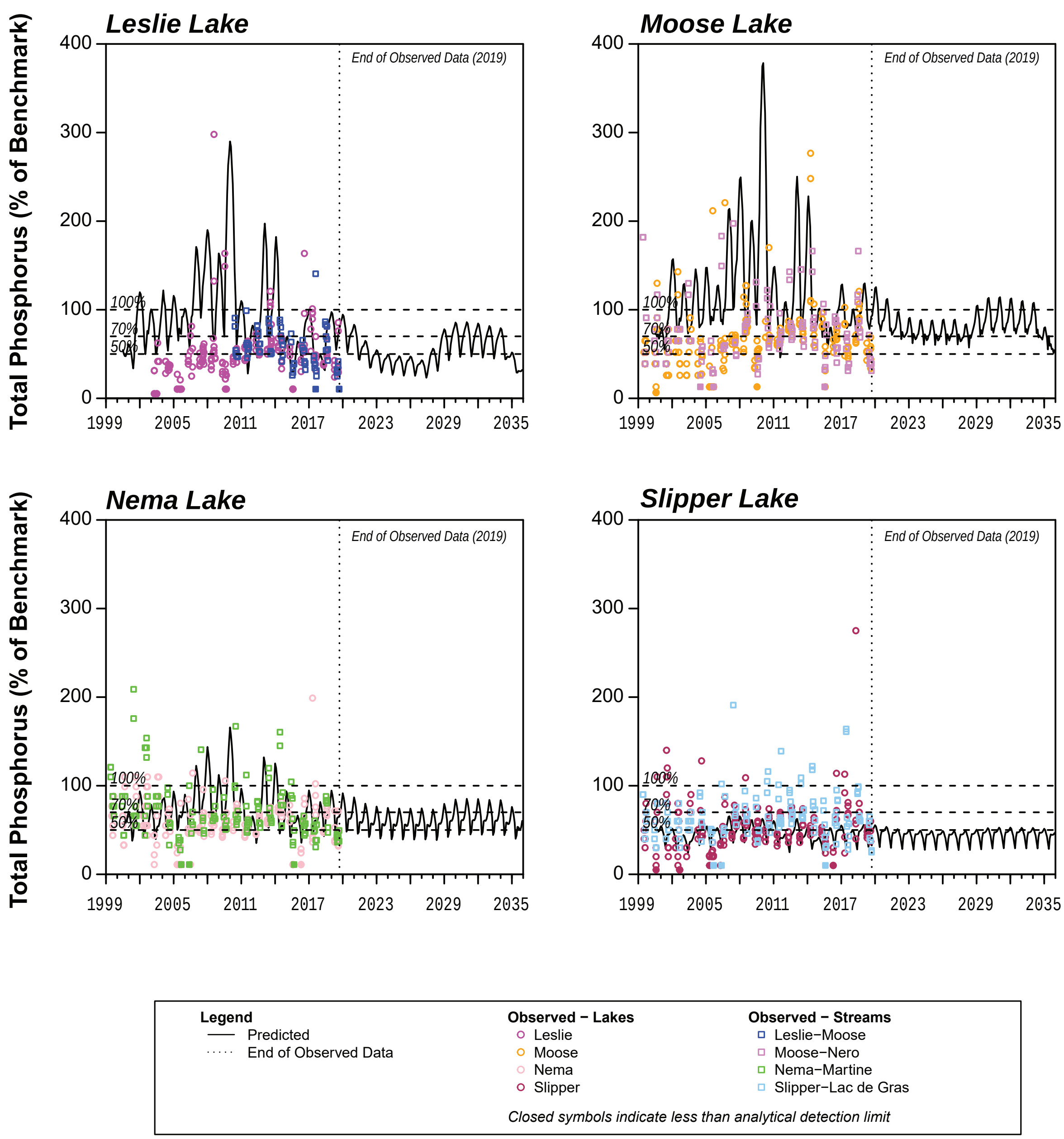

Figure B8: Observed and Predicted Total Phosphorus Concentrations for Lakes Downstream of the LLCF as Percentage of Benchmark

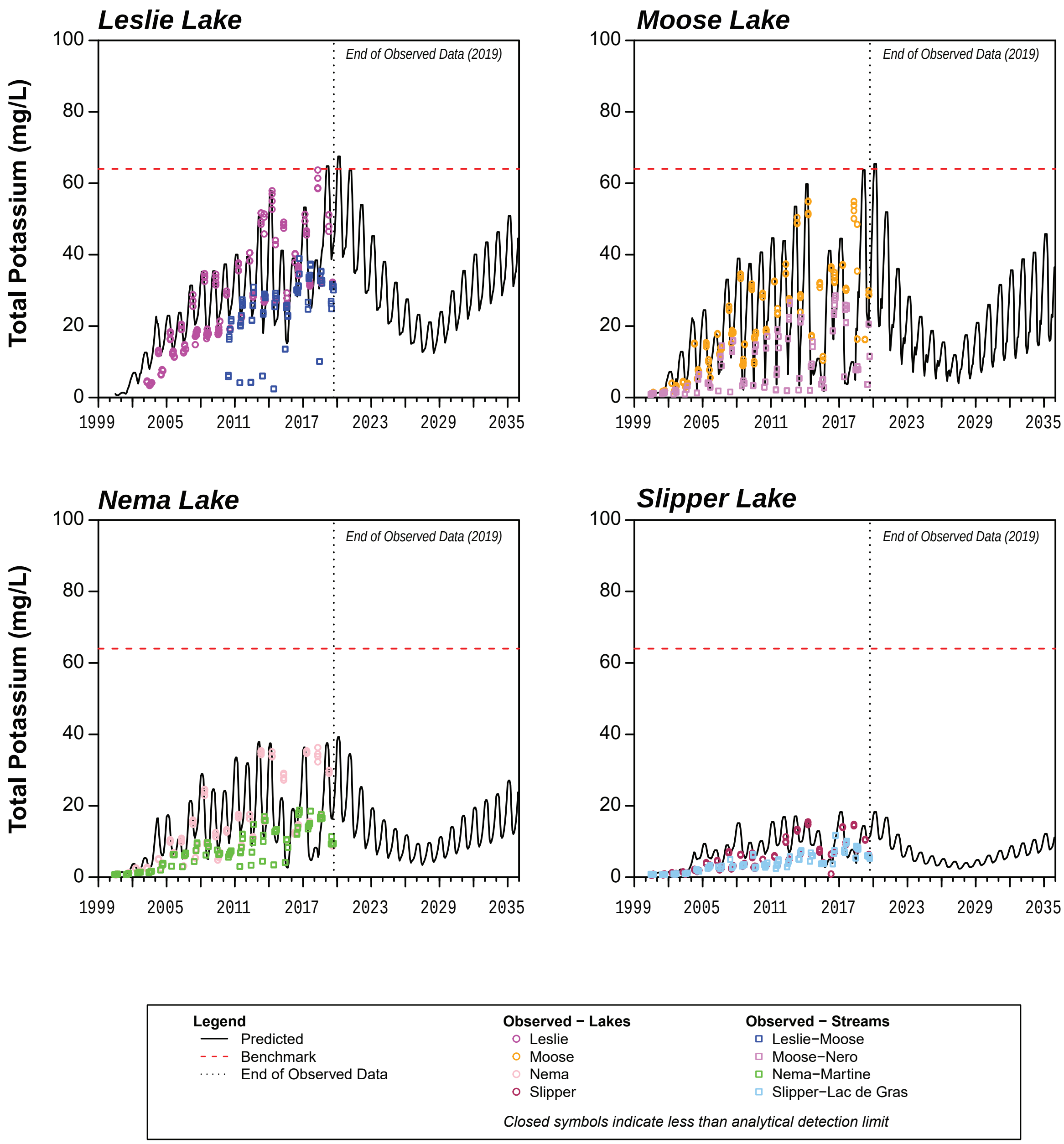

Figure B9: Observed and Predicted Total Potassium Concentrations for Lakes Downstream of the LLCF

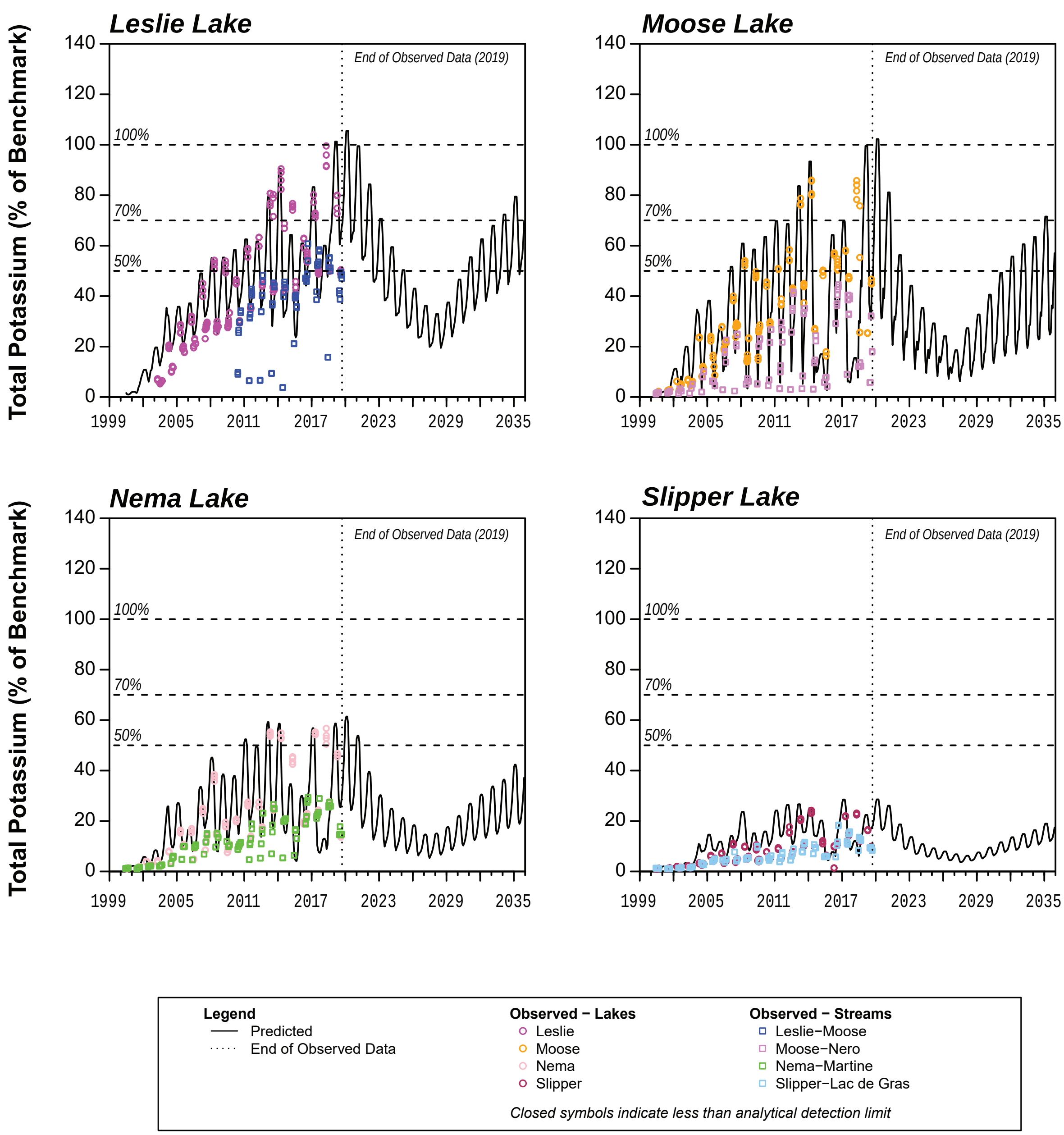

Figure B10: Observed and Predicted Total Potassium Concentrations for Lakes Downstream of the LLCF as Percentage of Benchmark

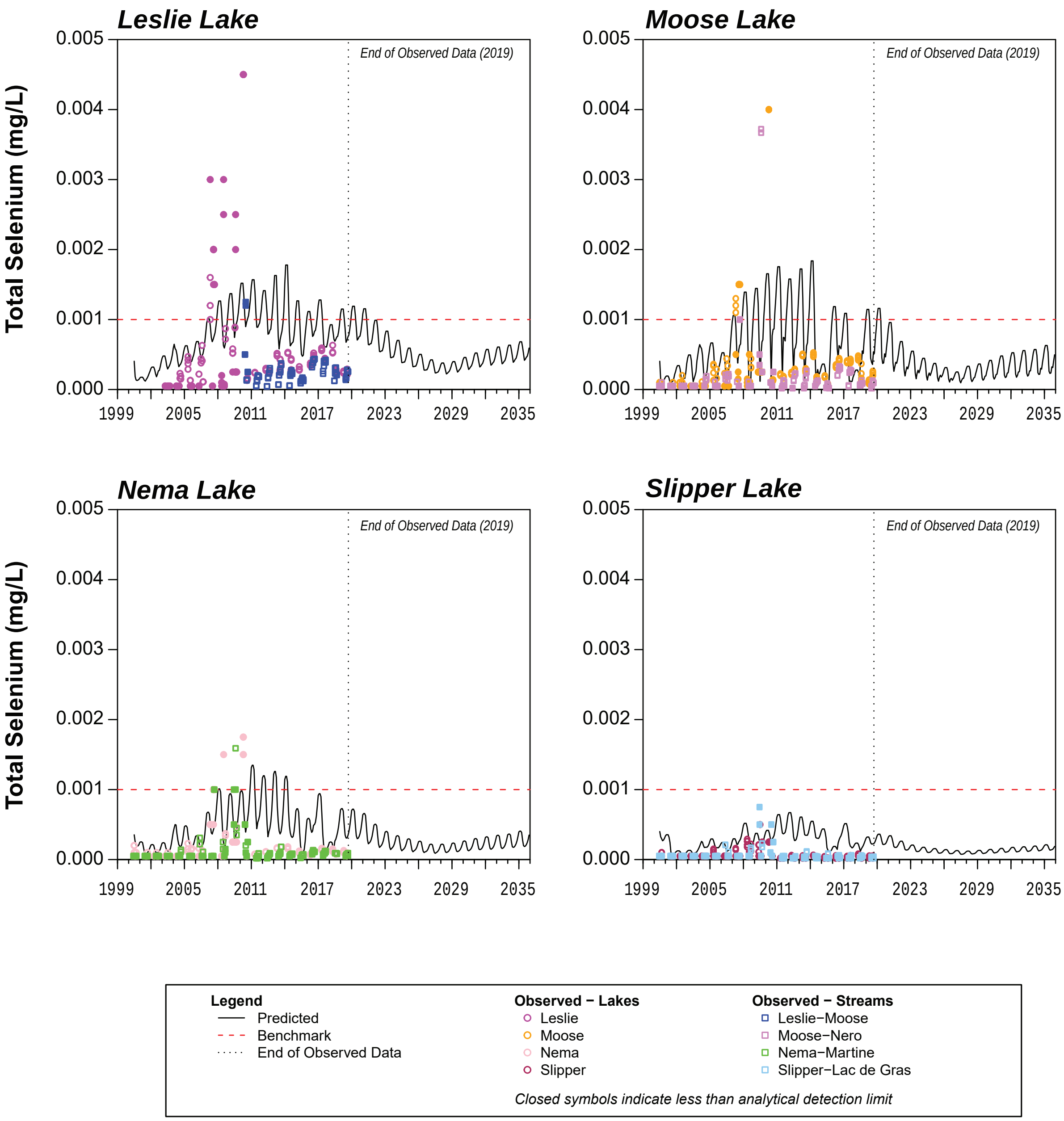

Figure B11: Observed and Predicted Total Selenium Concentrations for Lakes Downstream of the LLCF

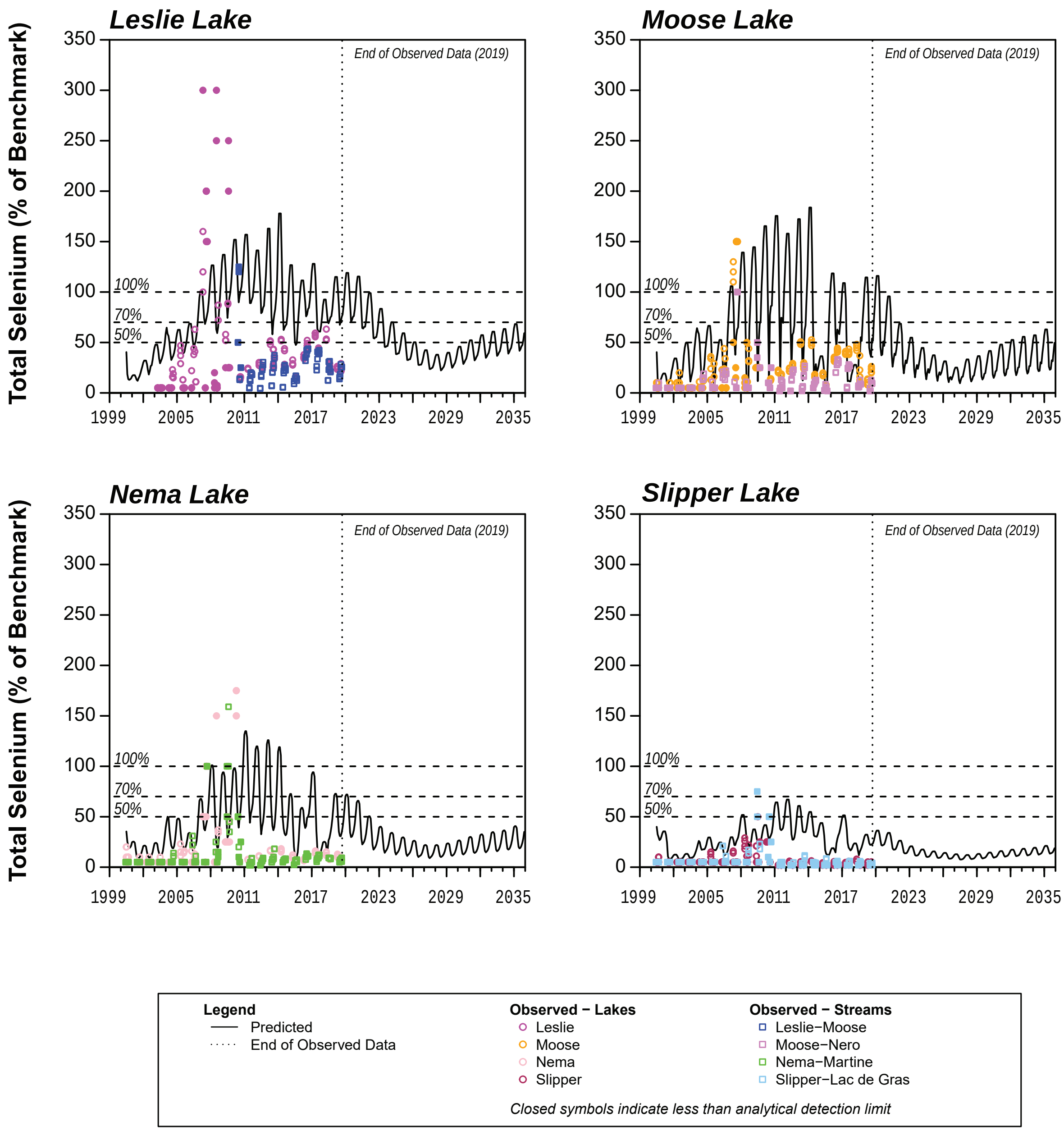

Figure B12: Observed and Predicted Total Selenium Concentrations for Lakes Downstream of the LLCF as Percentage of Benchmark

APPENDIX E
2019 Spills Summary

NWT Spill #	Date Occurred	Substance	Volume	Location	Source	Department	Cause	What Happened?	Comments
Spill-2019018	18-Jan-2019	Hydraulic Oil	200 L	Sable Truck Park	DRD2403 Drill	Mobile Maintenance	Mechanical Failure	Drill was moved into the Sable Maintenance Shelter to fix a hydraulic leak. Drill was returned to an outdoor location and a new leak (or same leak still occuring) caused a spill.	Leak was repaired and Site Services scraped up the contaminated snow/ice for disposal at the CSCF. Clean-up confirmed by Inspector during the January 23, 2019 inspection.
Spill-2019037	3-Feb-2019	Hydraulic Oil	144 L	Sable Pit	TRD7527 Dozer	Surface Mining	Hydraulic Failure	Hydraulic leak	Loader scraped up contaminated material and brought to Zone S for disposal. Clean-up confirmed by Inspector during the February 8, 2019 inspection.
Spill-2019075	25-Feb-2019	Explosive Emulsion	2,310 kg	1770 Level Koala UG	Pre-loaded emulsion	Underground Operations	Engineering Failure	Unrecovered emulsion, blast could not be initiated due to ground stability issues	Communicated the unrecovered material to the GNWT Inspector and ECCC Officer, spill can not be cleaned up and will be left in the flooded mine. Spill was closed by Inspector on February 25, 2019.
Spill-2019100	8-Mar-2019	Hydraulic Oil	490 L	Pigeon Pit PG380-11 Blast	EXD2567 Shovel	Surface Mining	Hydraulic Failure	Plug came loose from main hydraulic pump resulting in hydraulic leak.	One 777 Haul Truck load of contaminated materialwas taken to Zone S for dispoal. Clean up was confirmed by the Inspector during the April 9, 2019 inspection.
Spill-2019114	16-Mar-2019	Hydraulic Oil	125 L	Lynx Pit	EXD2566 Shovel	Surface Mining	Hydraulic Failure	The hydraulic hose rubbed through	3750 Loader scraped up the spill and put in 7493 Haul truck, brought to Zone S for disposal. Clean up was confirmed by the Inspector during April 9, 2019 inspection.
Spill-2019127	20-Mar-2019	Diesel	111,000 L	Sable Fuel Farm	Fuel system	Hydrocarbons	Overfill	The Generator Day Tank called for fuel and the fill stop high level failed and then the High Level failed. This caused the pump to run until the bulk tank lost suction and the pump shut down on low suction alarm.	Spill 2019127 will supercede Spill 2017450 in the Spills Database. Spill remains open with the NWT Spill Line. Dominion submitted a detailed report to the Board and Inspector on April 17, 2019 and a follow-up report on October 31, 2019.
Spill-2019166	22-Apr-2019	Hydraulic Oil	650 L	Sable Pit 458 Bench	EXD2569 Shovel	Surface Mining	Hydraulic Failure	The major pressurized swing motor hydraulic line failed	Dominion submitted a detailed report to the Board and Inspector on May 15, 2019. Clean up was confirmed by the Inspector during May 21, 2019 inspection.
Spill-2019181	29-Apr-2019	Hydraulic Oil	100 L	Pigeon Pit 380 Bench	EXD2567 Shovel	Surface Mining	Hydraulic Failure	Broken bolt on hydraulic pump	Dominion submitted a detailed report to the Board and Inspector on May 15, 2019. Clean up was confirmed by the Inspector during the May 21, 2019 inspection.
Spill-2019189	6-May-2019	Sodium Hypochlorite 12%	8 L	Main Camp Road near Winter Road Securtiy	20 L Container	Warehouse	Human Error	While transporting 10 pails on a pallet that was shrink wrapped with a IT 28 Loader, due to rough roadways one pail bounced off of pallet and broke.	An attempt to vacuum up the road water and nearby pooled water was completed. Water vacuumed up was taken to Cell B for disposal. Clean up was confirmed by the Inspector during the May 21, 2019 inspection. Dominion submitted a detailed report to the Board and Inspector on May 31, 2019
Spill-2019224	29-May-2019	Diesel	150 L	Koala WRSA road	PGS7006 HL160 Pump	Site Services	Human Error	Carrying a water pump and fuel started to leak out off fork pocket hole which goes through fuel tank. Forks of the Loader punctured the fuel tank.	Dominion submitted a detailed report to the Board and Inspector on June 24, 2019.
Spill-2019275	6-Jul-2019	Envirokleen dust suppressant	170 L	Pigeon Sable Haul Road	Envirokleen Truck	Site Services	Human Error	Envirokleen sprayed in no-spray area near waterbodies	Envirokleen will not be scraped up from the road. Dominion submitted a detailed report to the Board and Inspector on August 13, 2019. The area was visited by the Inspector and the spill was closed with the NWT Spill Line.
Spill-2019327	18-Aug-2019	Sodium Hypochlorite 12%	20 L	West side of STP	20 L Container	Warehouse	Human Error	Loader operator did not have load secured to back rest of forks. One pail fell off pallet and then the operator accidently ran over the pail.	Dominion submitted a detailed report to the Board and Inspector on September 16, 2019.
Spill-2019353	29-Aug-2019	Hydraulic Oil	1,000 L	Sable Pit SB434-06 Blast Pattern	EXD2569 Shovel	Surface Mining	Hydraulic Failure	Swing hydraulic hose rubbed through resulting in leak	A plan was formulated and executed using spill booms to isolate the spill and suck out using the vacuum truck. Dominion submitted a detailed report to the Board and Inspector on September 24, 2019.
Spill-2019394	24-Sep-2019	Diesel	500 L	Sable Fuel Bay	TKS6717 Lube Truck	Hydrocarbons	Human Error	Operator didn't realize the Scully Overfill System was in Bypass and truck overfilled at Fuel Bay when the operator was topping up the fuel tank.	Dominion submitted a detailed report to the Board and Inspector on October 18, 2019.

NWT Spill #	Date Occurred	Substance	Volume	Location	Source	Department	Cause	What Happened?	Comments
Spill-2019415	8-Oct-2019	Hydraulic Oil	120 L	Pigeon Pit 370 Bench	EXD2567 Shovel	Surface Mining	Hydraulic Failure	Broken hydraulic line under machine	Spill could not be cleaned up until 2567 had been repaired and moved. Environment Department confirmed clean-up had been completed on October 8th. Dominion submitted a detailed report to the Board and Inspector on November 7, 2019.
Spill-2019416	7-Oct-2019	Hydraulic Oil	1,500 L	Sable Pit 480 Bench	EXD2569 Shovel	Surface Mining	Hydraulic Failure	Broken hydraulic line	The spill could not be cleaned up until 2569 has been repaired and moved. 09-Oct-2019: Spill was cleaned up and photos submitted to the Environment Department. Dominion submitted a detailed report to the Board and Inspector on November 7, 2019.
Spill-2019417	8-Oct-2019	De-Icing Fluid, 54, Type 1	246 L	Airport apron	De-Icing Truck	Site Services	Aircraft De-Icing	De-icing the RJ 100 aircraft	Dominion submitted a detailed report to the Board and Inspector on November 7, 2019.
Spill-2019418	8-Oct-2019	Hydraulic Oil	500-1,000 L	Sable Pit 470 Bench On Tow Haul Deck	DRD2403 Drill	Surface Mining	Hydraulic Failure	Broken hydraulic line	The spill could not be cleaned up until 2403 Drill was repaired and moved off of Tow Haul Deck. 1,000L was a visual estimate. 10-Oct-2019: Updated spill with infomation from Surface Mining that the estimated spill volume was 500L to a Maximum of 1000L. Dominion submitted a detailed report to the Board and Inspector on November 7, 2019.
Spill-2019429	Oct 17-2019	Diesel	117 L	South wall of Light Duty shop at Misery site	Day tank in Misery Light Duty Shop	Electrical Services	Human Error	Manually filling fuel day tank of the Light Duty shop and Technician walked away to complete another quick task. When returned, pump was stopped and then the spill was identified.	26-Oct-2019: Confirmed with Site Services that most of the contaminated ground went to the Landfarm for disposal. The final scrape was disposed of at Misery Zone S. 20-Oct-2019: Environment Department visited spill location. Surface area has been cleaned up more, but some staining (fuel odours) still present. 18-Oct-2019: Spoke with Inspector and confirmed that dig permit is required and the complete spill clean-up will be delayed due to electrical concerns. Spill has yet to be entirely cleaned up. 18-Oct-2019: Spill was originally reported as 75L. Upon investigation of the spill, amount re-estimated at 117 L. Spill will remain open with the NWT Spill Line until the Inspector can confirm clean up. Dominion submitted a detailed report to the Board and Inspector on November 15, 2019.
Spill-2019456	6-Nov-2019	Engine Oil	450 L	Inside Sable Maintenance Shelter	Lube Island	Maintenance	Mechanical Failure	O-Ring seal on filter for lube island in shop blew out, causing the oil to pump out	11-Nov-2019: Sable personnel sent photos showing the before/after clean-up of the contaminated oil around the shop. Spill was still in process of clean-up. 05-Dec2019: Spill cleaned up to the Inspector's satisfaction. Any oil that leaked between the rig matting will be addressed when the building is torn down. Volume adjusted to 450 L based on pumping rate from the tank and maximum time the shop would have been left unattended (150 minutes). Spill will remain open with the NWT Spill Line. Dominion submitted a detailed report to the Board and Inspector on December 5, 2019.
Spill-2019473	26-Nov-2019	Hydraulic Oil	650-800 L	Pigeon Pit	DRD2416 Drill	Surface Mining	Hydraulic Failure	Main hydraulic hose suction line from tank blew resulting in hydraulic spill	The spill was contained and cleaned up after the failed hose was repaired and the drill was moved. Dominion submitted a detailed report to the Board and Inspector on December 18, 2019. Clean-up confirmed by the Inspector during January 7, 2020 inspection.
Spill-2019478	6-Dec-2019	Diesel Fuel	100 L	Explosives Building	Fuel Truck	Hydrocarbons	Mechanical Failure	Internal truck sump mechanical issue caused overflow of diesel onto snow/ground	Dominion submitted a detailed report to the Board and Inspector on January 3, 2020. Clean-up confirmed by the Inspector during January 7, 2020 inspection.
Spill-2019479	10-Dec-2019	Hydraulic Oil	280 L	Pigeon Pit	EXD2567 Shovel	Surface Mining	Hydraulic Failure	Hydraulic line seal failed	Dominion submitted a detailed report to the Board and Inspector on January 3, 2020. Clean-up confirmed by the Inspector during January 7, 2020 inspection.

APPENDIX F
2019 Closure and Reclamation Progress Report

Dominion Diamond Mines
Dominion Diamond Ekati ULC
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Calgary, Alberta T2P1T1 (403) 910-1934 fax
www.ddmines.com

December 20, 2019

Mr. Joseph Mackenzie
Chair
Wek'èezhìi Land and Water Board
#1, 4905-48th Street
Yellowknife, NT, X1A 3S3

Re: W2012L2-0001 Ekati Mine Water Licence - Submission of 2019 Annual Closure and Reclamation Progress Report

Dominion Diamond Ekati ULC (Dominion) is pleased to provide the 2019 Annual Closure and Reclamation Progress Report (the Report). The purpose of the Report is to meet Dominion's Water Licence reporting requirements (Part K Item 4 of Water Licence, W2012-0001). Given the ongoing review of the submitted Interim Closure and Reclamation Plan (ICRP) V 3.0 and corresponding RECLAIM estimate update no ICRP updates or RECLAIM updates are outlined in 2019 Report. The report intent is to keep stakeholders and the Wek'eezhii Land and Water Board (WLWB) informed on completed reclamation research, activities and monitoring:

- A Reclamation Completion Report for the reclamation completed within the underground workings of Panda, Koala, and Koala North in 2019 and is provided in Appendix G. This report meets the expectations of WLWB Guidelines for closure planning and closure costing. Dominion seeks that the Reclamation Completion Report is reviewed by stakeholders and WLWB staff confirm that it meets conformity to the WLWB guidelines.

- Section 4.0 provides a summary of the activities completed for the various Ekati mine research areas. Included in this section is an update on LLCF Reclamation Research, Vegetation Monitoring, Ekati Waste Rock Seep Hydrology, Jay WRSA Co-Placement Study, an overview of a Pigeon WRSA GTC Installation, and a Conceptual Subsurface Flow Model.

- Section 5.0 provides a summary of reclamation activities monitoring completed across the Ekati mine site, including 2019 reclamation monitoring results for the Old Camp Reclamation Project.

Dominion trusts this is clear and informative. If you have any questions or concerns relating to the content of the report, please feel free to contact the undersigned at lukas.novy @ddcorp.ca or 403-910-1933 ext 2407 or Kurtis Trefry – Environment Specialist Reclamation - at 403-910-1933 ext 2406 or kurtis.trefry@ddcorp.ca.

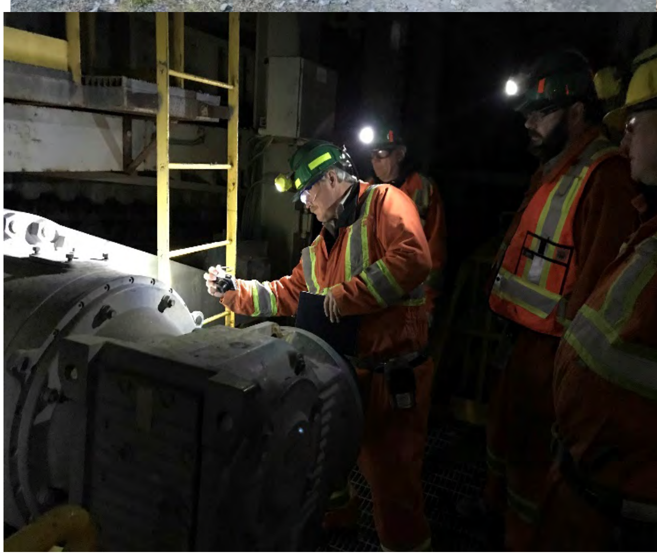
Sincerely,

Lukas Novy, M.Sc., P.Eng.
Team Leader - Life of Mine Planning, Environment

Ekati Diamond Mine

2019 Closure and Reclamation Progress Report






Dominion Diamond Mines

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1.0 Introduction

1.1. Interim Closure and Reclamation Plan

Reclamation planning at the Ekati Diamond Mine is guided by the Reclamation Goal “to return the Ekati site to viable, and wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment, human activities, and the surrounding environment”. The Ekati Diamond Mine Interim Closure and Reclamation Plan (ICRP) Version 2.4 was approved by the WLWB in November 2011, with various updates approved by the WLWB through these annual progress reports.

The ICRP is interim in nature because Dominion is still in the process of mining operations, learning from environmental monitoring, and undertaking various research studies that assist with how the mine will be successfully reclaimed. A Final Closure Plan is required to be submitted at least two years before end of mining operations under the Ekati Mine WL W2012L2-0001. On August 15, 2018, Dominion submitted Version 3.0 of the ICRP for the Ekati Mine, in accordance with Part K: Condition 2 of WL W2012L2-0001. Proponent responses to comments were submitted on July 5, 2019 and Dominion is currently awaiting a decision from the WLWB.

1.2. Report Purpose

The 2019 Closure and Reclamation Plan Progress Report (2019 Progress Report) is intended to meet Dominion’s annual WL reporting requirements, which are to highlight and report reclamation progress and to recommend revisions to future reclamation planning. The WL requirement for annual closure and reclamation reporting is:

- WL W2012L2-0001, Part K Item 4: “Licensee shall submit an annual Closure and Reclamation Plan Progress Report which shall be in accordance the Mackenzie Valley Land and Water Board and Aboriginal Affairs and Northern Development Canada’s Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories, and any additional direction from the Board.”

2.0 Engagement

2.1. Introduction

Dominion engages with potentially affected communities and stakeholders in an open, timely, and comprehensive manner. Community engagement activities are completed on a regular and routine basis as part of its management of the Ekati mine in accordance with the WLWB approved Ekati Mine Engagement Plan. Dominion works to align Traditional Knowledge (TK) with scientific knowledge. In 2019 Dominion's engagement was focused around the review of ICRP Version 3.0.

2.2. ICRP Version 3.0 Workshop

Building on feedback received through 2018 community visits, the ongoing ICRP review process and based on advancing closure planning, a two-day workshop on the ICRP was held January 22-23, 2019 in Yellowknife with various representatives from communities and regulatory agencies in attendance. The purpose of the workshop was to discuss key updates presented in ICRP Version 3.0 and allow for reviewer questions and concerns to be addressed prior to the comment submission due date of March 7, 2019. The workshop involved presentations from Dominion on various sections of ICRP Version 3.0 followed by an open floor on each topic where anyone could voice their related questions or concerns.

Day one of the workshop consisted of presentations on an ICRP Version 3.0 introduction, Progressive Reclamation and Research Plans, Permanent Closure and Reclamation of Site Wide components, Open Pits, Underground Workings, Waste Rock Storage Areas, and Processed Kimberlite Containment Areas. Day two focused on Water Management, Buildings and Infrastructure, and an update on financial securities.

2.3. Technical Conferences

Dominion continued to make use of technical conferences to provide exposure and technical insight to the reclamation research being completed. Conferences enable discussion of new ideas for future closure planning research. In 2019, Long Lake Containment Facility (LLCF) Reclamation Research was presented at the 47th Annual Geoscience Forum from November 19-21, 2019 in Yellowknife, NT. The Geoscience Forum is a national conference focused on the fields of geo-engineering, permafrost, and engineering geology. Dominion has provided a copy of the LLCF Reclamation Research Presentation in Appendix A.

3.0 Mine Schedule

Scheduling of mine operations of the Ekati Diamond Mine is based on a variety of operational, economic, and business factors, and is routinely reviewed and changed. Updated satellite imagery for the Ekati mine site is available in Appendix B and a high-level summary of the mining activities per pit is provided below.

- **Fox**
  - Open pit operations ended in 2014
- **Panda**
  - Open pit operations have been completed
  - Underground operations have been completed and reclaimed
  - In-pit deposition of processed kimberlite is ongoing
- **Koala North**
  - Open pit operations have been completed, and the lower section of the pit has been reclaimed in preparation for pit flooding
  - Underground operations have been completed, and reclaimed in preparation for pit flooding
- **Koala**
  - Open pit operations have been completed and reclaimed
  - Underground operations were completed in 2018
  - Reclamation of the underground workings was completed in 2019
  - In-pit deposition of processed kimberlite is ongoing
- **Beartooth**
  - Open pit operations have been completed
  - In-pit deposition of processed kimberlite is ongoing
- **Lynx**
  - Open pit operations have been completed
  - The open pit is currently being utilized for water management from the King Pond Settling Facility
- **Sable**
  - Open pit is in production scheduled to end in 2022
- **Pigeon**
  - Open pit production commenced in 2015 and is scheduled to end in 2021
- **Misery**
  - Open pit operations ended in 2018
  - Misery underground is currently in production
- **Point Lake**
  - Project permitting application scheduled to be submitted in 2020
- **Jay**
  - Optimization study of the Jay Project is ongoing

4.0 Reclamation Research

4.1. Introduction

Reclamation research at the Ekati Diamond Mine has been underway since commencement of mine operations. In 2018, Dominion submitted a Reclamation Research Plan that focused on the closure plan laid out in the 2018 ICRP Version 3.0. The Research Plan (Appendix C of the ICRP Version 3.0) contains the following 9 individual RPs to address reclamation uncertainties.

- RP 1 – Wildlife Safety
- RP 2 – Panda/Koala Closure Freshwater Cap Depth
- RP 3 – Misery and Jay Meromictic Pit Lake Freshwater Cap Depth
- RP 4 – Pigeon Waste Rock Storage Area Closure Cover
- RP 5 – Waste Kimberlite Seepage
- RP 6 – Jay Waste Rock Storage Area Co-placement
- RP 7 – Kimberlite Waste Rock and Coarse Processed Kimberlite Vegetation Physical Stabilization
- RP 8 – Long Lake Containment Facility Stabilization Cover
- RP 9 – Long Lake Containment Facility Water Quality

The RPs will evolve to accommodate ongoing updates in research findings, mine operating schedule, Environmental Management Plans, and changes in the ICRP. In 2019, Dominion continued the completion of reclamation research and monitoring for key identified uncertainties. Table 4.1-1 provides the 2019 completed reclamation research reports and technical memorandums with a reference to the proposed RP's as outlined in ICRP Version 3.0.

Table 4.1-1. 2019 Reclamation Research Plan Reports and Technical Memorandums related to Reclamation Research

Date Submitted to WLWB	Report/Memo Title	Reclamation Research Plan (RP)
December 20, 2019	Ekati Diamond Mine 2018 LLCF Reclamation Research Report (Appendix C of 2019 Closure and Reclamation Progress Report)	RP 8 Long Lake Containment Facility Stabilization Cover
December 20, 2019	Ekati Diamond Mine 2019 Vegetation Annual Report (Appendix D of 2019 Closure and Reclamation Progress Report)	RP 7 Kimberlite Waste Rock and Coarse Processed Kimberlite Vegetation Physical Stabilization
December 20, 2019	Ekati Waste Rock Seep Hydrology, 2018 and 2019 Monitoring Results (Appendix E of 2019 Closure and Reclamation Progress Report)	N/A
December 20, 2019	Conceptual Subsurface Flow Model for the Ekati Diamond Mine (Appendix F of 2019 Closure and Reclamation Report)	N/A

4.2. Long Lake Containment Facility (LLCF) Reclamation Research (RP 8)

The report summarizing reclamation research completed in 2018 is provided in Appendix C. Reclamation research at the LLCF continued in 2019 with the following research efforts undertaken:

- Surface water management research through trial channel construction and further bio-engineering of existing channels;
- Expanded implementation of rough and loose mounding through depressions as erosion mitigation;
- Seeded 2.2 hectares of Cell B with annual grasses as companion crops (Triticale and Fall Rye);
- Establishment of topsoil propagule islands utilizing topsoil material from Pigeon;
- Monitoring of existing species trials and investigation into optimal planting strategies;
- Use of indigenous mycorrhiza to evaluate their potential to enhance vegetation growth;
- Expanding of trials to evaluate the feasibility of using organic matter generated from the Ekati composter facility;
- Collecting of native plant seeds around Ekati for future seeding efforts and trials;
- Establishment of vegetation trials utilizing seed and seedlings collected from Kugluktuk in 2018; and
- Fertilization of trial areas within the boulder field

Plate 4.2-1. Trial established with plant materials collected from Kugluktuk (July 2019)

4.3. Vegetation Monitoring

In support of vegetation reclamation research, annual vegetation monitoring activities are completed at various sites. Vegetation monitoring activities completed in 2019 are summarized in the Ekati Diamond Mine 2019 Vegetation Annual Report provided in Appendix D and included the following vegetation reclamation sites:

- Fay Bay
- Paul Lake Laydown
- Old Camp
- Old Camp Road
- Misery topsoil storage stockpile

4.4. Ekati Waste Rock Seep Hydrology Monitoring

A flow monitoring program was initiated at Ekati to evaluate seasonal variability in Panda Koala and Pigeon WRSA seepage rates. Two weirs were installed with pressure transducers and conductivity probes, downstream of the Pigeon WRSA at SEEP-389 and the Panda Koala WRSA at SEEP-018B. Data were collected over a two-month period during the open water season of 2018, from July 12 to September 6, and over a 3-month period during 2019, from June 23 to September 5. The memo in Appendix E presents the design, installation, and results from two flow monitoring stations which collected continuous water level measurements from the 2018 and 2019 open water seasons, in seepage channels downstream of the WRSA. Monitoring locations selected for the program were SEEP-018B downstream of the Panda-Koala WRSA, and SEEP-389 downstream of the Pigeon WRSA.

SEEP-018B flows present correlation with air temperature as well as localized fluctuations from rainfall events. Increases in flow produced a mirrored decrease in conductivity levels, suggesting the melt water and direct precipitation provided dilution to the WRSA seepage. Rainfall events have a longer lasting effect in SEEP-389 flows. Conductivity steadily increases over time as flows decrease but were diluted and decreased during the higher rainfall periods. This is likely to be linked with the age of the waste rock dumps, since the Pigeon WRSA is still an active area and is much newer than the Panda/Koala WRSA. Continued monitoring is required before comprehensive conclusions can be drawn regarding the WRSA seepage seasonality and rates.

Plate 4.4-1. Seep 018B Weir (July 2019)

4.5. Jay Waste Rock Storage Area Co-Placement Study (RP 6)

The study design was developed to meet the requirements of the Ekati mine Water Licence amended to include the Jay Project. The overall objective of the co-placement study design is "to optimize the co-placement strategy, determine the target NP/AP [neutralization potential/acid potential] ratio and identify the scale of mixing that will prevent Acid Rock Drainage from the Jay Waste Rock Storage Area."

To date, a laboratory-scale geochemical testing program has been undertaken to determine the effective NP of blasted waste rock from the Ekati Diamond mine including material characterization, detailed mineralogical analysis, and laboratory leach testing. Leach testing is ongoing with results to be included within a future Effective Neutralizing Potential Report. A report providing preliminary laboratory results and an updated Jay WRSA Co-Placement study design is planned to be provided in 2020.

4.6. Pigeon WRSA GTC Install (RP 4)

4.6.1. Introduction

Waste rock from the Pigeon Pit is comprised primarily of mixed metasediment and granite-diabase. Operational acid-base accounting data for Pigeon waste rock indicates that the material is of uncertain acid-generating potential; this finding differs from results of laboratory-scale humidity-cell tests conducted using core-sample charges, which identified that the rock was potentially acid generating. The scope of the proposed research project is to re-assess the acid-generating and metal-leaching potential of waste rock from the Pigeon Pit through an integrated program of field-sample collection, laboratory experimentation and characterization, and reactive transport modelling. The Pigeon Waste Rock Storage Area Closure Cover Research Plan (RP 4) will look to provide critical insights into the potential long-term water-quality impacts that may arise from waste-rock weathering; and develop scaling relationships to predict contaminant release, transport, and attenuation in the field. The information will help determine acceptable closure strategy for the WRSA, specifically influencing whether the use of a thermal till cover at closure is necessary to manage metasediment.

4.6.2. Ground Temperature Cable Installation

In 2019, Dominion entered into a partnership with the University of Waterloo to begin the evaluation of the Pigeon WRSA with a preliminary focus on the installation of thermal monitoring instrumentation. The program involved the installation of one 200 m horizontal thermistor string with (15) independent beads running north to south along the 529 bench of the Pigeon WRSA. The placement of the thermistor extended laterally beyond the anticipated footprint of the future 541 and 548 benches. The installation of the thermistor took place between December 3-10, 2019 with the follow activities undertaken:

- (1) D10 dozer utilized a ripper shank implement to break up frozen waste rock along the designated trench area and side cut the trench with a blade edge to remove loosened aggregates for instrument placement
- The final trench was ~200 m in length and ranged from 15-30 cm in depth
- University of Waterloo personnel emplaced the thermistor cable in the bottom of the trench and connected the cable to a Campbell Scientific CR1000x data logger and AM16/32B multiplexor
- (1) thermistor was left above ground at the datalogger installation to monitor ambient air temperature
- The location of each of the thermistors was surveyed by Dominion surveyors to delineate exact location and elevation
- (1) IT28 loader backfilled the trench with 2" minus crushed granite waste rock to armor the cable and protect the installation from haul truck traffic and further waste-rock placement as the 541 bench is constructed

Plate 4.6-1. D10 dozer utilized a ripper shank implement to break up frozen waste rock along the designated trench area (December 2019)

Plate 4.6-2. Placement of thermistor string within horizontal trench along 529 bench of Pigeon WRSA (December 2019)

4.6.3. Future Research

Further investigation is required at the Pigeon WRSA as there remains uncertainty regarding the type of cover, if any, required for the closure of the Pigeon WRSA. In 2020, reclamation research will continue in partnership between Dominion and the University of Waterloo to this end. The University of Waterloo has received a NSERC Engage Grant to assist in funding the Geochemical Characterization and Reactive Transport Simulation of Metal Leaching and Acid Generation in Waste Rock from the Ekati Diamond Mine, NT. The Program will be coordinated under Dr. David Blowes and his team in the Department of Earth and Environmental Sciences at the University of Waterloo. The research team will provide expertise and guidance for the installation of monitoring equipment in waste rock at the Ekati site.

4.7. Subsurface Flow Evaluation

Subsurface (groundwater) flow is a complicated interaction of processes in a heterogenous environment. It is further complicated in permafrost environments where frozen ground can restrict or impede groundwater movement. Dominion requested Tetra Tech with providing a general overview of groundwater processes, particularly as they relate to the areas surrounding the WRSAs. Site-specific variances can be expected and will require individual consideration. The investigation was limited to subsurface flow through the active layer and does not address deep groundwater movement underlying the permafrost.

The Conceptual Subsurface Flow memo is available in Appendix F. The work completed indicates that surface flow is considered to be the likely transport mechanism for most seepage from the waste rock piles at Ekati site and only a limited quantity is transmitted via subsurface flow. This conclusion is supported by site observations and established permafrost hydrology:

- During freshet most surface water and seepage occurs overland when the active layer is still frozen;
- Measured hydraulic conductivities are low to moderate and calculated flow velocities are far less than associated surface flow velocities;
- Surficial geology shows the waste rock piles are surrounded by glacial material whose seepage potential is far from overland flow potential;
- EM surveys show subsurface flow velocities around the waste rock piles to be relatively slow; and
- WRSA seepage is typically observed as ponding water at the toe or as visible surface flow.

5.0 Reclamation Activities and Monitoring

5.1. Panda, Koala, and Koala North Underground Reclamation

5.1.1. Introduction

The Panda, Koala and Koala North underground mines are the first three underground mines established at the Ekati Diamond Mine. All three of these underground developments are interconnected, sharing common access and ventilation systems. The Koala North Underground began development in 2002 as a trial test to determine what types of equipment, materials, and processes worked best in Arctic permafrost underground conditions. The test mine evaluation was successfully completed in 2004. Full scale development at Koala North was initiated in 2010 with production ceasing in 2014. The Panda Underground came into production in 2005. Mineral reserves were exhausted, and operations ceased in 2010. The accumulation of seepage inflows into the Panda workings was actively maintained by pumping below safety thresholds that prevent spillage into the active areas at the Koala workings. Lower Panda workings from 2030 to 1890 were successfully reclaimed and closed out by 2010. The Panda Underground came into production in 2005. Mineral reserves were exhausted, and operations ceased in 2010. The accumulation of seepage inflows into the Panda workings was actively maintained by pumping below safety thresholds that prevent spillage into the active areas at the Koala workings. Lower Panda workings from 2030 to 1890 were successfully reclaimed and closed out by 2010.

5.1.2. Reclamation Activities and Inspections Summary

Final reclamation of all the underground workings was initiated at the end of the Koala underground operations in November 2018 and was completed on February 26, 2019. At closure, all mobile equipment and vehicles that could be salvaged and sold from the underground mines were removed. Pipes, cables, electrical gear and fixed equipment that had remaining salvage value were removed but all other equipment will be left in place (e.g., mobile equipment, rock breaker and conveyor system that have been cleaned of fuels and lubricants). A detailed tagging system was utilized to confirm the draining of oils and purging of grease systems in the underground workings. Oxygen bottles, chemical cleaners and all materials with potential for chemical degradation that were in the maintenance shops (e.g., petroleum products, batteries) were 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. Any inventory of explosives remaining underground was removed and disposed of safely.

GNWT Department of Lands Inspectors completed regular inspections to verify that the reclamation work was being completed in accordance to ICRP Ver 2.4. Additionally, the Inspector received daily decommissioning reports from Dominion which described the reclamation activities completed each day. Final GNWT inspection of the completed reclamation activities was completed on March 12, 2019 and afterwards the surface underground portals were sealed to prevent access by wildlife and humans.

5.1.3. Reclamation Completion Report

A Reclamation Completion Report has been completed for the Ekati mine based on progressive reclamation completed within the underground workings of Panda, Koala, and Koala North in 2019. The Reclamation Completion Report for the closure of Panda, Koala, and Koala North Underground Workings is specific to the removal of hazardous materials and mobile equipment. The Reclamation Completion Report is available in Appendix G. This report meets the expectations of WLWB Guidelines for closure planning and closure costing. Dominion seeks that the Reclamation Completion Report is reviewed by stakeholders and WLWB staff confirm that it meets conformity to the WLWB guidelines.

Plate 5.1-1. Portal to Underground Workings Sealed (June 2019)

5.2. Old Camp Reclamation

5.2.1. Introduction

The Old Camp Closure and Reclamation Plan was submitted to the WLWB in December 2013 and approved in April 2014. Reclamation activities for the Phase I South Pond were implemented in 2014 and included the excavation and removal of PK and liner materials and grading to promote positive drainage through the excavated areas. Reclamation continued in 2015 with the completion of the channel to route water through the reclaimed Phase I Pond, minor grading to promote positive drainage and cleaning of debris. In 2017 Dominion began the excavation of contaminated soil within the Old Camp area, however, confirmatory sampling revealed that residual hydrocarbon contamination remained in one location. In 2018 Dominion completed any remaining remediation and excavation of potentially contaminated soils. Water quality monitoring of the channel through the former Phase 1 Containment Pond has continued through 2019.

5.2.2. Water Quality Monitoring

Water quality monitoring within the constructed channel of the reclaimed Phase 1 Pond has been completed since 2015. Samples are collected at the North inlet, South outlet, and within the collection trench at the capped North Pond. Provided a summary of the samples collected in 2019 and put the lab results into an Appendix H.

All water quality values excluding total arsenic in the South Channel and dissolved aluminum in the Phase 1 Trench were in compliance with Water Licence (W2012L2-001) effluent criteria. It is also worth noting that following the remediation of PHC contaminated soils on the Old Camp Pad, no concerns regarding TVH, TEH, or TPH in any samples was observable.

The arsenic concentration in the South Channel was recorded as (0.00812 mg/L) on September 15, 2019 but was well below Water Licence effluent criteria at 0.005 mg/L on June 21, 2019. As previously discussed and outlined in the 2018 Annual Progress Reports water from the reclaimed Old Camp area is undergoing natural attenuation and dilution before it enters into Larry Lake. As part of the reclamation monitoring, Dominion will continue to complete monitoring of water quality performance in the reclaimed water channel. Monitoring results will be used to evaluate the need for the implementation of any water quality mitigation efforts. This evaluation will include analysis of historical water quality variables of interest including arsenic and aluminum.

6.0 Interim Closure and Reclamation Plan Updates

ICRP updates can be the result of various factors but generally originate from the reclamation research and design and from new developments at the Ekati mine. ICRP updates can consist of updating of figure or material quantities or changes to specific ICRP closure objectives or closure designs. Given that the overall regulatory approval process for the submitted ICRP Version 3.0 is ongoing at this time, Dominion has not proposed any ICRP updates for the 2019 Progress Report.

7.0 Security and Relinquishment

7.1. Reclamation Security Held

The Mine Site Reclamation Policy for the Northwest Territories indicates that adequate security should be provided to ensure the cost of reclamation, including shutdown, closure and post-closure, is born by the operator of the mine rather than the Crown.

As of December 31, 2019, the current total reclamation security held by the GNWT for the Ekati Diamond Mine is equal to **$295,773,906.** Provided in Table 7-1.1 is an overall summary of security held by GNWT for the Ekati Diamond Mine. The total amount held represents an increase of $ 2,780,000 to the $292,993,906 held by the GNWT on December 31, 2018. The increase is a result of the Phase 3: Sable Water Licence ($2,780,000) posted on April 8, 2019.

On November 20, 2019 the WLWB approved Dominion's proposed security adjustment of a refund of $ 7,860,181 for progressive reclamation of the Misery Waste Rock Storage Area (WRSA). In order to less administrative burdens of numerous amendments to ILOC's and surety bonds, Dominion will incorporate the Misery WRSA refund amount with the WLWB security decisions on the following proposed ICRP V 3.0 security items for ICRP V 3.0. on the proposed land and water splits for Jay and Misery Underground Projects and the proposed Jay phasing schedule.

Table 7.1-1. Ekati Mine Reclamation Security Held (December 31, 2019)

Security Item	Amount Held
Water Licence Security W2012L2-0001	$273,875,482
Ekati Environmental Agreement	$19,991,424
Jay Early Works Land Use Permit W2016F0007	$1,480,000
Pigeon Land Use Permit W2016D0005	$427,000
Total:	**$295,773,906**

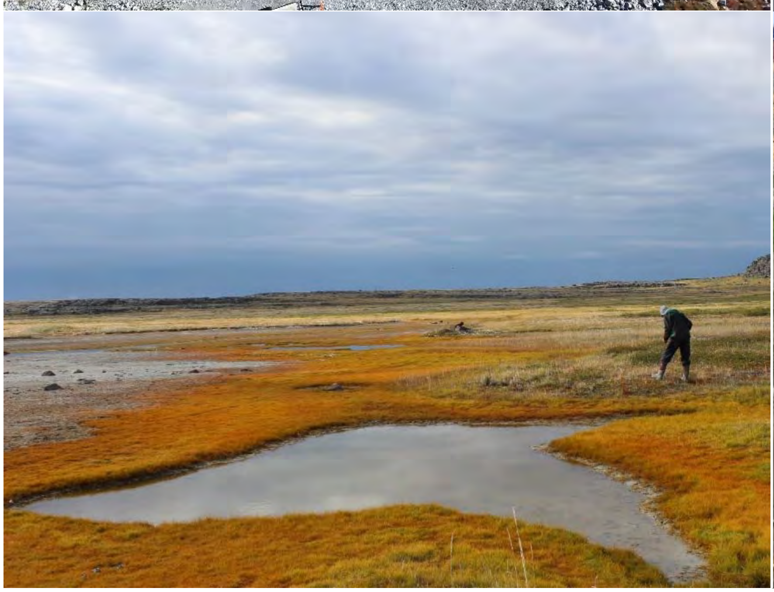
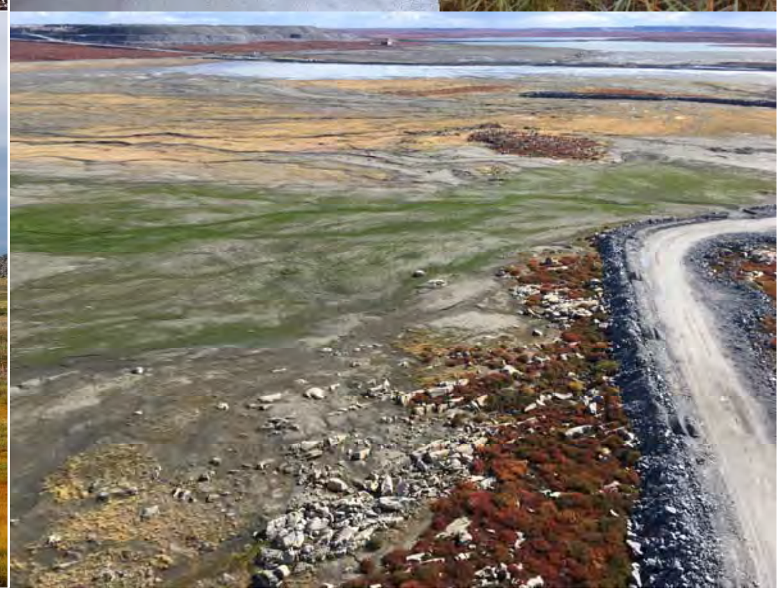
7.2. RECLAIM Updates

Given that the overall regulatory approval process for the submitted ICRP Version 3.0 including proposed RELAIM updates Dominion has not proposed any RECLAIM updates for the 2019 Progress Report.

Ekati Diamond Mine

2018 LLCF Reclamation Research Report



Dominion
Diamond Mines

Dominion Diamond Mines ULC

Ekati Diamond Mine

2018 LLCF Reclamation Research Report

November 2019

Version B.1

Prepared by: Dominion Diamond Mines ULC

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1. INTRODUCTION

The extraction of diamonds from diamond-bearing kimberlite at the Ekati Diamond Mine (Ekati mine) results in the need for large volumes of processed kimberlite (PK) tailings to be deposited and stored on site. The Long Lake Containment Facility (LLCF) serves this purpose. It has been in operation since 1998 with processed kimberlite deposition occurring in three of its five cells (Cells A, B, C) while the remaining two cells (Cells D and E) are used for water “polishing” to help meet discharge criteria. To date, only Cell B has been filled to capacity. See Figure 1-1 below.

Originally, a rock cover was proposed to stabilize the surface of the tailings areas but encouraging results of early revegetation research conducted in Cell B (Martens, 2005) lead to a change in thinking such that the 2011 Interim Closure and Reclamation Plan (BHP Billiton, 2012) for the Ekati mine outlines a plan to cover the PK surface with a combination of rock and vegetation. To investigate that opportunity a Pilot Study Area (PSA) was designated on the west side of Cell B near its north end (Figure 1-1).

Early revegetation research in Cell B was conducted along its east side on tailings from kimberlite mined from the Panda kimberlite pipe (Martens, 2005). In 2007 PK deposition began from the cell's west side that covered most of the original deposit (including the PSA and original research plots) with PK extracted from the Fox Pit. A sampling program undertaken to characterize the PK in the PSA was undertaken in June 2012. The results of that sampling reveal a substrate notably different than the original PK and the natural tundra soils surrounding the site. Compared to the old PK the new material has a finer texture with greater percentages of silt and clay sized particles. Sodium concentrations (and therefore exchangeable sodium percentage (ESP) and sodium adsorption ratio (SAR)) and pH are elevated in the new PK compared to the old PK and to natural tundra mineral soil. Table 1-1 below shows some surface chemical and physical characteristics of PK in the new PSA and original Cell B research plots and the local tundra soil.

Table 1-1: Average Surface (0 to 30 cm) Chemical and Physical Characteristics of Processed Kimberlite and Natural Soil at Ekati Mine, NT (Martens, 2013)

Measured Parameter	Pilot Study Area	Original Cell B Research Plots	Tundra Mineral Soil
% Sand	65	81	64
% Silt	21	10	32
% Clay	14	9	4
Soil Texture	sandy loam	sand	sandy loam
pH	9.3	7.8	5.6
Cation Exchange Capacity (meq/100g)	30 – 40	20	6
Electrical Conductivity (dS/m)	2.6	4.6	0.42
Exchangeable Sodium Percent (ESP)	78	<0.2	<0.1
Sodium Adsorption Ratio (SAR)	19	0.2	0.3

Of special note for revegetation is the marked change in ESP and SAR. Elevated ESP and SAR indicate that both the solid (ESP) and liquid (SAR) phases of the newly deposited substrate are dominated by sodium. Soil with SAR 15 (or ESP 17%) or greater is, by definition, sodic. Sodic conditions present two challenges for vegetation: due to the overwhelming presence of sodium it becomes difficult for plants to obtain other essential nutrients (calcium, magnesium, potassium, etc.) and with SAR above 15 wet soil can swell thereby reducing air and water permeability. Surface crusts can also form that interfere with seedling development (Hausenbuiller, 1985).

A variety of field trials are being conducted in the PSA to assist in the design of a long-term cover that will ultimately be used across the entire LLCF. Surface amendments and preparation, waste rock placement, plant species trials and vegetation establishment and equipment requirements are among the issues being investigated. The overall objective of this research is to develop a cover system that will physically stabilize the tailings and create a landscape safe for wildlife and human use. The following sections provide more detail about research activities in Cell B.

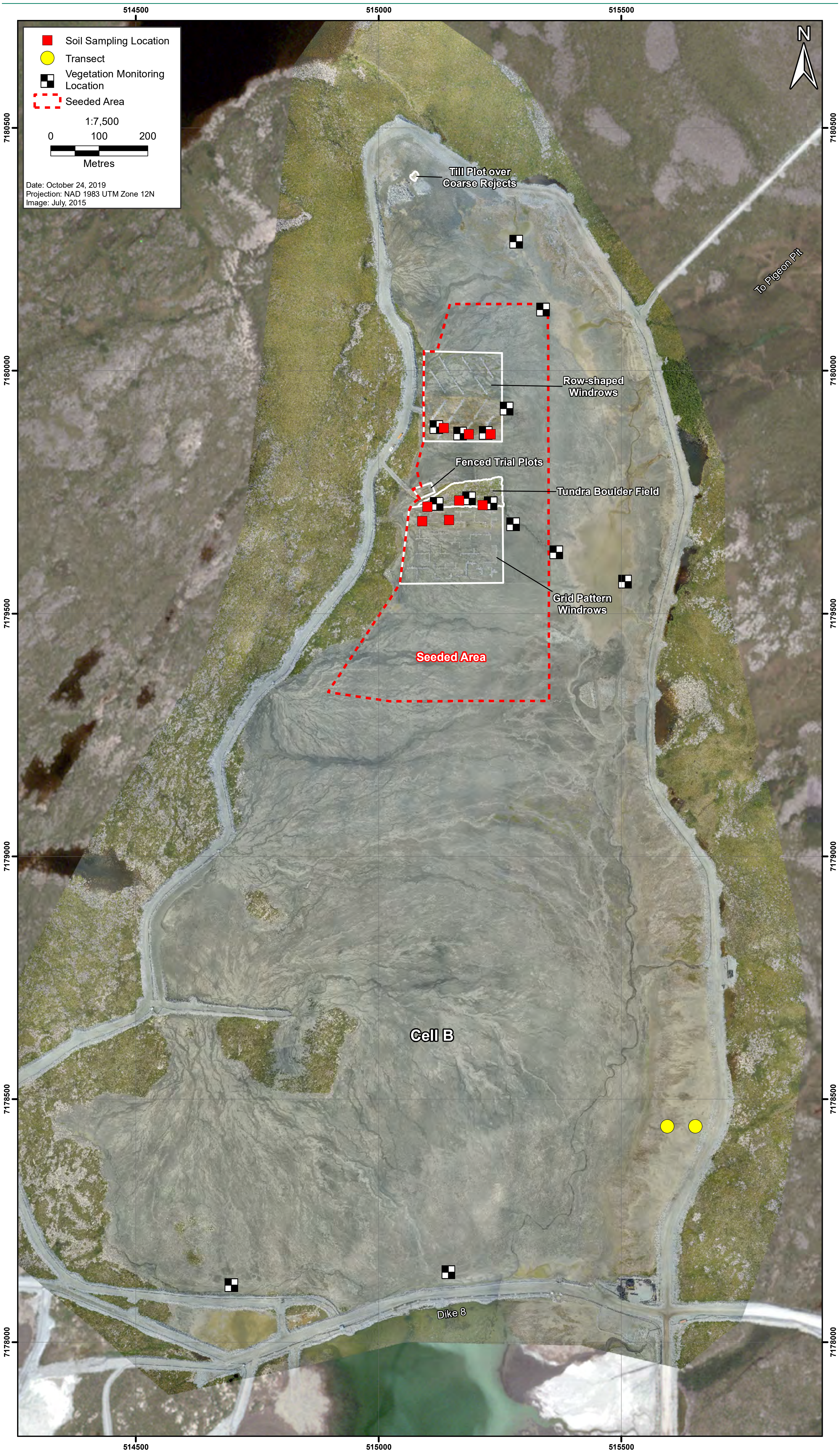


Figure 1-1: Long Lake Containment Facility Cell B Reclamation Research Layout

2. ANNUAL COVER CROP TRIAL

2.1 Introduction

Cover crops are used extensively in land reclamation to provide temporary ground cover until permanent vegetation is established. The primary reasons for establishing short-term vegetation on a bare substrate are to control erosion, to provide micro niches for colonizing plants, and to add organic matter to the soil environment. Organic matter serves to stimulate and/or maintain soil biological activity, it is as a long-term source of plant nutrients, acts to buffer soil pH, and improves a soil's moisture holding capacity, structure, and tilth. Due to their relative ease of establishment and rapid growth common agricultural field crops or annual grasses are often chosen for short-term cover.

In 2018, cover crops were planted over 6.1 hectares (ha) in Cell B of the LLCF at the Ekati mine. That area comprises 1.8 ha of barley (*Hordeum vulgare*), 1.5 ha of spring triticale (X *Triticosecale*), 1 ha of fall triticale, and 1.8 ha of fall rye (*Secale cereale*). All but fall triticale have been grown previously in Cell B. (See EcoSense, 2017 for more information.) Fall rye and fall triticale are biennial crops that require cold treatment or winter to induce seed set. Growth during the first year (or until after a cold treatment) is limited to a low growing rosette of leaves. The next season plants produce a single stem and the seed head then die.

Seeding was conducted in stages. First the surface of the area to be seeded was loosened by pulling a weighted chain harrow across it with a track-mounted all terrain vehicle (ATV) or, where ground conditions allowed, by roto-tilling with a small track-mounted tractor. Seed and then fertilizer were broadcast using a large tired spreader pulled behind the ATV. A final pass with the chain harrow and a roller was conducted to incorporate the seed and improve seed to soil contact. The seeding rate for all crops was 100 kg/ha and 200 kg/ha 28.5-26-0 (N-P-K) fertilizer was applied to each. Spring triticale, barley and fall rye were panted between July 5 and July 9, 2018 but the fall triticale could not be planted until July 22, 2018. Seeding was delayed due to scheduling difficulties. Figure 2.1-1 below provides an overview of the 2018 trial and Photo 2.1-1 depicts the seeding operation.

The cover crops being grown at the Ekati mine have limited potential to persist and/or spread beyond the seeded areas. Due to the cool, short growing season they are not expected to produce viable seed and without cultivation the odds of any viable seed establishing are reduced significantly. Ongoing monitoring will be conducted and any crop plants observed growing beyond the confines of the research area will be removed.

2.2 Monitoring Activities

To assess the performance of the different cover crops and cultivation treatments monitoring was conducted on August 22 and 23, 2018. The number of seedlings were counted and three random plant heights were measured in 15 Daubenmire frames (0.1 square metre (m^2)) along each of two 30 metre (m) long transects established in each of the treatment areas.

2.3 Results and Discussion

The 2018 cover crop trial monitoring results are summarized in Table 2.3-1 below. July 2018 was unusually dry at the Ekati mine with very little precipitation in the first few weeks following seeding. Despite that, reasonably good establishment was observed for all crops although the delayed (July 22) seeding date for fall triticale may have hampered its establishment. Pre-seeding cultivation with the roto-tiller appears to have positively impacted barley establishment and growth (Photo 2.3-1). Slightly better establishment and growth was recorded for the harrowed spring triticale compared to the harrowed barley. Assuming good over-winter survival of fall rye and fall triticale more robust growth is expected from them in 2019.

Photo 2.1-1: Seeding annual cover crops at the Ekati mine, July 2018. The top photo shows re-seeding surface preparation with the roto-tiller and a harrowed area in the foreground; and bottom photo shows broadcast seeding.

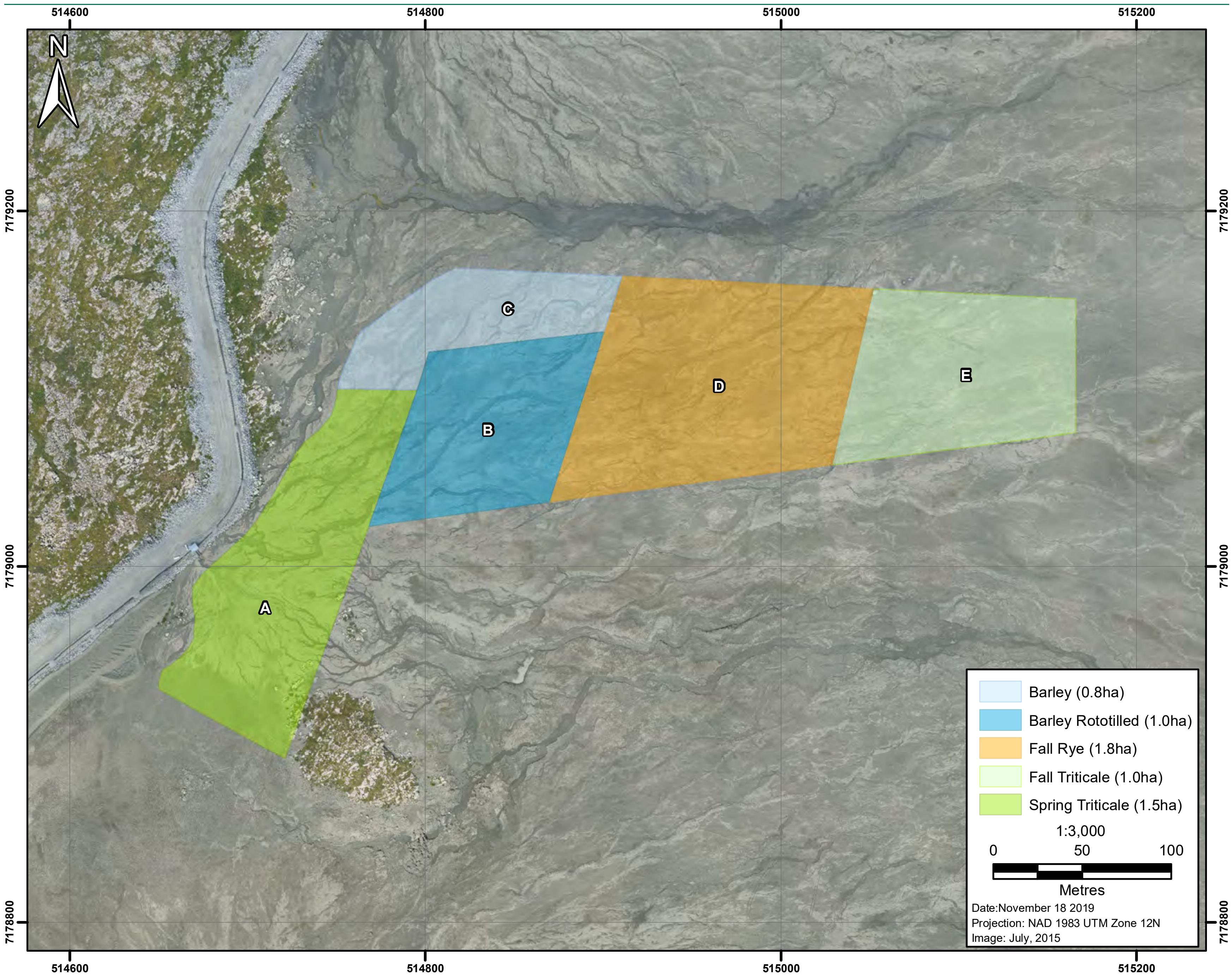
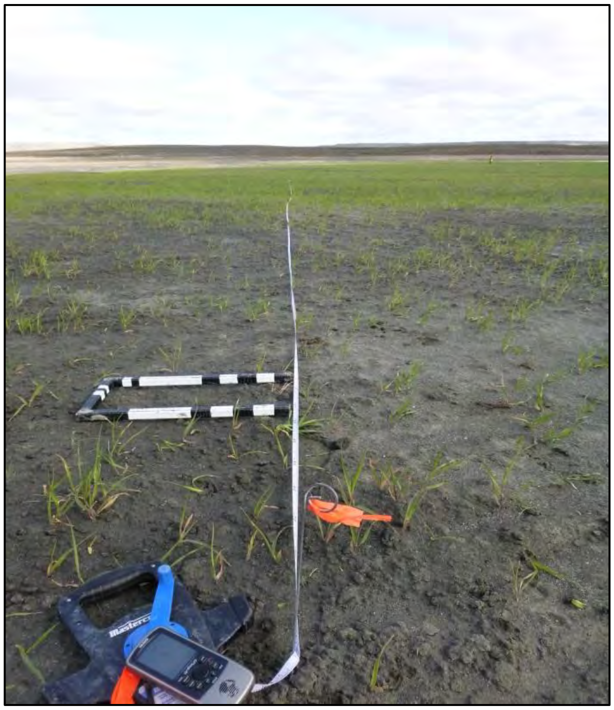


Figure 2.1-1: Annual Cover Crop Trial at the Ekati Mine, 2018



View along transect 1 in harrowed barley

View along transect 1 in roto-tilled barley

Aerial view of the 2018 cover crop trials area (dark green)

Photo 2.3-1: 2018 cover crop trial area site photographs. Ekati Mine, August 2018.

Table 2.3-1: 2018 Ekati Mine Cover Crop Trial Monitoring Summary, August 2018

Crop	Pre-seeding Surface Treatment	Seeding Date	Mean Number of Seedlings (No./m^2)	Mean Seedling Height (cm)
Barley	roto-tilled	July 7	154	18.9
Barley	harrowed	July 8	128	11.6
Spring triticale	harrowed	July 5	138	13.8
Fall triticale	harrowed	July 22	118	5.0
Fall rye	harrowed	July 9	191	5.9

No. = Number; cm = centimetre.

2.4 Conclusion and Recommendations

Cover crops are commonly used in land reclamation to help control surface erosion and introduce organic matter into the soil environment. In summer, 2018 cover crop trials involving four common agricultural cereal crops and two pre-seeding cultivation techniques were conducted. The results indicate roto-tilling prepares a more favorable seed bed than harrowing and, as a result, crop growth in roto-tilled areas was enhanced. Wherever ground conditions permit pre-seeding roto-tilling is recommended. Spring triticale out performed barley marginally but both crops are reasonably well adapted to growing conditions in Cell B. Two of the crops are biennial and therefore their performance will not be assessed until after the 2019 growing season.

3. ROCK AND VEGETATION COMBINATIONS

3.1 Introduction

The 2011 Interim Closure and Reclamation Plan (BHP Billiton, 2012) for the Ekati mine outlines a plan to cover PK contained in the LLCF with a combination of rock and vegetation. To investigate alternative cover design options a study was developed by Tetra Tech EBA in 2013 involving three rock windrow configurations and vegetation:

- Tundra Boulder Field with vegetation cover;
- Rock Grids with vegetation cover; and
- Rock Rows with vegetation cover.

The goals of all three designs are the same: to limit erosion by wind and water, to provide habitat for additional plant species, whether introduced intentionally or that colonize the sites naturally and to encourage snow accumulation thereby increasing soil water available for leaching excessive sodium and soil moisture for plants. For a more complete discussion of the rationale behind the study see Martens (2014).

The study area is comprised of two areas (north plot and south plot) of approximately 1.5 ha each separated by about 70 m. Rock Rows were built in the north plot and the Boulder Field and Rock Grids are in the south plot (Figures 3.1-1 and 3.1-2). Construction of the site began in August 2013 with surface preparation and seeding. The rock was placed during the winter of 2013/2014 when the ground was frozen and accessible for equipment.

3.2 Site Development

Within the rock configurations, substrate amendment and seeding trials were established, including substrate amendment with organic matter, seeding biennial fall rye, and perennial native and non-native alkali grasses.

Research in oil sands tailings has indicated that the addition of an organic soil amendment (Alfalfa Green pellets at a rate of 10 tonnes/ha, mixed to a depth of 15 cm) can improve plant growth, due to increased soil moisture holding capacity and the nutrients contained in the alfalfa pellets (Woosaree and Hiltz 2011, cited in Martens, 2014). Site development work commenced in late August, 2013 when ground conditions are at their (unfrozen) best. The first step in site preparation was broadcasting Alfalfa Green pellets over approximately 0.25 ha of each of the north and south plot areas using a tracked side by side all terrain vehicle (ATV). The original work plan called for a D6 Caterpillar dozer (D6) pulling a large breaking disc to prepare a uniform surface layer by mixing the PK/alfalfa to about 15 cm depth. That plan had to be abandoned, however, when the D6 and disc became mired in the tailings. Instead, an ATV pulling a weighted harrow was used but with only moderate success; mixing was incomplete.

Approximately one-half of each of the two areas was broadcast seeded with fall rye (*Secale cereale*) at 25 kg/ha. Fall rye is a biennial agricultural crop that requires cold treatment or winter conditions to induce its seed set. Growth during the first year (or until it receives a cold treatment) is limited to a low growing rosette of leaves. The next season plants produce a single stem and seed head that subsequently die. Under normal growing conditions fall rye provides good ground cover and it leaves a good cover of litter after setting seed and dying. Fall rye seeded in August 2013 that germinated before freeze-up was expected to set seed in late summer, 2014. Unfortunately, due either to poor initial establishment or winter kill (or some combination of both) very few rye plants survived until spring 2014. However, by 2015 appreciable amounts of alkali grass had begun to infill those areas and they have been left to colonize naturally thereby providing the opportunity to monitor that process.

Rock Rows

Boulder Field and Rock Grids

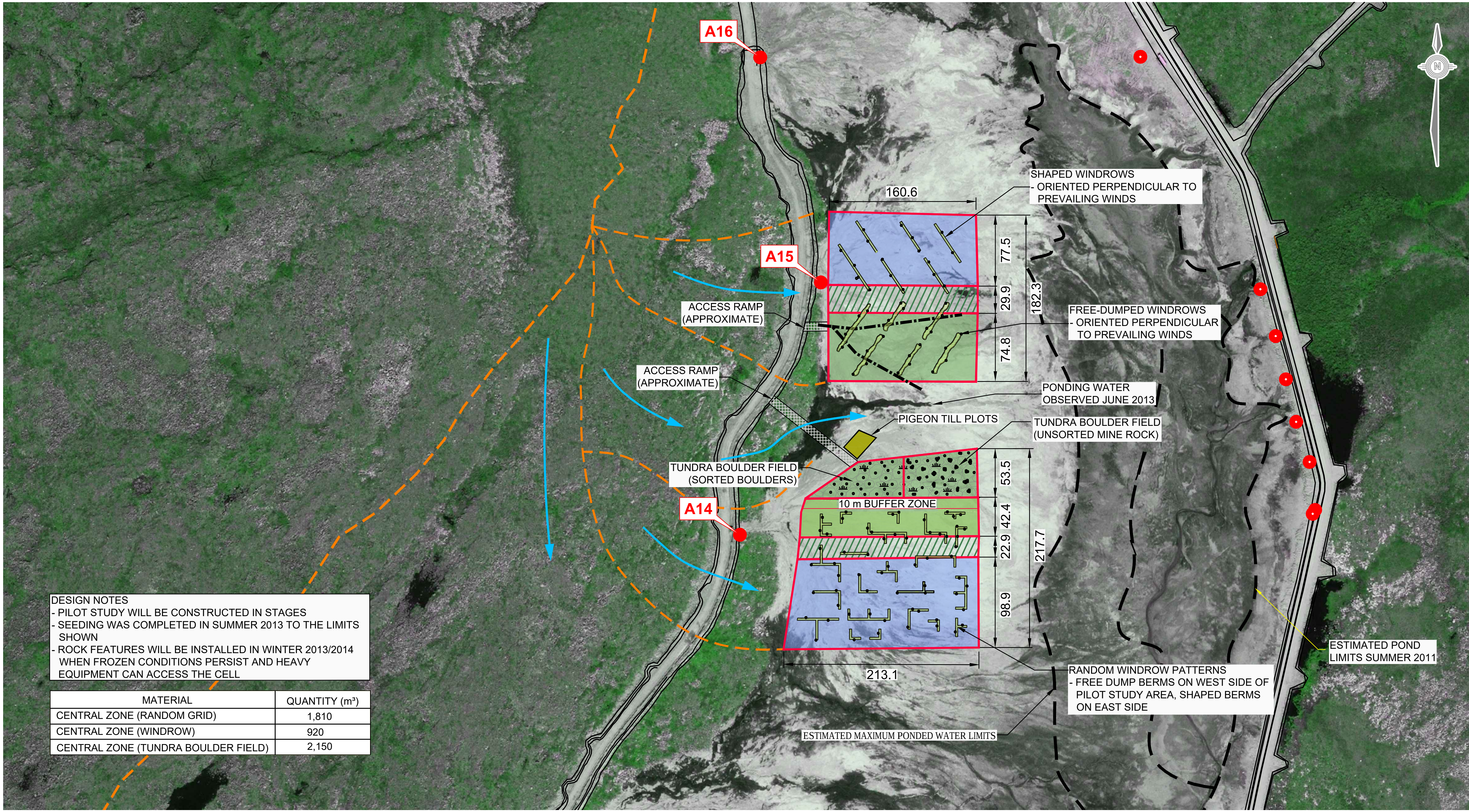
Figure 3.1-2: Aerial Views of the Rock Configurations and Vegetation Treatment Areas, July 2015

The southern half of the north plot, in the Rock Rows area, was seeded with a commercially available variety of alkali grass (Fult's Alkali Grass (*Puccinellia distans* (Fult's)). Hand harvested native alkali or goose grass (*Puccinellia borealis*) seed collected from the east side of Cell B where it has colonized naturally was used on the northernmost quarter of the south plot in the Boulder Field rock configuration area. The next most northerly quarter of the southern plot, which includes a narrow strip in the southern part of the boulder field, was seeded with Fult's Alkali Grass. Figure 3.1-2 above provides an aerial view of the rock configurations and vegetation treatments.

3.3 Monitoring Activities

In 2016, eight permanent transects were established in the Rock Rows and Rock Grids treatment areas; two in each of the seeded and not seeded areas. The data is collected in the Boulder Field as well but due to the difficulty of running straight 30 m long transects among the boulders the frame is placed randomly. All transects were examined again in 2017 and 2018.

The long-term solution to the problem of excessive sodium in the soil is leaching (or flushing) it down and away from the rooting zone. To assess the effectiveness of the rock configurations to promote leaching, soil sampling and salts analysis is conducted. Soil samples are collected from 0 to 15 cm and 15 to 30 cm from upper, mid, and lower slope locations in each of the three rock pattern areas. Beginning in 2016, a separate set of samples has been collected from the alfalfa treated strips. To facilitate repeated sampling, sample locations were marked and a GPS co-ordinate was obtained. Soil samples were collected annually from 2014 until 2016 and sampling was repeated in 2018.



DESIGN NOTES
- PILOT STUDY WILL BE CONSTRUCTED IN STAGES
- SEEDING WAS COMPLETED IN SUMMER 2013 TO THE LIMITS SHOWN
- ROCK FEATURES WILL BE INSTALLED IN WINTER 2013/2014 WHEN FROZEN CONDITIONS PERSIST AND HEAVY EQUIPMENT CAN ACCESS THE CELL

MATERIAL	QUANTITY (m^3)
CENTRAL ZONE (RANDOM GRID)	1,810
CENTRAL ZONE (WINDROW)	920
CENTRAL ZONE (TUNDRA BOULDER FIELD)	2,150

LEGEND:
- 2013 BOREHOLE
- SPIGOT POINT LOCATION
- TRAFFICABILITY TEST PATH
- CATCHMENT BOUNDARY
- FLOW DIRECTION
- SEEDING LIMITS
- SEEDED WITH ALKALI GRASS
- SEEDED WITH RYE
- ALFALFA PELLET SURFACE TREATMENT

0 200 m

Scale: 1: 4 000

NOTES
1. CONTOURS BASED ON 2010 LIDAR DATA
2. IMAGE BASED ON 2012 SATELLITE IMAGERY
3. ALL DIMENSIONS IN METRES

STATUS
ISSUED FOR DISCUSSION

CLIENT
Dominion Diamond Mines

A TETRA TECH COMPANY

LLCF PILOT STUDY
EKATI DIAMOND MINE

ROCK AND VEGETATION TRIAL LAYOUT

PROJECT NO.	DWN	CKD	REV
E14103056-02	EP	GDK	2

OFFICE	DATE
EBA-EDM	December 2013

Figure 3.1-1

3.4 Results and Discussion

Both species of alkali grass seeded into the rock and vegetation treatments (Fult's in the Rock Rows and Grids and native goose grass in the Boulder Field) established successfully and have developed into fairly uniform stands that provide good ground cover. In 2018 total cover ranged from 51% in the Rock Grids seeded with Fult's to 78% in the Boulder Field seeded with locally sourced goose grass (Table 3.4-1). Litter contributed over half of the total cover in every treatment. Perhaps aided by the accumulated litter (which tends to keep the soil surface cool and moist) trace amounts of moss was observed in all the treatment areas in 2018. Compared to the 2016 data in 2018 small decreases in live cover were measured in both the Rock Grids and Rock Rows seeded with Fult's while live cover by both species of grass increased slightly in the Boulder Field. Total ground cover has been consistently highest in the Boulder Field seeded with goose grass.

Table 3.4-1: 2016 and 2018 Seeded Grass Performance in the Rock and Vegetation Trials

Treatment	Mean Percent Ground Cover							
	Rock Grids with Fult's		Rock Rows with Fult's		Boulder Field with Fult's		Boulder Field with Goose Grass	
Cover Type	2016	2018	2016	2018	2016	2018	2016	2018
Alkali grass	29	16	23	18	24	29	20	24
Mosses	-	1	-	6	-	1	-	3
Live Cover	**29**	**17**	**23**	**24**	**24**	**30**	**20**	**27**
Litter	8	34	11	39	18	32	30	51
Total cover	**37**	**51**	**24**	**63**	**42**	**62**	**50**	**78**

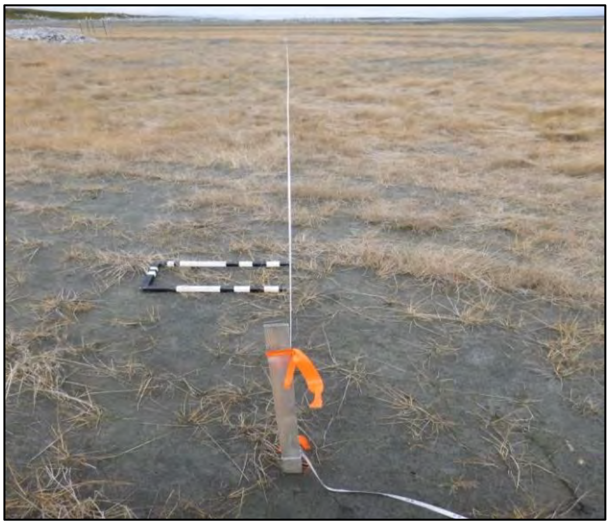
Natural colonization by alkali grasses is progressing steadily and at similar rates in the areas left essentially bare by the failed fall rye crop in the north half of the rock rows and southern half of the rock grids (Table 3.4-2). Permanent transects were established in each of those areas in 2015 to monitor the rate of infill by natural processes. Ground cover by live vegetation in both areas increased from 2015 to 2016; marginal increases were observed from 2016 to 2018 (Table 3.4-2).

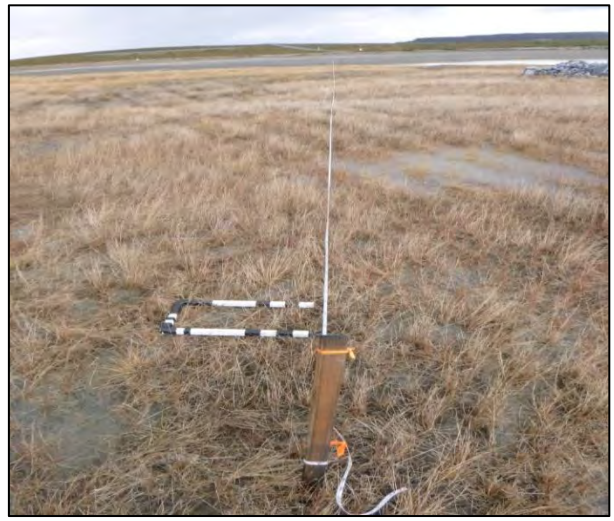
Table 3.4-2: Natural Colonization in the Rock and Vegetation Trials, 2015, 2016, 2018

Treatment	Mean Percent Ground Cover					
	Rock Grids			Rock Rows		
Cover Type	2015	2016	2018	2015	2016	2018
Alkali grass	4	12	16	1	11	12
Mosses	-	-	-	-	-	2
Live Cover	**4**	**12**	**16**	**1**	**11**	**13**
Litter	tr	2	15	tr	3	19
Total cover	**4**	**14**	**31**	**1**	**14**	**33**

Dashes indicate no species present; tr = trace.

Total cover more than doubled from 2016 to 2018 due, primarily, to a sevenfold increase in litter. The increase in litter could be attributed to the dry conditions experienced at the Ekati mine in 2018 where it becomes difficult to distinguish between live grass and litter. Thus it was possible that some of the material judged as litter in 2018 was, in fact, live. In the Rock Rows in 2018 ground cover by mosses was observed for the first time. Please also see site photos in Photo 3.4-1





Naturally colonized area in the Rock Rows

Seeded area in the Rock Rows

Photo 3.4-1: Site photos of the rock and vegetation trials, August 2018.

Soil salts analytical results are summarized were summarized by rock configuration treatment (Table 3.4-3) and by slope position (Table 3.4-4) below. From 2014 to 2015 there was a general reduction in soil salts concentrations in the upper 30 cm. This is most probably due to leaching caused by unusually high rainfall at the mine site in August, 2015. With the return of more normal weather in 2016 average salts concentrations rebounded and in 2018 were comparable to their 2016 levels. Generally, sodium adsorption ratio (SAR) was higher in 2016 and 2018 than it was in 2014. After 2014 salts concentrations were greater in the surface 15 cm compared to the 15 to 30 cm interval in all but the Boulder Field treatment and are generally lowest in the 0 to 15 cm interval in the Boulder Field than in the other treatments and depths. Some combination of greater leaching and reduced evapotranspiration in the Boulder Field may be responsible. SAR still exceeds the sodic soil threshold in all treatments and sample depths. A small decline in soil pH has occurred over time in all treatments and sample depths (Table 3.4-3).

Table 3.4-4 shows soil salts analytical results organized by slope position. Two phenomena are apparent in the data: after 2015 electrical conductivity (EC) has been consistently higher in the 0 to 15 cm interval in the lower slope position than elsewhere and after rebounding from the 2015 lows SAR has been consistently highest in the upper slope position in both depth intervals and especially so in 0 to 15 cm.

During site preparation 10 tonnes/ha of alfalfa pellets were applied to strips approximately 25 m wide in the Rock Rows and Rock Grids areas. Difficulty accessing the sites with large equipment prevented uniform mixing of the pellets and PK and although some success was achieved using a tracked ATV instead much of the alfalfa remained on the ground surface and was washed away with surface water. The remaining alfalfa pellets have had a small but measurable positive effect on vegetation, however, and in 2016 soil sampling in the treated areas was initiated. The sampling pattern used is the same as that used in the balance of the rock and vegetation trials areas: samples are collected from 0 to 15 cm and 15 to 30 cm from lower, mid and upper slope positions. Those data, and that from the rock configuration area adjacent to each alfalfa strip is presented below in Table 3.4-5. Electrical conductivity in the 0 to 15 cm interval in the treated strips is somewhat lower than in the adjacent treatments but that may be due to natural variability in the PK. Small amounts of organic carbon were detected in the 0 to 15 cm sample interval in the Rock Rows in 2016 and in 2018 it was present in all of the 0 to 15 cm samples as well as 15 – 30 cm in the Rock Rows. That result cannot be attributed to the alfalfa strips however because it occurs in both treated and untreated areas. Organic matter is critical component of healthy soils and until 2016 was generally absent from PK samples. It appears to be becoming more widespread and that development is encouraging, even in the very small amounts present to date.

Table 3.4-3: Mean Soil Salts by Treatment over Time

Treatment	Rock Grids				Boulder Field				Rock Rows			
Parameter	2014	2015	2016	2018	2014	2015	2016	2018	2014	2015	2016	2018
0 – 15 cm												
pH	9.17	8.7	8.3	8.0	9.16	9.2	8.6	8.3	8.82	8.8	8.1	8.3
SAR	23.6	18.6	40.8	41.3	25.8	4.9	25.9	30.6	23.2	17.5	41.6	34.5
EC (dS/m)	7.01	7.3	11.5	11.9	6.94	1.6	2.2	4.0	6.38	7.1	13.5	6.3
Na (mg/kg)	454	701	1,406	2630	431	91.2	160	751	383	420	1,182	1,074
15 – 30 cm												
pH	9.15	9.1	8.5	9.2	9.41	9.2	8.7	8.6	9.52	9.3	8.8	8.4
SAR	21.3	7.0	34.7	21.30	22.2	6.8	36.3	33.1	19.0	5.8	37.7	32.8
EC (dS/m)	6.09	2.2	4.5	6.1	4.14	2.0	3.4	3.5	2.35	2.1	4.9	4.8
Na (mg/kg)	424	199	479	424	293	148	313	603	122	119	322	538

Table 3.4-4: Mean Soil Salts by Slope Position over Time

Treatment	Lower Slope				Mid Slope				Upper Slope			
Parameter	2014	2015	2016	2018	2014	2015	2016	2018	2014	2015	2016	2018
0 – 15 cm												
pH	8.9	8.8	8.1	8.0	9.3	8.9	8.4	8.4	9.0	9.0	8.5	8.3
SAR	20.2	14.8	32.5	34.8	23.7	12.1	32.1	34.1	28.8	14.1	43.6	39.0
EC (dS/m)	6.7	6.0	14.0	10.1	5.6	4.9	7.7	5.7	8.1	5.1	5.4	6.5
Na (mg/kg)	400	475	1210	2207	335	387	1048	1118	534	350	489	1130
15 – 30 cm												
pH	9.2	9.0	8.5	8.3	9.4	9.2	8.7	8.5	9.5	9.3	8.7	8.6
SAR	16.3	6.9	32.3	32.4	15.4	5.0	38.2	28.8	25.7	7.7	38.4	34.7
EC (dS/m)	5.1	2.4	4.0	5.2	3.6	1.6	4.5	4.4	3.9	2.3	4.1	3.3
Na (mg/kg)	389	173	345	951	219	126	435	607	231	168	334	499

Table 3.4-5: Soil Analytical Results from Alfalfa-treated Strips and Adjacent Controls, 2016 and 2018

Parameter	Rock Grids				Rock Rows			
	Treated		Untreated		Treated		Untreated	
	2016	2018	2016	2018	2016	2018	2016	2018
0 – 15 cm								
pH	8.3	8.3	8.1	8.0	8.1	8.4	8.1	8.4
SAR	41.6	42.3	29.3	41.3	29.3	29.1	41.6	32.8
EC (dS/m)	8.9	4.6	5.8	11.9	5.8	2.9	13.5	4.8
TOC (%)	BDL	0.09	BDL	0.10	0.13	0.38	0.20	0.18
15 – 30 cm								
pH	8.5	8.2	8.5	8.4	8.6	8.6	8.8	8.4
SAR	33.9	36.7	34.7	30.0	29.9	43.8	37.7	32.8
EC (dS/m)	4.1	5.0	4.5	4.6	5.2	3.7	4.9	4.8
TOC (%)	BDL	BDL	BDL	BDL	BDL	0.04	BDL	0.17

SAR = sodium adsorption ratio; EC = electrical conductivity; TOC = total organic carbon; BDL = below laboratory detection level.

Because fine textured soils generally hold more moisture and have greater capacity to retain plant nutrients soil particle size distribution is important. During the PSA project planning the expected pattern of soil particle distribution was for the largest particles (sand (0.063 mm to 2 mm diameter)) to settle out first, in upper slope positions, followed by greater and greater amounts of finer particles (silt (0.004 mm to 0.063 mm)) and clay (< 0.004 mm diameter) in progressively lower positions. That hypothesis is supported by the data in Table 3.4-6 that shows progressively less sand from 0 to 15 cm in the upper slope position and more silt and clay with progressively lower slope position and sample depth with the most clay in the 15 to 30 cm interval at the lower slope position. The data is also presented graphically in Figure 3.4-1.

Table 3.4-6: Mean Particle Size Distribution and Texture Class by Slope Position, 2018

Depth (cm)	Mean Particle Size						Soil Texture	
	Percent Sand		Percent Silt		Percent Clay		Class	
	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30
Slope position								
Upper	68.2	63.8	21.0	22.6	10.8	13.6	SL*	SL
Mid	62.4	58.4	23.4	25.4	14.1	16.2	SL	SL
Lower	58.3	51.7	26.3	30.2	15.5	18.2	SL	L

SL = sandy loam; L = loam.

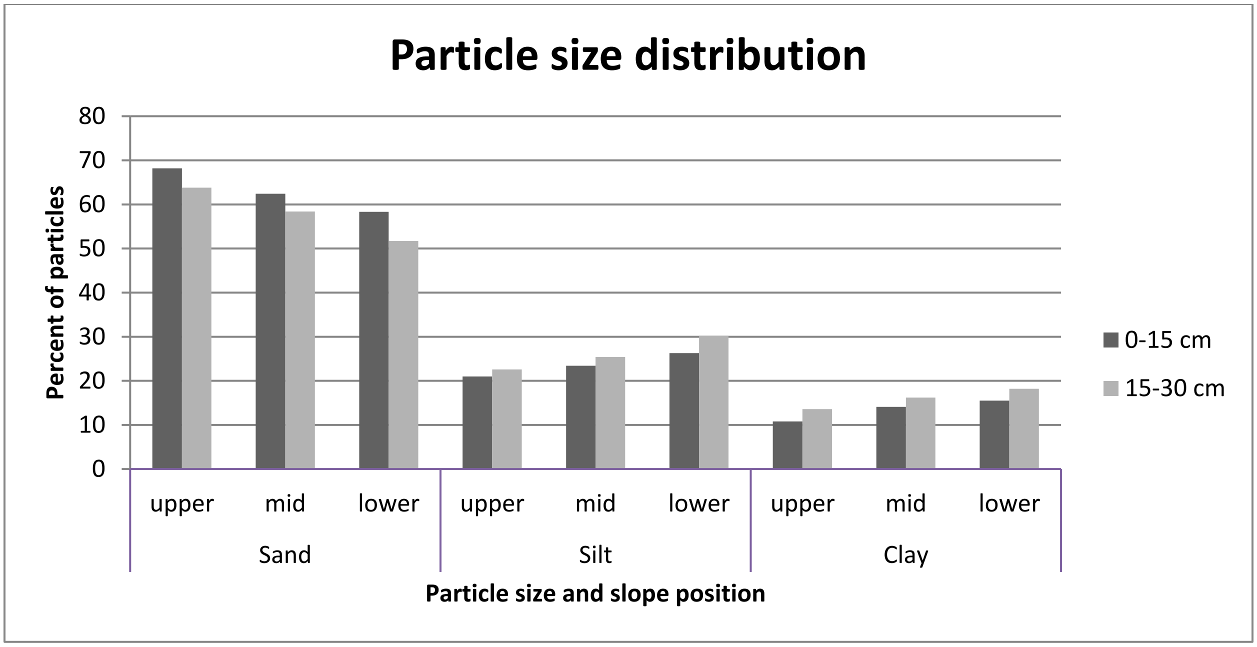


Figure 3.4-1: Mean Particle Size Distribution by Slope Position, 2018

Cover for the LLCF was set up in late summer, 2013 and spring, 2014 near the north end of Cell B of the LLCF. Areas with three different rock patterns in combination with two grass species and an annual cover crop were established.

There appears to be no appreciable difference in vegetation and litter cover build up between the different rock configurations seeded with Fult's Alkali grass. In 2018 total ground cover measured 51%, 63%, and 62% in the Rock Grids, Rock Rows and Boulder Field respectively. At 78%, total cover was slightly more in the Boulder Field seeded with native goose grass. Litter cover is building, and exposure of bare ground is decreasing significantly for all trial sites. Perhaps aided by the accumulated litter (which tends to keep the soil surface cool and moist) trace amounts of moss was observed in all the treatment areas in 2018.

Unseeded areas in the Rock Rows and Rock Grids are being colonized naturally by alkali grasses (a mixture of the native goose grass and introduced Fult's), whose fine seed is easily disbursed by wind. Rates of living vegetation and litter build up are progressing at very similar rates in both treatments and total ground cover is now about half that of the seeded areas.

Likely due to high rainfall in 2015 soil sampling results showed a general decline in surface salts concentrations throughout the trial area from 2014 to 2015 but they rebounded in 2016 and remain high in 2018. Sodium adsorption ratio remains at levels indicative of sodic conditions in all treatments and sample depths. In 2016 traces of soil organic carbon were detected for the first time in the alfalfa pellet-treated strip in the Rock Rows and it's adjacent control. In 2018 organic carbon was detected in 0 to 15 cm samples from both alfalfa-treated strips and both of their associated controls as well as in the 15 to 30 cm interval in treated and untreated areas in the Rock Rows.

3.5 Conclusion and Recommendations

The addition of mosses to the plant community and the slow accumulation of soil organic carbon indicate that site conditions are not static, that natural processes are at work. Monitoring should be repeated after two more growing seasons.

4. MYCORRHIZAE TRIALS

4.1 Introduction

Approximately 85% of all vascular plant species in undisturbed, natural ecosystems form symbiotic relationships, called mycorrhizas, with a group of soil fungi known collectively as mycorrhizae. The mycorrhizae colonise the roots of the host plant and in exchange for carbon from the plant their hyphae extend laterally in all directions from the roots effectively increasing the plant's root surface area and therefore its ability to extract nutrients and water from the surrounding soil (Fortin, 2009). Mycorrhizal associations may also enhance the host plants' resistance to disease and other stressors (Brundrett, 1991). Kidd (1996) reported that mycorrhizas occurred with an average 81% of plant roots from five species common at the Ekati mine site.

Of the various mycorrhizal associations found in nature, two are of particular interest in current reclamation research at the Ekati mine site, namely arbuscular mycorrhizas (AM) and ectomycorrhizas (ECM). About 70% of all vascular plants, including most grasses and herbaceous plants and some conifers, form AM and about 5% of existing species, primarily trees, form ECM. Some woody species (e.g. willow and alder) can form both types of association, sometimes simultaneously (Fortin, 2009). A third association (ericoid mycorrhizas) forms with plants in the Ericaceae family which includes blueberries, cranberries and rhododendrons that are common on the tundra surrounding the mine site and may become subjects of future reclamation research.

Mining creates large surface disturbances and generates significant volumes of waste material that require reclamation. Establishment of a functioning soil biological community, including mycorrhizal associations, may be a key factor for successful plant growth on reclamation sites (Boldt-Burisch and Naeth, 2016). Boldt-Burisch and Naeth (2016) conducted a study at the Diavik Diamond Mine on sites that were one, three or ten years old on lake sediment or PK with or without soil amendment (fertiliser or salvaged topsoil) and vegetation (seeded reclamation grasses). The results of the study indicated that time, vegetation, and especially amendment with salvaged topsoil (as a source of inoculum) had positive effects on mycorrhiza density on both substrates. They also found greater mycorrhiza density in lake sediment compared to PK.

Studies conducted by Mikro-Tek Inc. (Mikro-Tek) on gold mine tailings in Ontario found that plant nutrition, and consequently growth, was significantly enhanced in reclamation plants inoculated with native, locally adapted mycorrhizae (Mikro-Tek, 2000). The system developed by Mikro-Tek to capture and transfer mycorrhizae involves installing "mycorrhizae transfer pouches" amongst the roots of target plant species and collecting them at least one full growing season later. The transfer pouches contain bio-char and micro-nutrients that attract the mycorrhizae and are constructed from nylon mesh material that is too fine for plant roots but allows fungal hyphae to penetrate.

Transfer pouches supplied by Mikro-Tek (Photo 4.1-1) were planted in undisturbed tundra soil below willow (*Salix sp.*), dwarf birch (*Betula glandulosa*), fireweed (*Epilobium angustifolium*), locoweed (*Oxytropis sp.*) and bluejoint reedgrass (*Calamagrostis canadensis*) plants at various locations around Cell B in June 2016. The intention was to inoculate seed and/or seedlings of the target plant species with native mycorrhizae harvested on site, plant them in the PK in Cell B (and elsewhere on the mine site) and monitor their growth relative to uninoculated control seedlings. A potential drawback to that plan is the unknown adaptability of mycorrhizae from low pH tundra soil (pH approximately 4.5) and the high pH environment of PK in Cell B (pH approximately 8.5). Boldt-Burish and Naeth (2016) suggest that substrate with neutral pH of 6 to 7 (i.e., lake sediment) may be more amenable to native tundra mycorrhizae colonisation than is PK with its higher pH. To address that issue and attempt to screen for high pH tolerant fungi one half of the pouches obtained from Mikro-Tek contained bio-char with high (8) pH and the other half with neutral (6.5) pH. At each harvest site an equal number of both types of transfer pouches were planted. In September 2016, one set of transfer pouches (i.e., one high pH transfer pouch and one neutral pH pouch) was collected from below a selection of the target species and shipped to Mikro-Tek for assessment of hyphae colonisation. Although neutral pH pouches generally had higher hyphae counts all of the pouches were well colonised and were judged suitable as sources of inoculum (Kean, M., pers. comm.).

Photo 4.1-1: Mycorrhizae transfer pouches.

In June 2017, a trial using locally harvested willow (*Salix ssp.*) cuttings and mycorrhizae was established in the PSA in Cell B. Three hundred sixty-nine willow stakes were planted among five fenced plots, two of which occupy mid-slope positions and three that were downslope. One hundred twenty of the willows were inoculated with neutral pH mycorrhizae, 120 with high pH mycorrhizae and 129 were not inoculated. In August 2017, four similarly established plots containing a total of 192 bluejoint reed grass (*Calamagrostis canadensis*) seedlings (i.e. two plots mid-slope, two downslope each containing 48 seedlings, 1/3 with high pH mycorrhizae, 1/3 with neutral pH mycorrhizae and 1/3 uninoculated) were added to the trial (Photo 4.1-2). Those seedlings were grown in a nursery from seed supplied by the nursery and were inoculated in the nursery as seedlings.

In June 2018, one trial plot containing 32 birch (*Betula glandulosa*) seedlings inoculated with neutral pH mycorrhizae and 32 uninoculated plants was established in the Old Camp area. Then in July 2018, three plots of 48 fireweed (*Epilobium angustifolium*) seedlings each (16 with high pH mycorrhizae, 16 with neutral pH mycorrhizae, and 16 uninoculated) were set up in Cell B. Two of the fireweed plots occupied mid to upper slope locations and the third at a lower slope position.

4.2 Monitoring Activities

The willows were monitored in August, 2017 by measuring plant heights. Plant height and size of the willows and birch were measured in 2018. Plant size is determined by averaging the length of the plant's longest axis plus the length of the axis perpendicular to that and maximum plant height. The fireweed and bluejoint reed grass were monitored by documenting the number of plants with flowers and/or height.

Photo 4.1-2: Bluejoint reedgrass with mycorrhizae trial plot. August, 2017.

4.3 Results and Discussion

The 2018 willow with mycorrhizae monitoring data is summarized in Tables 4.3-1 to 4.3-3 below.

Table 4.3-1: Willow with Mycorrhizae Trial First and Second Year Percent Survival Rates, 2017 and 2018

	Mycorrhizae Treatment					
	High pH		Neutral pH		Uninoculated	
	2017	2018	2017	2018	2017	2018
Plot Name: EK17WIL1						
Location: upslope	87% (13/15)	87% (13/15)	93% (14/15)	90% (13/15)	90% (18/20)	90% (18/20)
Plot Name: EK17WIL2						
Location: downslope	47% (7/15)	-	67% (10/15)	-	60% (9/15)	-
Plot Name: EK17WIL3 south						
Location: downslope	70% (21/30)	7% (2/30)	67% (20/30)	-	40% (12/30)	-
Plot Name: EK17WIL3 north						
Location: downslope	40% (12/30)	-	13% (20/30)	3% (1/30)	47% (16/34)	-
Plot Name: EK17WIL4						
Location: upslope	80% (24/30)	67% (20/30)	77% (23/30)	60% (18/30)	70% (21/30)	37% (11/30)
Treatment Mean	64% (77/120)	29% (35/120)	59% (71/120)	27% (32/120)	59% (76/129)	22 %(29/129)

All Plots and All Treatments		
Location Mean	2017	2018
Upslope	81% (113/140)	66% (93/140)
Downslope	48% (111/229)	1 %(3/229)

Dashes indicate no species observed.

Table 4.3-2: Willow with Mycorrhizae Trial Mean Plant Height, 2017 and 2018

	Mycorrhizae Treatment					
	High pH		Neutral pH		Uninoculated	
	2017	2018	2017	2018	2017	2018
Plot Name: EK17WIL1						
Location: Upslope	29.1	22.5	25.5	26.5	20.7	22.2
Plot Name: EK17WIL2						
Location: Downslope	17.7	-	12.0	-	15.8	-
Plot Name: EK17WIL3 south						
Location: Downslope	19.7	-	22.8	24.0	22.3	-
Plot Name: EK17WIL3 north						
Location: Downslope	14.8	16.0	19.8	-	17.4	-
Plot Name: EK17WIL4						
Location: Upslope	20.6	19.9	26.0	27.1	18.2	17.5
Treatment Mean	20.6	20.6	22.6	26.8	19.0	20.4

All units are cm.
Dashes indicate no species observed.

Table 4.3-3: Willow with Mycorrhizae Trial Mean Plant Size, August 2018

	Mycorrhizae Treatment		
	High pH	Neutral pH	Uninoculated
Plot Name: EK17WIL1			
Location: Upslope	23.1	26.4	22.0
Plot Name: EK17WIL3 south			
Location: Downslope	-	23.3	-
Plot Name: EK17WIL3 north			
Location: Downslope	15.8	-	-
Plot Name: EK17WIL4			
Location: Upslope	19.6	22.0	14.2
Treatment Mean	20.7	23.8	19.1

All units are cm.
Dashes indicate no species observed.

Only three of the 229 willows originally planted in the downslope plots survived two growing seasons (Table 4.3-1). Those that did survive were treated with mycorrhizae. The 2-year survival was greater in the upslope plants with 93 of 140 (66%) planted judged alive (Photo 4.3-1). The overall survival rate for plants treated with high pH mycorrhizae was slightly better than those treated with low pH inoculum (29% versus 27%) and survival in both groups surpassed that of uninoculated plants (22%). Inoculated plants were also taller and larger on average than those not treated (Tables 4.3-2 and 4.3-3). The biggest plants were those in the group that received low pH inoculum.

Upslope trial plot in June, 2017

View of the same plot in August, 2018

Photo 4.3-1: Upslope willow with mycorrhizae trial plot.

Monitoring results from the bluejoint reed grass with mycorrhizae trial are comparable to those from the willow trial. Survival rates were highest in upslope plots and among plants growing with mycorrhizae (Table 4.3-4).

Table 4.3-4: Bluejoint Reed Grass with Mycorrhizae Trial First Year Percent Survival Rates, August 2018

	Mycorrhizae Treatment		
	High pH	Neutral pH	Uninoculated
Plot Name: EKBJMYC1			
Location: Upslope	88% (14/16)	100% (16/16)	94% (15/16)
Plot Name: EKBJMYC2			
Location: Upslope	6% (1/16)	25% (4/16)	6% (1/16)
Plot Name: EK1BJMYC3			
Location: Downslope	81% (13/16)	25% (4/16)	25% (4/16)
Plot Name: EKBJMYC4			
Location: Downslope	-	-	-
Treatment mean	44% (28/64)	38% (24/64)	31% (20/64)

	Mycorrhizae Treatment		
	High pH	Neutral pH	Uninoculated
Location Mean			
Upslope	53% (51/96)		
Downslope	22% (21/96)		

On average bluejoint plants treated with neutral pH inoculum were tallest followed by those with the high pH inoculum and the uninoculated control plants (Table 4.3-5). The data suggests mycorrhizae also enhanced the numbers of plants that produced flowers (Table 4.3-6).

Table 4.3-5: Bluejoint Reed Grass with Mycorrhizae Trial Mean Plant Height, August 2018

	Mycorrhizae Treatment		
	High pH	Neutral pH	Uninoculated
Plot Name: EKBJMYC1			
Location: Upslope	21.1	21.9	17.7
Plot Name: EKBJMYC2			
Location: Upslope	9	11.3	3
Plot Name: EK1BJMYC3			
Location: Downslope	14.0	14.0	11.0
Plot Name: EKBJMYC4			
Location: Downslope	-	-	-
Treatment Mean	14.7	15.7	10.6

All units are cm.
Dashes indicate no species observed.

Table 4.3-6: Bluejoint Reed Grass with Mycorrhizae Trial Percent Flowering, August 2018

	Mycorrhizae Treatment		
	High pH	Neutral pH	Uninoculated
Plot Name: EKBJMYC1			
Location: Upslope	36% (5/14)	38% (6/16)	27% (4/15)
Plot Name: EKBJMYC2			
Location: Upslope	-	50% (2/4)	-
Plot Name: EK1BJMYC3			
Location: Downslope	15% (2/13)	50% (2/4)	-
Plot Name: EKBJMYC4			
Location: Downslope	-	-	-
Treatment Mean	25% (7/28)	42% (10/24)	20% (4/20)

Dashes indicate no species observed.

First season percent survival of fireweed was good, averaging 70% across all treatments and slope positions. Unlike the willow and reed grass however, percent survival was better in the downslope plot. Similar to the other species more inoculated than uninoculated plants survived their first growing season and treated plants were, on average, slightly taller (Tables 4.3-7 and 4.3-8). And, once again, plants growing with neutral pH inoculum were tallest.

Table 4.3-7: Fireweed with Mycorrhizae Trial First Year Percent Survival, August 2018

	Mycorrhizae Treatment		
	High pH	Neutral pH	Uninoculated
Plot Name: EKFWMYC1			
Location: Downslope	94% (15/16)	88% (14/16)	75% (12/16)
Plot Name: EKFWMYC2			
Location: Upslope	69% (11/16)	63% (10/16)	63% (10/16)
Plot Name: EK1FWMYC3			
Location: Upslope	69% (11/16)	75% (12/16)	38% (6/16)
Treatment Mean	77% (37/48)	75% (36/48)	58% (28/48)
Location Mean			
Upslope	66% (63/96)		
Downslope	85% (41/48)		

Table 4.3-8: Fireweed with Mycorrhizae Trial: Mean Plant Height, August 2018

	Mean Plant Height		
	Mycorrhizae Treatment		
	High pH	Neutral pH	Uninoculated
Plot Name: EKFWMYC1			
Location: Downslope	6.9	6.2	5.4
Plot Name: EKBJMYC2			
Location: Upslope	7.6	10.1	7.5
Plot Name: EK1BJMYC3			
Location: Upslope	9.5	8.8	8.0
Treatment mean	8.0	8.4	7.0

All units are cm.

After one growing season, any effect due to mycorrhizae was not measured among birch seedlings planted at Old Camp. All of the plants survived and mean plant height and size were virtually identical in both inoculated and control plant groups (Table 4.3-9; Photo 4.3-2).

Table 4.3-9: Birch with Mycorrhizae Trial: First Year Plant Survival, Height and Size, August 2018

Mycorrhizae Treatment					
Neutral pH			Uninoculated		
Percent Survival	Plant Height (cm)	Plant Size (cm)	Percent Survival	Plant Height (cm)	Plant Size (cm)
100% (32/32)	4.3	3.6	100% (32/32)	4.5	3.6

Fireweed seedling

Birch seedling

Photo 4-3-2: Healthy seedlings growing with mycorrhizae. August, 2018.

4.4 Conclusion and Recommendations

A trial intended to provide insight into the potential for beneficial soil fungi (mycorrhizae) to enhance plant growth on reclamation sites at the Ekati mine site was started in June 2017. To date, four plant species are included in the trial with plots in processed kimberlite in Cell B of the LLCF and in a reclaimed area at Old Camp. Monitoring results in 2018 suggest mycorrhizae enhance both survival and growth of plants in processed kimberlite tailings but after only one growing season no differences were measured among treated and untreated plants at Old Camp.

Annual monitoring should continue and, if possible, the trial should be expanded to include additional plant species.

5. MINE-GENERATED ORGANIC MATTER

5.1 Introduction

Successful long-term reclamation of the PK tailings at the Ekati mine is dependent upon the development of a healthy soil ecosystem of which organic matter is a critical component. Organic matter provides a slow release source of plant nutrients, especially nitrogen, it aids in the development of soil aggregates and structure, provides much of the cation exchange and moisture retention capacity of the surface layers and it's the substrate upon which most soil microorganisms depend for energy and body building material. Soil organic matter acts as a storehouse for carbon, the element upon which all life depends.
Those properties and the biota they support are critical to promote and sustain the growth of plants. Without organic matter and the microbiology it supports a substrate really ought not be considered soil.

Levels of organic carbon in the PK in Cell B are undetectable within the completed laboratory analysis (Tables 5.1-1, 5.1-2, and 5.1-3.). The below detection limit values suggest there is little (total organic carbon lowest detection limit = 0.15%) to no organic matter and amending the PK with additions of imported organic matter has been shown to enhance plant growth on it. However, importing the large volumes of commercially available organic amendments required for an area the size of Cell B (or potentially the entire LLCF) is cost prohibitive so the use of organic matter generated on site could provide an attractive alternative.

Table 5.1-1: Analytical Results of Ekati MGOM Compared to CCME Category A Compost Guidelines

Trace Elements (mg/kg)	Ekati	CCME	
	MGOM (mg/kg)	Category A (mg/kg)	Maximum Cumulative Additions to Soil (kg/ha)
Arsenic	0.18	13	15
Cadmium	0.74	3	4
Chromium	2.59	210	NA
Cobalt	0.36	34	30
Copper	11.5	400	NA
Lead	1.52	150	100
Mercury	NA	0.8	1
Molybdenum	1.64	5	4
Nickel	3.21	62	36
Selenium	< 0.20	2	2.8
Zinc	33.1	700	370
Saturated Paste Extracts			
pH	6.9	-	-
EC (dS/m)	4.68	-	-
SAR	6.43	-	-
Percent saturation	478	-	-
Physical Tests			
Moisture percent	14.4	-	-

Category A compost shall not contain any sharp foreign matter of dimension greater than 3 mm per 500 ml.

Category A compost shall contain no more than one (1) piece of foreign matter greater than 25 mm in any dimension per 500 ml (CCME 2005).

Table 5.1-2: Mean (n=3) Baseline Soil Characteristics in the 2016 MGOM Trial Area, June 2016

Parameter	Rate of MGOM Application (tonnes/ha)				Tundra Topsoil
	0	2	5	10	
pH	8.6	8.8	8.6	8.7	5.4
EC (dS/m)	6.2	3.3	5.3	5.6	0.4
SAR	40.4	39.0	39.8	49.9	3.0
Total Organic Carbon (%)	BDL	BDL	BDL	BDL	3.0
Plant Available Nutrients (mg/kg)					
N	21.0	5.6	19.6	18.4	1.2
P	2.8	2.5	2.4	2.6	8.6
K	1613.3	1586.7	1656.7	1643.3	134.5
Soil texture	SL - LS	LS - SL	SL	SL	SL

BDL = below laboratory detection limit; SL = Sandy Loam; LS = Loamy Sand; N = nitrate nitrogen; P = phosphate phosphorus; K = Potassium

Table 5.1-3: Mean (n=4) Baseline Soil Characteristics in the 2017 Upper Slope MGOM/ Compost Trial Plots, July 2017

Parameter	Ekati MGOM				Edmonton Compost			
	Rate of MGOM Application (t/ha)				Rate of Compost Application (t/ha)			
	0	2.5	5	10	0	2.5	5	10
pH	8.6	8.7	8.5	8.7	8.6	8.5	8.6	8.6
EC (dS/m)	2.5	1.9	3.5	2.4	2.4	2.5	2.4	2.8
SAR	33.5	29.6	35.8	31.3	31.8	33.8	33.2	34.6
Total Organic Carbon (%)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
% Saturation	37.8	36.5	37.3	36.8	38.0	37.5	38.5	39.3
Plant Available Nutrients (mg/kg)								
N	3.5	2.2	6.8	2.7	3.4	3.6	5.5	4.7
P	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
K	1,110.0	1,062.5	1,370.0	1,052.5	1,050.0	1,050.0	1,065.0	1,090.0
Heterotrophic Plate Count (Bacteria)								
CFU/g	99,025	51,425	338,875	214,125	55,000	16,750	66,500	34,500

BDL = below laboratory detection limit; N = nitrate nitrogen; P = phosphate phosphorus; K = potassium; CFU = colony forming unit.

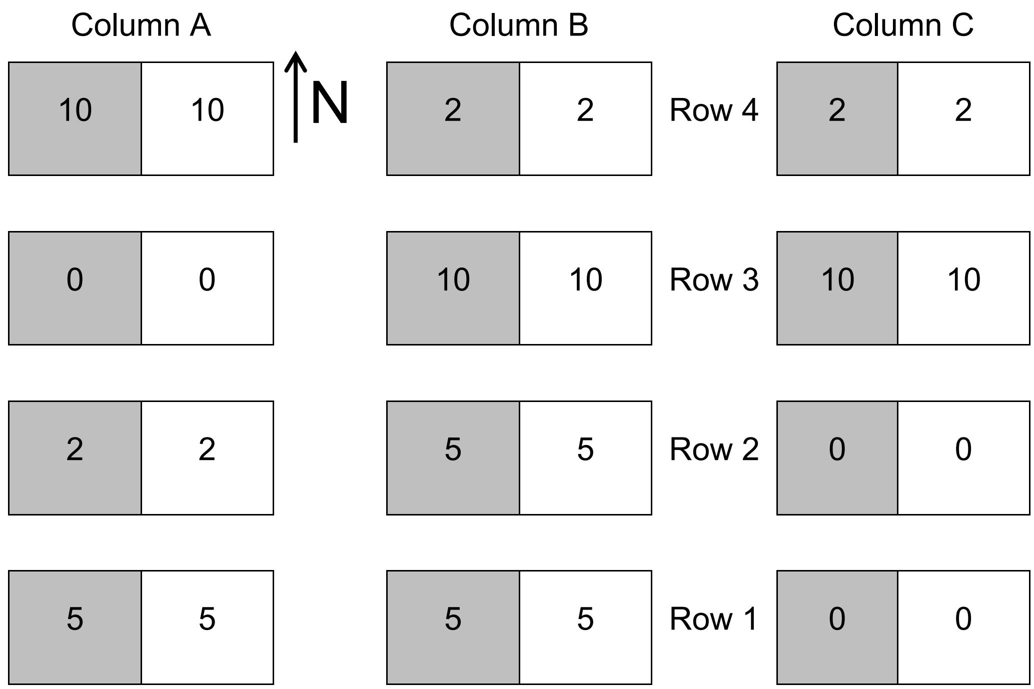
To improve the efficiency of waste disposal at the Ekati mine site a commercial composting system was acquired in 2015 and currently about 450 kg per day of organic waste is being processed thereby diverting approximately half of the waste stream otherwise destined for the incinerator. Organic material, including cardboard, paper and kitchen waste is collected in separate bins throughout the mine site and then transported to the waste management facility where employees remove large pieces of plastic and other nonorganic constituents. The material is then shredded and conveyed into the composter where biological decomposition begins. The system began operation in October 2015 and until the end of 2016 approximately 68,000 kg of organic material had passed through it.

To date most of the processed waste has been landfilled but a potentially beneficial alternative is its use in reclamation. In summer 2016, a trial was set up in a mid to upper slope position on the PK in Cell B to test various rates of mine-generated organic matter (MGOM) application and to assess the value of tilling the material into the PK versus simply spreading it across the surface. The latter question arises due to difficulty accessing unfrozen PK with equipment large enough to deal with significant volumes of material. The trial was set up as three replicates of four application rates (0, 2, 5, and 10 tonnes/ha) with and without tillage after material application. Individual plots are 3 m x 3 m and all plots were roto-tilled prior to applying the organic material. After application and final tillage Boreal creeping red fescue (*Festuca rubra*) was broadcast seeded on all the plots at 15 kg/ha (1878 pure live seeds/m^2) followed by light raking to incorporate the seed (Photo 5.1-1). The trial plot layout is depicted below in Figure 5.1-1.

Photo 5.1-1: 2017 MGOM / compost trial plots being prepared, June 2017.

To establish baseline soil physical and chemical conditions one sample was collected from 0 cm to 20 cm at the centre of each of the two-plot blocks shown above (i.e., 12 samples were collected) before applying MGOM and two control samples were obtained from the nearby tundra. Analytical data from one sample of MGOM, collected in May, 2016, was provided by waste management personnel. Pertinent data from both sources are presented in Tables 5.1-1 and 5.1-2.

To ensure the use of MGOM in Cell B would cause no adverse environmental effects the analytical results from the sample were compared to data presented in 'Guidelines for Compost Quality' created by the Canadian Council of Ministers of the Environment (CCME) in 1996 and updated in 2005 (CCME 2005). The 'Guidelines' provide criteria for unrestricted use compost (Category A) intended for farm land, residential gardens etc. and Category B compost the use of which may be restricted due to the presence of sharp foreign objects or elevated trace element content. Table 5.1-1 provides a comparison of trace element content of the MGOM and CCME Category A compost guidelines. CCME (2005) also presents guidelines regarding cumulative trace element additions which may occur with repeated applications. Although their need is not anticipated at the Ekati mine those guidelines are included in Table 5.1-1 for reference. Saturated paste extracts and moisture content were also analysed in the MGOM sample.



Notes: Sub-plots are 3 m X 3 m. Rows and columns are separated by 0.5 m walkways. Numbers within plots indicate rate of organic matter application in tonnes/ha Shaded plots were roto-tilled following application of organic matter.

Figure 5.1-1: 2016 Mine-generated Organic Matter Trial Plot Layout

Concentrations of all of the trace elements analysed in the MGOM sample are well below CCME guidelines for Category A compost and at the highest rate of application (10 t/ha) additions are much lower than the guidelines for cumulative additions.

Concentrations of saturated paste extracts in the MGOM are more favorable for plant growth than are those in the receiving PK (Table 5.1-2). Sodium adsorption ratio is well within the acceptable range (< 12), pH is near neutral and while slightly elevated EC is comparable to that in the receiving PK. Given its high percent saturation addition of the MGOM is likely to enhance the moisture holding capacity of the coarse textured PK.

The PK in the MGOM trial area is similar to that found in upslope positions elsewhere in Cell B: It’s coarse textured, has high pH, elevated EC and very high SAR. Organic carbon content is below laboratory detection levels and while nitrate and potassium are in relatively good supply compared to the tundra soil phosphate is lacking. Calcium and magnesium concentrations, both of which are essential plant nutrients, are very low (data not shown).

In 2017, an additional trial was established that includes compost obtained from the Edmonton, Alberta landfill. The 2017 trial was set up to test variable rates (0, 2.5, 5, and 10 tonnes/ha) of MGOM against the same rates of imported compost at two different landscape positions (mid to upper slope and lower slope) within Cell B. At each landscape position two trial plots containing 16 sub-plots (four replicates of four application rates) were constructed. Sub-plots are 3 m X 3 m. To facilitate decomposition of the MGOM locally sourced topsoil (as inoculum) and nitrogen fertiliser were added to the MGOM plots, including the control (0 tonnes/ha) sub-plots. The equivalent of 5 tonnes/ha topsoil and 50 kg/ha 46-0-0 fertiliser were incorporated with the MGOM. Plots were roto-tilled to a depth of 20 cm following material application. Fertiliser was re-applied once during mid-summer and again in mid-September. The plots were seeded with Boreal creeping red fescue at 15 kg/ha in mid-September. Figures 5.1-2 and 5.1-3 show the plot layouts and an aerial view of the trial plots is provided in Photo 5.1-2.

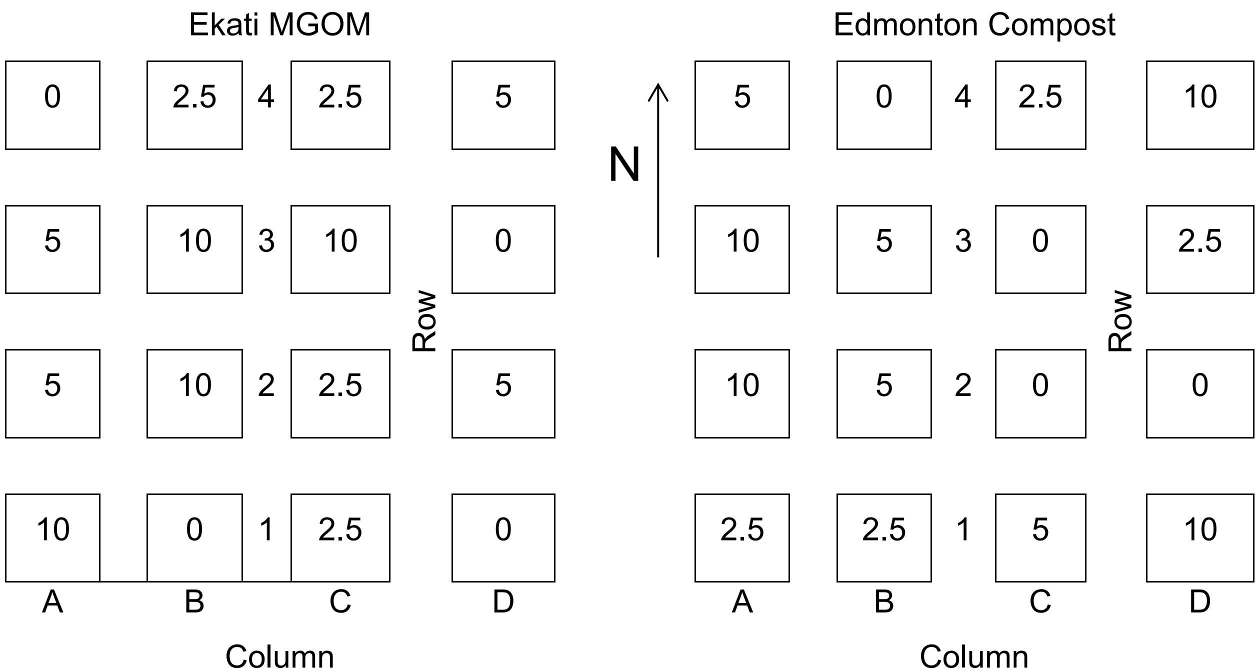
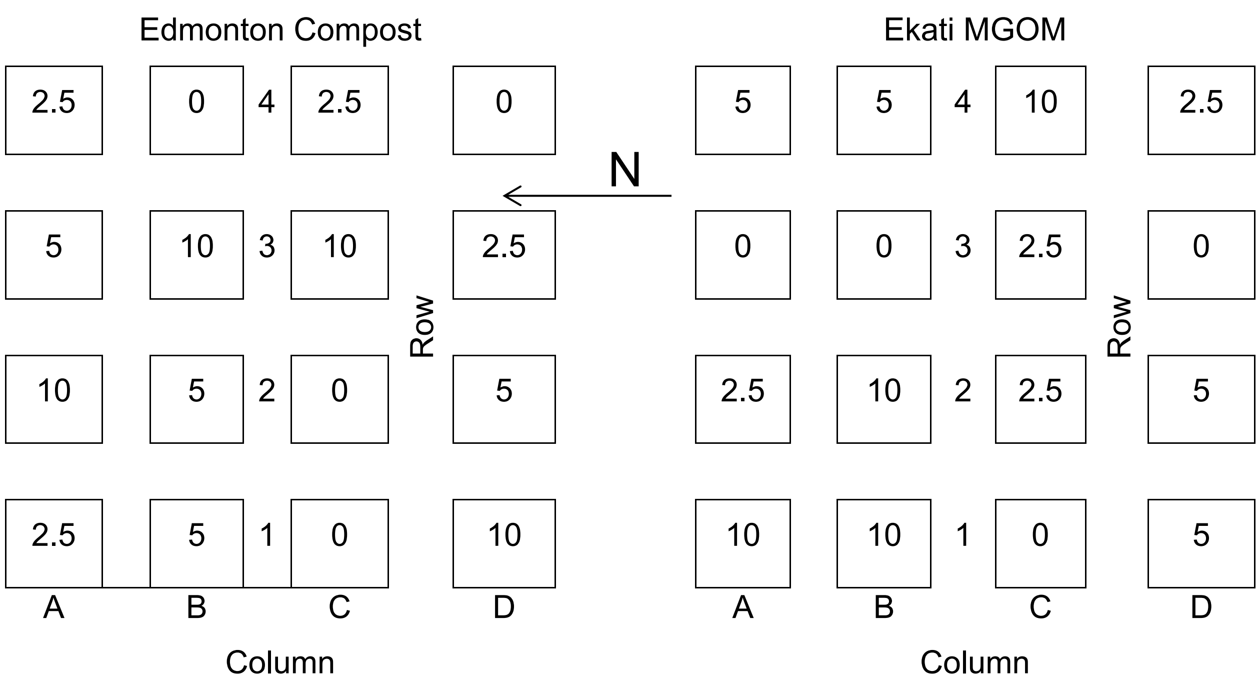


Figure 5.1-2: Upper Slope Compost / Mine-generated Organic Matter Trial Layout



Notes: Blocks are 5 m apart. Plots are 3 m X 3 m. Rows and columns are separated by 0.5 m walkways. Numbers within plots indicate rate of material application (tonnes/ha)

Figure 5.1-3: Lower Slope Compost / Mine-generated Organic Matter Trial Layout

2016 MGOM trial plots.

Upper slope 2017 MGOM/compost trial plots.

Photo 5.1-2: Aerial views of 2016 MGOM and 2017 Compost / MGOM trial plots, June 2017.

Composite soil samples consisting of three sub-samples were collected from 0 - 20 cm in each of the sub-pots prior to any material application. This baseline soil chemical and biological information is presented in Tables 5.1-3 and 5.1-4.

Table 5.1-4: Mean (n=4) Baseline Soil Characteristics in the 2017 Lower Slope MGOM/ Compost Trial Plots, July 2017

Parameter	Ekati MGOM				Edmonton Compost			
	Rate of MGOM Application (t/ha)				Rate of Compost Application (t/ha)			
	0	2.5	5	10	0	2.5	5	10
pH	8.4	8.3	8.3	8.4	8.3	8.2	8.2	8.2
EC (dS/m)	6.4	7.5	6.8	7.0	7.5	7.6	8.4	8.5
SAR	36.1	33.8	33.6	36.6	36.8	33.1	33.6	33.6
Total Organic Carbon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
% Saturation	87.5	88.5	97.0	83.8	94.5	86.8	93.3	92.5
Plant Available Nutrients (mg/kg)								
N	22.4	21.9	18.9	26.8	35.6	28.3	36.2	37.9
P	3.7	3.8	3.9	3.6	4.6	4.2	3.8	4.1
K	1477.5	1487.5	1427.5	1515.0	1662.5	1527.5	1570.0	1605.0
Heterotrophic Plate Count (Bacteria)								
CFU/g	2942.5	4081.3	14188	4846.3	3107.5	4312.5	5750.0	2475.0

Notes: BDL – below laboratory detection limit; N – nitrate nitrogen; P – phosphate phosphorus; K – potassium; CFU – colony forming unit.

While comparable in some ways there are also some notable differences in baseline soil characteristics between the upper and lower slope trial plots. Soil pH and SAR are high in both locations and in both locations soil organic carbon content is undetectable. Soil salts content is considerably greater in the lower slope location as indicated by higher EC values there. Those higher ECs are reflected in greater plant nutrient (which are themselves ions of salts) availability. The higher percent saturation of the lower slope samples is indicative of a fine textured substrate, containing more silt and clay-sized particles than at the upland location. Higher levels of biological activity were measured in the upper slope samples.

5.2 Monitoring Activities

Vegetation response was assessed by counting all grass seedlings and, whenever possible, measuring the height of three seedlings in three randomly placed Daubenmire frames (0.1 m^2) in each of the trial sub-plots. In instances where fewer than three seedlings were present in the frame the height of all the seedlings was measured.

The 2016 MGOM trial was monitored in July, 2017 and again in August, 2018. The 2017 Compost/MGOM trial was monitored in August, 2018.

5.3 Results and Discussion

5.3.1 2016 MGOM Trial

While somewhat inconsistent, grass establishment was generally good with well over 100 seedlings/m^2 being counted in 2017 (Table 5.3-1). However, likely due to winter kill, seedling density was much lower in 2018 and it remains inconsistent across treatments. The data does show that after two full growing seasons in both tilled and not-tilled plots the most seedlings were counted in those treated with 10 tonnes/ha of MGOM. Overall, in 2018, seedling density was greatest in untilled plots treated with 10 tonnes/ha of MGOM.

Table 5.3-1: Mean (n = 3) Plant Response to MGOM Applications and Surface Treatments, 2017 and 2018

Application Rate (t/ha)	Not Tilled				Tilled			
	Mean Seedlings (Number/m^2)		Mean Height (mm)		Mean Seedlings (Number/m^2)		Mean Height (mm)	
	2017	2018	2017	2018	2017	2018	2017	2018
0	208	39	25.1	33.5	120	57	23.3	22.4
2	284	32	24.5	33.9	253	52	23.4	31.1
5	133	24	26.1	38.8	216	20	24.8	33.3
10	186	112	22.7	44.8	261	58	25.9	38.2

Mean plant height varied little across the trial in 2017 with the greatest difference between any of the plots being only 3.4 mm. In 2018, the plants were still small (averaging 34.5 mm across the entire trial) but differences between treatments were observed. In both not-tilled and tilled areas plant height increased progressively with additional amounts of MGOM. At the same MGOM application rates seedlings were taller in the not-tilled plots. Overall, the tallest seedlings were in the untilled plots that received 10 tonnes/ha of MGOM.

5.3.2 2017 Compost / MGOM trial

After only one growing season it is impossible to make meaningful, detailed comparisons among treatments; the 2018 data (Table 5.3-2) provides a benchmark for comparison with future monitoring results. However, judging from the fact that consistently more and taller seedlings were measured in the upper slope trial plots the 2018 data indicate growing conditions are generally better there than in the lower slope landscape position.

Table 5.3-2: Mean (n = 4) Plant Response to Compost and MGOM Applications in 2018

Application	Mean Grass Seedlings (number/m^2)		Mean Height (mm)	
Rate (t/ha)	MGOM	Compost	MGOM	Compost
Mid Slope Position				
0	133	114	30.1	30.2
2.5	124	143	31.2	30.8
5	114	114	29.2	33.6
10	92	219	28.5	38.9
Lower Slope Position				
0	74	53	15.9	22.5
2.5	46	33	19.6	28.4
5	49	48	31.2	26.6
10	49	63	24.0	28.8

5.4 Conclusion and Recommendations

In 2015 a commercial composting system was acquired to improve waste processing efficiency at the Ekati mine by diverting the organic component of the waste stream from the incinerator to the landfill. An alternative, potentially beneficial, use of MGOM is as a soil amendment in the PK tailings which, in their unamended state, contain very little organic matter. In June, 2016 a trial was established to test various application rates of mine-generated organic matter and to assess the value of incorporating the material by tillage. After two full growing seasons monitoring data suggest that, at least at the higher application rates, MGOM has a positive effect on plant growth in both tilled and not-tiled plots. Grass seedling density and height were greatest in the not-tilled plots in 2018.

In 2017 an additional trial intended to compare various application rates of MGOM and commercially available compost at different landscape locations was established. The 2018 monitoring results indicate growing conditions are better in the upper vs. lower landscape position. More time is needed before more detailed insights can be gained from this trial.

Annual monitoring of both trials should proceed as planned and soil sampling should be conducted in 2019.

6. SEED COLLECTION

To the extent practicable Dominion Diamond Mines ULC (Dominion) is committed to using native plants in revegetation projects at Ekati mine and much of the revegetation research being conducted at the mine site is focused on their use. Tailings generated by processing kimberlite are a new and challenging medium for plant establishment. The sodic and somewhat saline substrates in Cell B of the LLCF are essentially devoid of organic matter and range from sand to clay particle sizes. Their delivery into the LLCF in a watery slurry results in a deposit which is coarse textured and dry near the upper edges, grading to wet, fine textured material in the interior of the basin.

The cold climate, short growing season and extreme photo-period fluctuations of the southern Arctic present additional constraints for plant growth on the tailings. Native northern plant species have the advantage that they are adapted to these constraints.

The shores of the Arctic Ocean provide comparable substrates and challenges for colonization of plants, including bare saline substrates, coarse materials on beaches, and exposed finer substrates on the muddy backwater sediments. The reclamation research team from Dominion travelled to the coastal community of Kugluktuk, Nunavut in late August 2018 to collect salt tolerant plant materials from these environments to use in revegetation trials on the tailings in the LLCF at the Ekati mine (Photo 6-1).

Harvesting seed bearing stems of sea lyme grass

Collecting creeping alkali grass

Photo 6-1: Harvesting native plant material along the arctic coast, August 2019.

Plant material was collected from five sites accessed by boat along the coast near Kugluktuk and one location within the hamlet itself. The collections included seed, rhizomes, and whole plants. A list a plant species and material collected is presented in Table 6-1 below. The Ekati team gratefully acknowledges the assistance of local guides Jonathon Niptanatiak and Richard Akana in safely accessing the sites and their help harvesting.

Live plants and rhizomes were planted in Cell B of the LLCF immediately upon returning to the Ekati mine and seed from several species was shipped to a greenhouse for out-growing. When ready for planting those seedlings will be incorporated into on-going species trials in Cell B. The balance of the seed is in storage for future use.

For a detailed description of the expedition to Kugluktuk please see EcoSense, 2018.

Table 6-1: Arctic Seacoast Plant Materials Collections, August 2019

Plant Type	Scientific Name	Common Name	Material Collected
Grasses	*Alopecurus magellanicus*	Alpine foxtail	seed
	Bromus pumpellianus	Pumpelly Brome	plants
	Dupontia fisheri	Fisher's tundragrass	seed
	Elymus violaceus	Violet Wild Rye	seed
	Festuca rubra ssp. arctica	Richardson's Red Fescue	seed, plants
	Leymus mollis	sea lyme grass	seed, rhizomes
	Puccinellia arctica	Arctic alkali grass	seed
	Puccinellia phryganodes	creeping alkali grass	plants
Sedges and Rushes	*Carex glareosa var. amphigena*	gravel sedge	seed, plants
	Carex maritima	seaside sedge	seed
	Carex rariflora	loose-flowered Sedge	seed
	Juncus arcticus	Arctic rush	seed
Herbs	*Artemisia tilesii*	Tilesius sagebrush	plants
	Cochlearia officinalis	scurvy-grass	seed
	Honkenya peploides	seabeach-sandwort	seed
	Lupinus arcticus	Arctic lupine	seed
	Rumex arcticus	Arctic dock	seed
	Salix arctica	Arctic willow	seed
	Suaeda calceoliformis	western sea-blite	seed

7. NATURAL COLONIZATION

Over the long-term a key measure of revegetation success at the Ekati Mine will be the proportion of groundcover comprising indigenous native plant species. Therefore, creating conditions that encourage colonization of disturbed areas by local native plants is an important objective. Around 2004, a native northern alkali grass (*Puccinellia borealis*; also known as "goose grass") from the surrounding tundra began colonizing the west side of the Cell B beaches. Field observations indicated that natural colonization of goose grass continued to spread in the beltline crossing the center of Cell B.

Evaluation of the Cell B vegetation growth and rates of colonization was completed annually from 2014 to 2018 using satellite imagery and the Normalized Difference Vegetation Index (NDVI). Figure 7.2-1 provides a comparison of the 2015 to 2018 NDVI analysis. An overall 2.2% decrease in bare processed kimberlite has been observed between 2017 and 2018. An overall increase in the rate of natural colonization from goose grass was observed along the southern portion of Cell B below the beltline along the western border. Lower biomass growth has increased by 24.7% when comparing NDVI data from 2017 to satellite imagery data from 2018. The natural colonization values between 2014 and 2018 can be viewed below in Table 7.2-1. Overall, higher biomass was decreased by 22% from 2017 to 2018 with the largest reductions observed in the rock rows and grid patterns. Field observations correlate well with the 2018 satellite imagery analysis. The north-eastern corner of Cell B is also filling in with low biomass is confirmed by both field observations and NDVI results (Figure 7.2-1). There is also a visible increase of lower biomass in a strip just east of the grid patterns and boulder field (Figure 7.2-1).

Table 7.2-1: NDVI Satellite Imagery Results from 2014 to 2018 in Cell B of the LLCF

	2014	2015	2016	2017	2018	Percent Change (2017-2018)
Lower Biomass	5.7%	6.4%	9.9%	11.7%	14.6%	24.7%
Higher Biomass	5.7%	5.5%	6.0%	6.1%	5.0%	-22%
Processed Kimberlite	88.6%	88.1%	84.1%	82.2%	80.4%	-2.2%

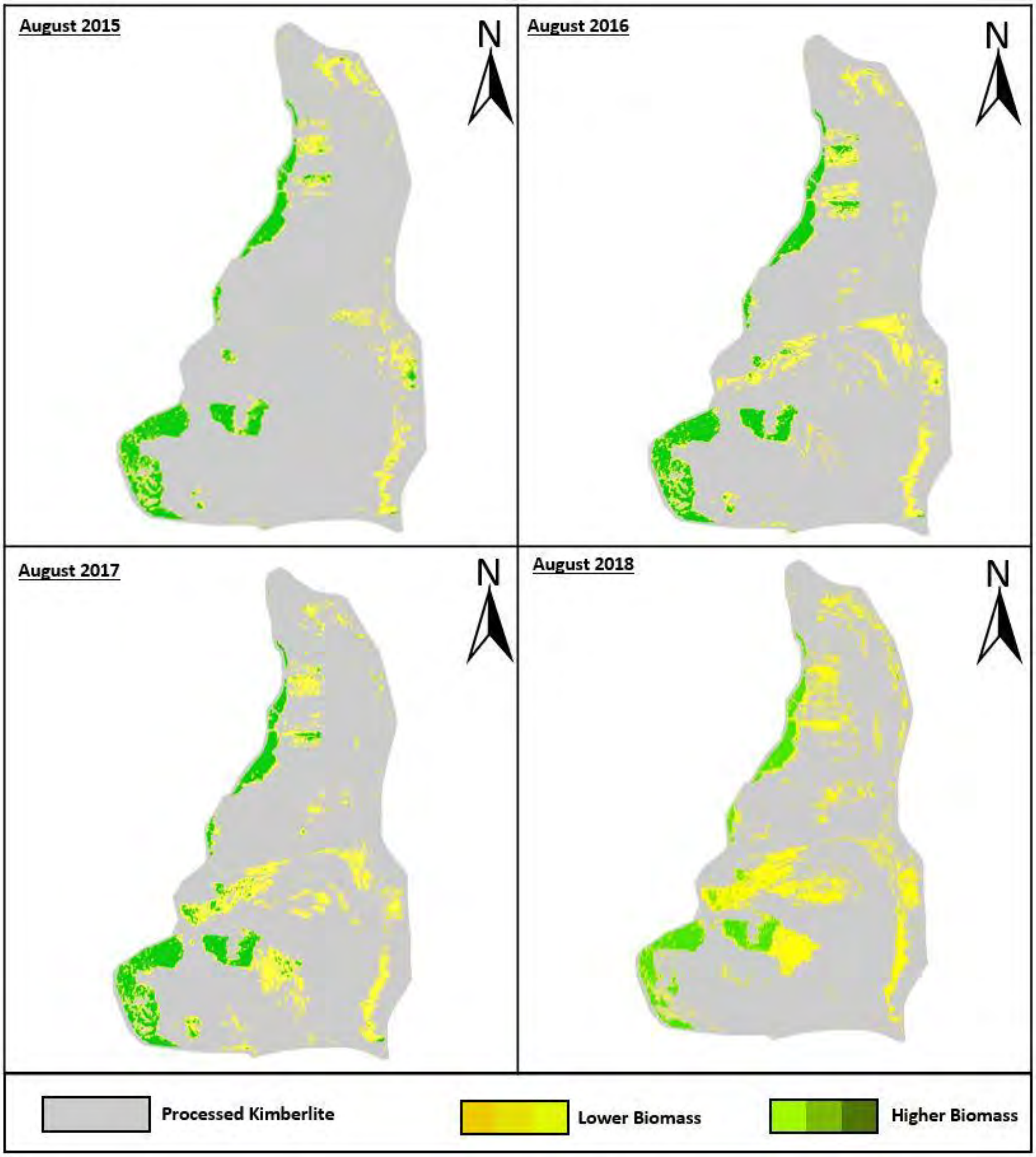


Figure 7.2–1: NDVI Satellite Imagery Maps from 2015 to 2018 in Cell B of the LLCF

8. CONCLUSIONS

Annual Crop Trials

- In summer, 2018 cover crop trials involving four common agricultural cereal crops and two pre-seeding cultivation techniques were conducted.
- The results indicate roto-tilling prepares a more favorable seed bed than harrowing and, as a result, crop growth in roto-tilled areas was enhanced.
- Spring triticale out performed barley marginally but both crops are reasonably well adapted to growing conditions in Cell B.
- Two of the crops are biennial and therefore their performance will be assessed after the 2019 growing season.

Rock and Vegetation Trials

- There appears to be no appreciable difference in vegetation and litter cover build up between the different rock configurations seeded with Fult's Alkali grass.
- Litter cover is building, and exposure of bare ground is decreasing significantly for all trial sites.
- Perhaps aided by the accumulated litter (which tends to keep the soil surface cool and moist) trace amounts of moss was observed in all the treatment areas in 2018.
- Unseeded areas in the Rock Rows and Rock Grids are being colonized naturally by alkali grasses (a mixture of the native goose grass and introduced Fult's), whose fine seed is easily disbursed by wind. Rates of living vegetation and litter build up are progressing at very similar rates in both treatments and total ground cover is now about half that of the seeded areas.
- In 2018 organic carbon was detected in 0 to 15 cm samples from both alfalfa-treated strips and both of their associated controls as well as in the 15 to 30 cm interval in treated and untreated areas in the Rock Rows.
- The addition of mosses to the plant community and the slow accumulation of soil organic carbon indicate that site conditions are not static, that natural processes are at work.
- Monitoring should be repeated after two more growing seasons.

Mycorrhizae Trials

- Monitoring results in 2018 suggest mycorrhizae enhance both survival and growth of plants in PK tailings but after only one growing season no differences were measured among treated and untreated plants at Old Camp.
- Annual monitoring should continue and, if possible, the trial should be expanded to include additional plant species.

Mine-Generated Organic Matter

- The 2018 monitoring results indicate growing conditions are better in the upper versus lower landscape position.
- More time is needed before more detailed insights can be gained from this trial.
- Annual monitoring of both trials should proceed as planned and soil sampling should be conducted in 2019.

Seed Collection

- The cold climate, short growing season and extreme photo-period fluctuations of the southern Arctic present additional constraints for plant growth on the tailings.
- The shores of the Arctic Ocean provide comparable substrates and challenges for colonization of plants, including bare saline substrates, coarse materials on beaches and exposed finer substrates on the muddy backwater sediments.
- The Dominion reclamation research team travelled to the coastal community of Kugluktuk, Nunavut in late August of 2018 to collect salt tolerant plant materials from these environments to use in revegetation trials on the tailings in the LLCF at the Ekati mine.
- Live plants and rhizomes were planted in Cell B of the LLCF immediately upon returning to the Ekati mine site and seed from several species was shipped to a greenhouse for out-growing.

Natural Colonization

- Field observations indicated that natural colonization of goose grass along the northeast corner of Cell B and less new growth within the rock rows and grid pattern trials.
- Satellite imagery analysis indicated an overall increase of lower biomass by 24.7% while higher biomass has decreased by 22% between 2017 and 2018.

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Appendix D

2019 Annual Vegetation Report

Ekati Diamond Mine

2019 Vegetation Annual Report

Dominion
Diamond Mines

Dominion Diamond Mines ULC

Ekati Diamond Mine

2019 Vegetation Annual Report

December 2019

Version B.1

Citation:

EcoSense. 2019. *Ekati Diamond Mine: 2019 Vegetation Annual Report*. Prepared for Dominion Diamond Mines ULC by EcoSense Environmental Inc.: Lethbridge, Alberta.

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1. INTRODUCTION

1.1 Background

Dominion Diamond Mines ULC (Dominion) has been conducting progressive reclamation at areas no longer part of active operations at the Ekati Diamond Mine (the Ekati mine) since the start-up of mining in 1995 in support of the reclamation goals outlined in the Interim Closure and Reclamation Plan (ICRP) version 3.0 (submitted to the Wek’èezhìi Land and Water Board, August 2018; Dominion 2018). .

The long-term goal of reclamation/revegetation work at the mine is to leave disturbed areas in a stable condition capable of supporting sustainable native plant communities. A number of surface treatments and plant species combinations have been tried at various locations across the mine site and the results documented through scheduled monitoring. This report summarizes reclamation monitoring activities conducted in 2019.

In 2019, vegetation monitoring was conducted at Fay Bay, Paul Lake Laydown, Old Camp and Old Camp Road and on the Misery topsoil storage stockpile. (Figure 1-1).

1.2 Monitoring Methods

The primary method used to describe vegetation throughout this report is percent ground cover, derived by averaging repeated estimates of the proportion of ground covered by individual vascular plant species within a 0.10 m^2 Daubenmire frame. Ground covered by non-vascular plants (mosses, liverworts, lichens, biological soil crust), plant litter and rock is also recorded. At some sites permanent 30 m transects have been established along which the data is acquired and at others the frame is placed randomly. Typically, 10 to 20 frames are read, and the data averaged. Other attributes that may be noted are pant height and size, overall plant health and/or vigour and leaf colour or discoloration.

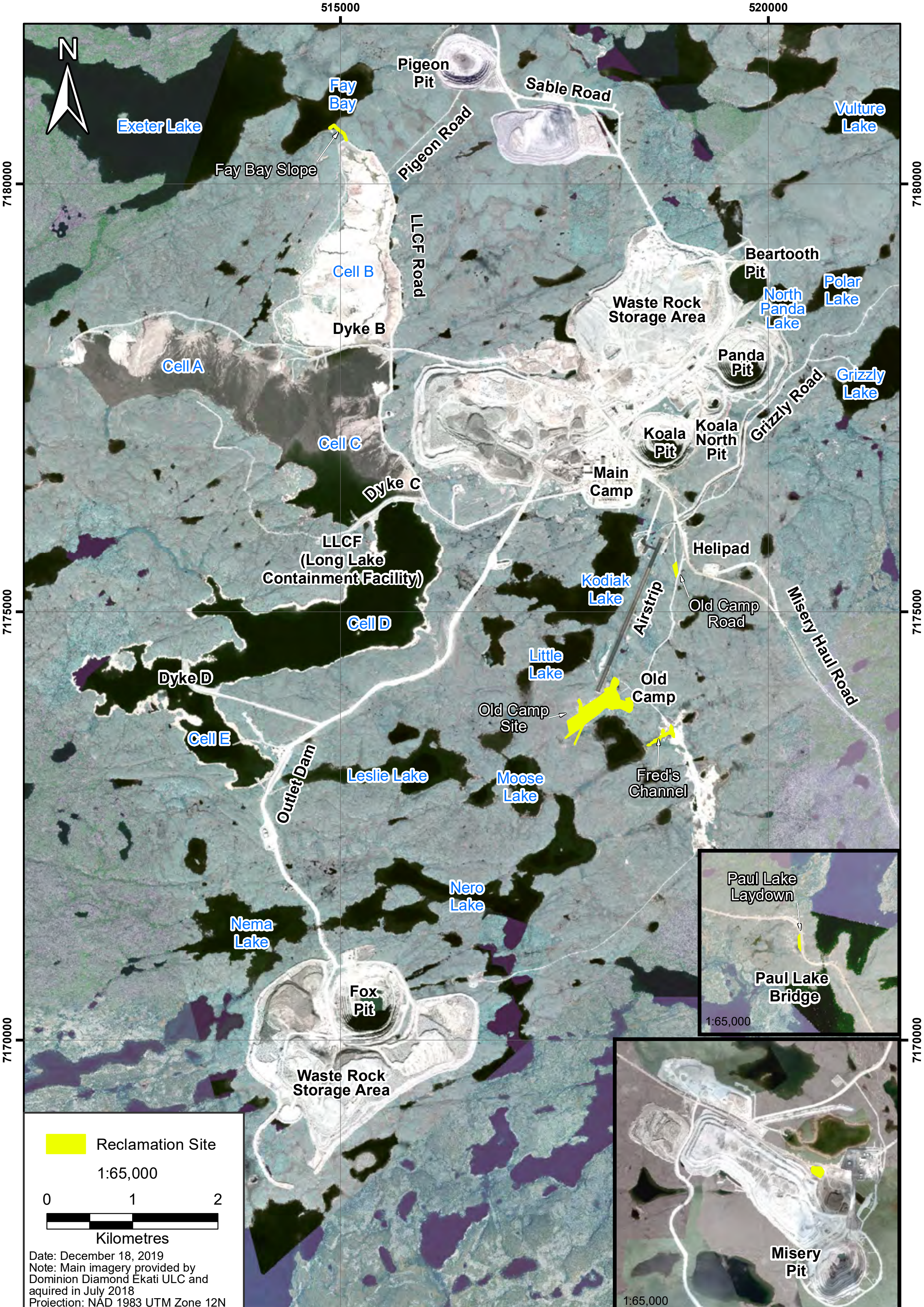


Figure 1-1: Vegetation Monitoring Locations, 2019

2. 2019 REVEGETATION AND MONITORING ACTIVITIES

2.1 Fay Bay Reclamation

2.1.1 Introduction

The disturbance at Fay Bay resulted from a spill and subsequent cleanup of processed kimberlite (PK) that overflowed from the north end of Cell B (part of the Long Lake Containment Facility) in 2008. To facilitate equipment movement during cleanup a rough road was constructed from the north end of Cell B downslope towards Fay Bay. Road construction resulted in removal of the shrub layer and caused the greatest impact in the area. Following cleanup a thin (0 to 2 cm thick) layer of PK remained on the ground surface in a twelve to fifteen meter wide band along the east side of the road base but the shrub layer remained more or less intact. In summer 2008 the road base was re-contoured and a number of sand bag dikes were installed to direct water from the disturbed area onto the adjacent tundra. Then it was covered with jute matting and seeded with an annual grass. In summer of 2009 a perennial native grass seed mix was applied to the area and three permanent transects were established along it to monitor its recovery (Figure 2.1-1). Two of the transects are on the slope: they begin a few meters west of the road base then cross it and the affected area east of it and finally extend seven to ten meters into undisturbed tundra. The third transect is in the level riparian area adjacent to Fay Bay. The eastern-most sections of the on-slope transects are used as control, but no control was established in the riparian zone (Martens, 2012).

Figure 2.1-1: Aerial View of Fay Bay Reclamation, August 2012 (Source: Martens, 2013)

2.1.2 Monitoring Activities

The site was first monitored in 2011, 2 years after final reclamation work was completed, and has been monitored intermittently since then; in 2012, 2014 and, most recently, in 2019. In every case percent ground cover was measured along the three permanent transects established in 2009, observations regarding site stability were made and the area was photographed.

2.1.3 Results and Discussion

As reported in Martens (2012, 2013) revegetation of the disturbance at Fay Bay was progressing well; the seeded grasses on the road base were becoming well established, shrubs in the area adjacent to the road bed were recovering and the slope showed no signs of erosion. The riparian zone was stable and ground cover by live vegetation there, primarily tall water sedge (*Carex aquatilis*), was expanding. Similar findings were reported by EcoSense in 2014 (EcoSense, 2015) by which time the seeded grasses on the road base were well developed and shrub cover in the affected area east of the road base was comparable to control (Table 2.1-1). However, unlike the control where the dominant cover is shrubs, in 2014 there was almost no shrub cover on the road base (Table 2.1-1).

Table 2.1-1: Mean Percent Ground Cover at Fay Bay in 2014 and 2019

Location	Cover Type	Mean percent ground cover (%)				
		Road Base		Eastern Area		Control
		2014	2019	2014	2019	2019
Upper mid-slope	Graminoid	57	6.3	10	3.4	8.5
	Herbaceous	3.7	2.8	0.5	1.0	0.4
	Shrub	1.7	-	52.3	47.7	62.3
	Non Vascular*	26.7	5.3	25	1.8	2.0
	Total Live Cover	**89.1**	**14.4**	**87.8**	**53.9**	**73.2**
	Litter	18	92	35	66.7	55
	Total Cover	**107.1**	**106.4**	**122.8**	**120.6**	**128.2**
Lower mid-slope	Graminoid	41.3	21.3	8.3	4.0	20
	Herbaceous	17.3	33.8	12.1	25	9.7
	Shrub	0.7	0.3	20.3	19.6	21.7
	Non Vascular	6.7	0.5	4.3	7.5	46.7
	Total Live Cover	**66.0**	**55.9**	**45.0**	**56.1**	**98.1**
	Litter	38.3	79.5	42.1	83.3	33.3
	Total Cover	**104.3**	**135.4**	**87.1**	**139.4**	**131.4**
Riparian Zone	Graminoid	40.6	12.9	-	-	-
	Herbaceous	1.9	0.1	-	-	-
	Shrub	0.5	-	-	-	-
	Non Vascular	22	1.8	-	-	-
	Total Live Cover	**65**	**14.8**	-	-	-
	Litter	3.1	36.5	-	-	-
	Total Cover	**68.1**	**51.3**	-	-	-

Note: Non vascular cover includes mosses, liverworts, lichen and biological soil crust. Dashes indicate no data recorded

Monitoring results in 2019 show a general decline in live cover and a corresponding increase in litter, especially along the road base (Table 2.1-1). Along the upper mid-slope transect total live cover on the road base decreased markedly from 89.1% in 2014 to 14.4% in 2019. Most of that change is attributable to large drops in live cover by seeded grasses (from 57% in 2014 to 6.3% in 2019) and non-vascular plants (26.6% in 2014; 5.3% in 2019). Litter cover increased five-fold to 92% in 2019 from 18% in 2014. Cover by shrubs and herbaceous plants changed only marginally, both continuing to contribute little to the total. Except for an increase in herbaceous cover similar, although less dramatic, changes in vegetation were observed on the road base in the lower mid-slope position as well. The 2019 data suggests the seeded grasses on the road base are dying back thereby (potentially) providing an opportunity for more of the nearby native shrub and herbaceous plants to colonise.

In the area east of the road base the initial surface disturbance was minimal but a thin layer of processed kimberlite (PK) remained on the ground following the cleanup. Vegetation in this location resembles control vegetation much more closely than does that on the road base (Photo 2.1-1). Cover by shrubs, the dominant vegetation in the undisturbed tundra, has remained fairly stable and comparable to control since 2014.

View of the road base (center) and eastern affected area (right).

View along the riparian transect

Photo 2.1-1: Site photos of Fay Bay reclamation. July, 2019.

The riparian transect lay under 20 to 30 cm of water in 2019 making meaningful comparisons with 2014 data impossible. Tall water sedge (a graminoid) remains dominant and the area appears stable (Figure 2.1-1).

No signs of instability were noted anywhere in the Fay Bay reclamation area.

2.1.4 Conclusion and Recommendations

In 2008 processed kimberlite (PK) overflowed the north end of Cell B of the Long Lake Containment Facility and flowed downslope into Fay Bay. To facilitate cleanup a rough road was constructed that resulted in more or less complete removal of the vegetation in a strip about 6 meters wide down the slope. Following cleanup a thin layer of PK remained on the ground surface in a 10 m wide band directly east of the road base but the native shrub layer there was not severely impacted. Site reclamation, that included seeding native grass cultivars on the road base, was completed in 2009. By 2014 the seeded grasses on the road had become very well established and shrub cover adjacent to it was recovering well. The dense cover of live grasses on the road base may have been inhibiting colonisation of that area by native shrubs and herbaceous plants. Monitoring in 2019 suggests the seeded grasses may be dying back which should, over time, allow more native vegetation to move onto the roadbed. The impacted riparian area appears on a trajectory towards full recovery. No indication of erosion was noted anywhere in the disturbed area in 2019. However, monitoring of the road base should be repeated in 5 years to ensure that recovery is proceeding.

2.2 Paul Lake Laydown

2.2.1 Introduction

The Paul Lake Laydown area is on the west side of Misery Road, 10 km south of main camp. It was used as a work pad / staging area during construction of Misery camp. The pad was removed to the extent possible in 2000 but the area remained largely covered with rock. In 2002 a seed mix containing native grass cultivars (50% alpine bluegrass (*Poa alpina*) and 50% tufted hairgrass (*Deschampsia cespitosa*)) and fertilizer (16-16-16 NPK) was broadcast across the area by helicopter. Seed and fertilizer were applied at 5 kg/ha and 38 kg/ha respectively. Following that, a small amount of native forb seed (deflexed oxytrope (*Oxytropis deflexa*) and fireweed (*Epilobium angustifolium*)) was scattered on exposed tundra soil between boulders (Kidd and Max, 2002).

2.2.2 Monitoring Activities

Two permanent transects (Transect 1 and Transect 2) were established in the reclaimed area in 2006 and it was monitored for the first time then. Transect 2 was relocated in 2010 when the site was monitored for the second time (Martens, 2011). Monitoring was repeated in 2015 and again in 2019. In all instances percent ground cover of plant litter and vascular and non-vascular plants was measured. In 2019 the percentage of ground surface area covered by enough dense gravel or rock (> ~ 5 cm diameter) to prevent plant establishment was also recorded and a control transect was run.

2.2.3 Results and Discussion

Total vascular plant cover increased markedly along both transects at the Paul Lake Laydown in the period from 2010 to 2015 (Table 2.2-1) due largely to increased cover by shrubs. Concurrent increases in non-vascular plant and litter cover lead to a sharp rise in total ground cover.

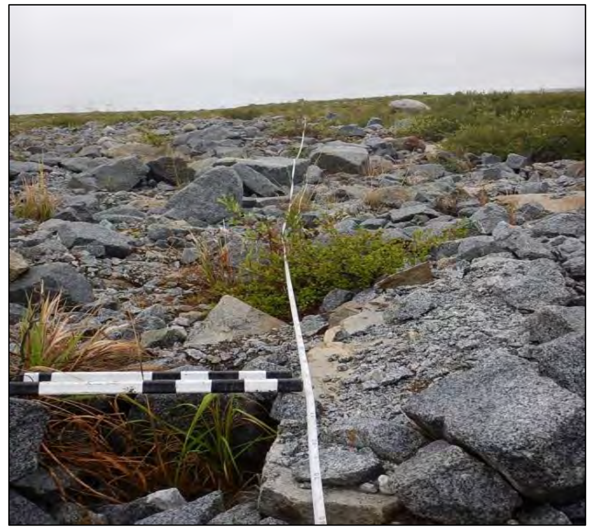
Table 2.2-1: Vegetation Performance over Time at the Paul Lake Laydown

Cover Type	Mean Percent Ground Cover (%)						
	Transect 1			Transect 2			Control
	2010	2015	2019	2010	2015	2019	2019
Graminoid	1.1	0.9	0.1	0.7	3.1	1.3	-
Herbaceous	1.0	-	0.7	1.1	0.3	0.3	-
Shrub	5.7	49.0	43.5	0.3	17.0	5.1	45.1
Total cover by vascular plants	**7.8**	**49.9**	**44.3**	**2.1**	**20.4**	**6.7**	**45.1**
Non-vascular*	28.3	30.8	14.3	7.5	25.0	23.2	28.1
Litter	1.1	5.3	27.9	0.7	6.9	5.1	2.1
Total Vegetative Cover	**37.2**	**86**	**86.5**	**10.3**	**52.3**	**35.0**	**75.3**
Gravel and Rock	-	-	26.9	-	-	71.9	29.7

Note: Non-Vascular cover includes moss, lichen, liverworts and biological soil crust. Dashes indicate no data recorded

Total vegetative ground cover was unchanged along Transect 1 in 2019 although there was a shift between observed amounts of non-vascular cover and litter (Table 2.2-1). However, along Transect 2 total cover declined from 52.3% in 2015 to 35% in 2019 due, primarily, as a result of a 70% reduction in measured shrub cover. Monitoring in 2019 failed to accurately capture shrub cover or perhaps it was overestimated in 2015. In either case shrub cover appears similar or slightly greater in 2019 compared to 2015 in the photographs in Photo 2.2-1. On both transects the majority of vascular plant cover is contributed by shrubs.

Facing south along Transect 2 in 2015



Facing south along Transect 2 in 2019

Photo 2.2-1: Paul Lake Laydown Transect 2 in 2015 (left) and 2019 (right).

When the area where plant establishment is inhibited by dense gravel or rock is taken into account the 2019 monitoring data suggests that virtually all available plant habitat is occupied.

On the nearby tundra control transect shrubs accounted for all of the vascular plant cover (Table 2.2-1), comparable to what was measured along Transect 1. Similar amounts of rock and gravel were also measured on Transect 1 and the control. While total vascular plant cover differs notably on Transect 2 compared to control both transects are dominated by shrubs. Over time, more shrubs may become established in cracks between rocks along Transect 2.

2.2.4 Conclusion and Recommendations

The Paul Lake Laydown was used as a work pad / staging area during construction of Misery camp. The site was decommissioned in 2000 but remained, in large measure, covered by rock.
Final reclamation took place in 2002 when low rates of native grass seed and fertiliser were applied aerially, and a small amount of native forb seed was broadcast by hand. Vegetation in those areas not extensively covered by rock has come to closely resemble the nearby, shrub dominated, tundra. Although plant cover is sparse shrubs are the dominant vegetation in the rocky areas as well and over time more may establish in cracks between rocks. Monitoring should be repeated in 5 years.

2.3 Old Camp

2.3.1 Introduction

Development at Old Camp began in 1993 in support of exploration and bulk sampling activities. During construction of Main Camp it was also used to house employees. Operational infrastructure included offices and accommodations, a pilot process plant and processed kimberlite (PK) storage area, a tank farm, equipment storage area, truck shop and associated roads. The site occupies approximately 9 ha. Active operations ceased in 2003 and decommissioning of infrastructure was completed the following year. Processed kimberlite and the underlying liner was excavated and removed from the site in 2014 and in 2015 final contouring of the former PK storage pond was completed (Figure 2.3-1). In 2017 salvaged topsoil and stockpiled gravel was spread and the surfaces of accessible areas were roughened by deep ripping with a large grader or by creating closely spaced mounds and pits using a tracked excavator (Photo 2.3-1). The objectives of surface reclamation are to leave the site in a stable condition conducive to natural colonization by native tundra plants (Dominion Diamond, 2017). Seeding and/or planting the area is not planned at this time but is an option should signs of instability develop or native vegetation fail to establish within a few years.

Aerial view of the upper region of Old Camp in 2018 showing surface roughening.

Mounds and pits along Old Camp's southern slope.

Photo 2.3-1: Surface reclamation at Old Camp.

2.3.2 Monitoring Activities

Permanent transects were established and monitored in four representative areas in 2019 and one surface (0 to 20 cm) soil sample was collected roughly mid-way along each. A control soil sample was also collected, in the nearby undisturbed tundra. UTM co-ordinates were obtained at one end of each transect with a handheld GPS device and a magnetic bearing was measured from the co-ordinate along the transect (Table 2.3-1).

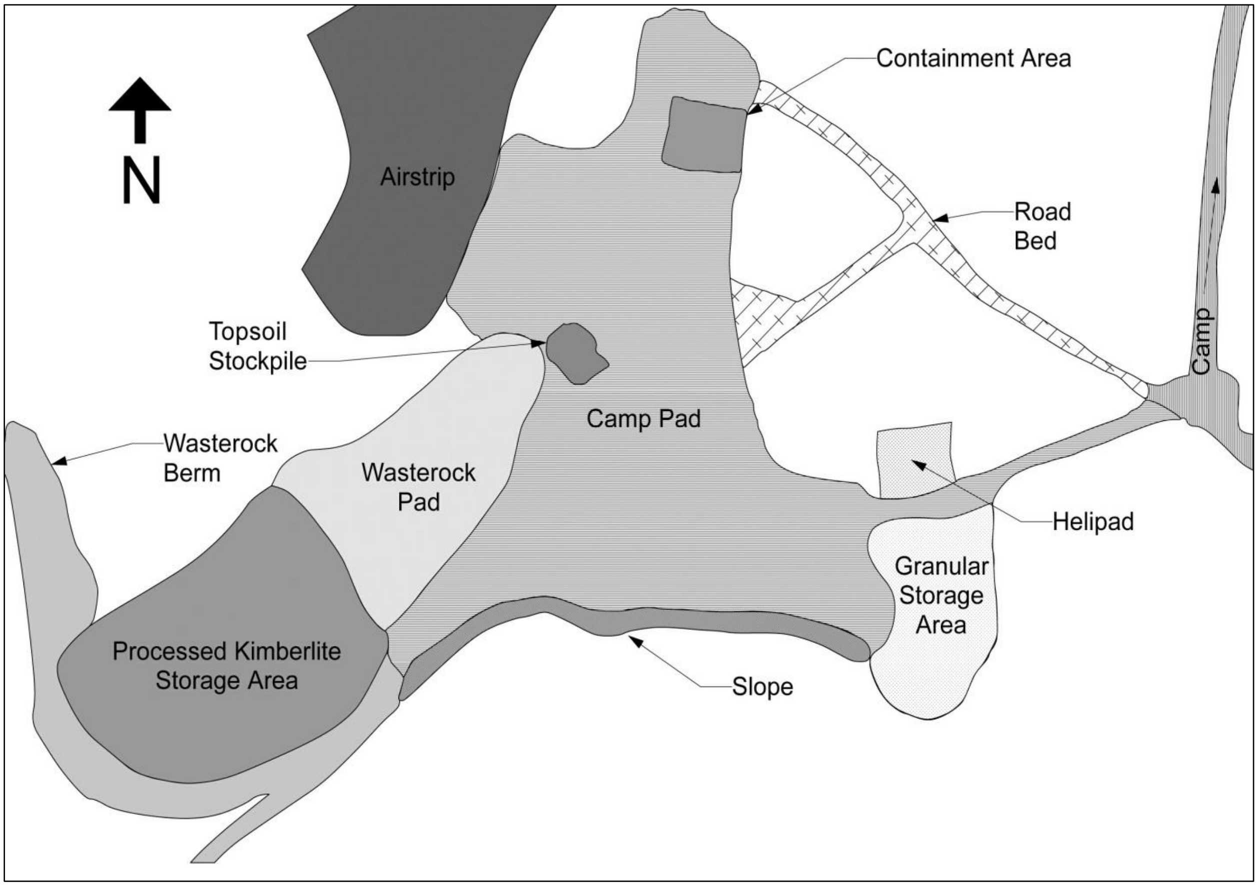


Figure 2.3-1: Old Camp Layout in 2013 (Source: Martens, 2014)

Table 2.3-1: Old Camp Transect Locations

Location	Easting (m)	Northing (m)	Magnetic Bearing (degrees)
Old Camp Transect 1	518210	7173998	251
Old Camp Transect 2	518194	7174076	264
Old Camp Transect 3	518367	7173988	210
Old Camp Transect 4	517903	7173903	230

Note: All co-ordinates lie within UTM Zone 12

2.3.3 Results and Discussion

A control soil sample was collected from undisturbed tundra about 100 m east of Old Camp. Analytical results are typical for tundra soils: It is coarse textured with a combined sand and gravel content of over 80%, 15.7% silt and no detectable clay (Table 2.3-2; clay and silt-sized particles—soil fines—are important because they influence a soil's water holding capacity and fertility.) Soil salts as measured by electrical conductivity (EC) and sodium adsorption ratio (SAR) are low and pH is moderately acidic. With respect to plant available nutrients nitrate nitrogen levels were undetectable and phosphate and potassium content is low but typical for undisturbed tundra soils. Soil organic carbon content of the sample measured 0.5% which equates to less than 1% soil organic matter (SOM). By contrast typical undisturbed Canadian prairie soils contain about 4 to 8% SOM.

Table 2.3-2: Old Camp Surface Soils (0 to 20 cm) Characteristics

Parameter	Transect 1	Transect 2	Transect 3	Transect 4	Control
Saturated Paste Extracts					
pH	6.78	8.86	7.59	7.59	5.03
EC (dS/m)	0.27	1.77	0.95	0.30	0.13
SAR	0.76	30.2	11.4	0.35	1.03
Plant Available Nutrients					
Nitrate (mg/kg)	<1.0	<1.0	<1.0	<1.0	<1.0
Phosphate (mg/kg)	13.0	2.9	36.0	4.8	6.1
Potassium (mg/kg)	53	1130	73	44	21
Organic carbon (%)	0.472	<0.13	0.195	0.137	0.511
Particle Size					
% Gravel (>2mm)	33.4	22.2	38.8	54.7	25.1
% Sand (2.0mm - 0.063mm)	60.7	54.1	57.8	39.0	58.3
% Silt (0.063mm - 4um)	5.2	16.4	2.9	5.3	15.7
% Clay (<4um)	<1.0	7.3	<1.0	<1.0	<1.0
Soil Texture	Sand	Sandy loam	Sand	Sand	Loamy sand

Notes: EC – electrical conductivity; SAR – sodium adsorption ratio

Old Camp Transect 1 is in the level, central region of the former camp pad. Soil at this location contains fewer fines and more sand and gravel than the control and, comparatively, pH and plant available phosphate and potassium are elevated (Table 2.3-2). Those differences in soil characteristics are not, however, expected to impede natural colonisation by tundra plants. Vegetation monitoring data support that notion: two species of native forbs and two species of native shrubs were recorded along Old Camp Transect 1 (Table 2.3-3). Five native grass species were also found although four of those are frequent constituents of seed mixes used on the mine site in the past (See Section 2.4 below). That information combined with the relatively elevated soil phosphate and potassium, both of which are common fertilisers, suggests that some parts of Old Camp may have been reclaimed sometime but no documentation confirming that was found. Industrial debris remains scattered around this area (Photo 2.3-2).

Old Camp Transect 2 lies on level ground about 80 m north of Transect 1 in the northern part of the former camp pad (Photo 2.3-1). Compared to the other Old Camp transect locations surface soil here is unique: It's gray, contains more salts (especially sodium), and has high pH. Phosphate content is relatively low but plant available potassium is very high. It is the only location where soil organic carbon was below the laboratory detection level and it contains an appreciable amount of clay making its texture comparatively fine (Table 2.3-2). Goose grass was the only plant found along Transect 2 (Table 2.3-3). It is a common early coloniser on the mine site, especially on the LLCF.

Old Camp Transect 3 runs diagonally across the former helipad. In many respects the soil here is comparable to control but it contains only 2.9% silt, making it the coarsest textured of the five locations sampled and SAR is elevated (although not problematic) and it has relatively high phosphate content. Compared to control soil pH is also elevated (Table 2.3-2). Despite those differences this area should support early colonising tundra plant species (e.g. fireweed (*Epilobium angustifolium*), birch, willow). To date the area is mostly bare with only 1.4% live ground cover and a little litter (Table 2.3-3). Live ground cover consists of three grasses, two of which may have been seeded sometime in the past.

Photo 2.3-2: View Along Old Camp Transect 1, July 2019.

Table 2.3-3: Mean Percent Ground Cover at Old Camp, July 2019

Cover Type	Mean Percent Ground Cover (%)			
	Transect 1	Transect 2	Transect 3	Transect 4
Graminoid				
Tundra bluegrass* (*Poa glauca*)	1.9	-	0.1	-
Alpine bluegrass* (*Poa alpinum*)	0.1	-	-	-
Creeping red fescue* (*Festuca rubra* var Arctared)	0.7	-	-	-
Polargrass* (*Arctagrostis latifolia* var Aleyska)	0.1	-	0.2	-
Goose Grass (*Puccinellia borealis*)	0.6	1.4	1.1	0.1
Total Graminoid Cover	**3.4**	**1.4**	**1.4**	**0.1**
Herbaceous				
Cinquefoil sp (*Potentilla sp*)	0.1	-	-	-
Milky Draba (*Draba lactea*)	0.2	-	-	-
Total Herb Cover	**0.3**	-	-	-
Shrub				
Diamond leaf willow (*Salix planifolia*)	0.1	-	-	-
Dwarf birch (*Betula glandulosa*)	1.8	-	-	-
Total Shrub Cover	**1.9**	-	-	-
Total Vascular Plant Cover	**5.6**	**1.4**	**1.4**	**0.1**

Cover Type	Mean Percent Ground Cover (%)			
	Transect 1	Transect 2	Transect 3	Transect 4
Mosses	12.1	-	-	-
Total Live Cover	**17.7**	**1.4**	**1.4**	**0.1**
Litter	3.3	-	0.4	-
Total Cover	**21.0**	**1.4**	**1.8**	**0.1**

** Indicates a grass species found frequently in commercial native grass cultivar seed mixes. Tundra bluegrass is also widespread on tundra near Ekati. Dashes indicate no data recorded*

Old Camp Transect 4 is on the moderate (~15o) south-southeast facing gravel slope north of and above the former PK storage pond. It is inaccessible to heavy equipment and, therefore, this area was not deep ripped so the surface is relatively smooth. Soil is coarse textured and contains a lot of gravel therefore has very limited water holding capacity. It contains few nutrients and very little organic carbon (Table 2.3-2). All these attributes combined will make plant establishment challenging at this location. Despite that a small amount of goose grass cover was measured along the transect in 2019 (Table 2.3-3).

2.3.4 Conclusion and Recommendations

Final surface reclamation of Old Camp was completed in summer 2017 with the goal of leaving the site suitable for natural colonization by tundra vegetation (Photo 2.3-3). Salvaged topsoil and stockpiled gravel was spread and the surfaces of accessible areas were roughened by deep ripping with a large grader or by creating closely spaced mounds and pits using a tracked excavator. In July, 2019 permanent transects were established in four representative locations around the site to monitor revegetation progress. One surface soil sample was collected adjacent to each transect and from the nearby undisturbed tundra. Surface materials in the vicinity of Old Camp Transects 1, 3 and 4 are amenable to native tundra vegetation and colonization should proceed quickly around Transects 1 and 3. Transect 4 lies on a gravelly slope with a southern aspect that could not be deep ripped so this area will likely be drier than the others. As a result, plant establishment may be inhibited at this location. Live ground cover amounted to almost 18% along Transect 1 in 2019 and consisted of several native plant species including a few forbs and shrubs. The other areas remain mostly bare but traces of vegetation were measured at every location. Scattered industrial debris was observed in the vicinity of Transects 1 and 2.

Vegetation monitoring and a thorough site inspection should be conducted annually for at least 3 years. It is also recommended that the remaining industrial debris be cleaned up as soon as possible.

2.4 Old Camp Road

2.4.1 Introduction

In the summer of 1996, 2 small pullouts along the Old Camp Road were seeded and fertilized. A seed mix containing 4 native grass cultivars (20% tundra bluegrass, 20% alpine bluegrass, 40% Arctared fescue and 20% polargrass) was seeded at 33 kg/ha and 440 kg/ha 16-16-16 (NPK) fertilizer was applied. Then in 1997, a small amount (< 50 g) of seed from two native legumes (licorice root (*Hedysarum Mackenzii*) and deflexed oxytrope (*Oxytropis deflexa*)) was broadcast on one pullout (Kidd and Max, 2002).

2.4.2 Monitoring Activities

The pullout that received the full seed treatment (i.e., grasses and legumes) was first monitored in July 2002 when a permanent transect was established on it. Monitoring has been repeated periodically since then; in 2008, 2012 and, most recently, in 2019.

View along Old Camp Transect 2 in July, 2019

View along Old Camp Transect 3 in July 2019

View along Old Camp Transect 3. July 2019

Photo 2.3-3: Old Camp Transects 2, 3 and 4. July, 2019.

2.4.3 Results and Discussion

In 2002, seeded grasses provided the majority of live plant cover (7%) with small contributions from fireweed (0.3%) and mosses (1%; Table 2.4-1). Traces of two other seeded species (polargrass and licorice root) were also recorded. Litter supplied most of the total cover (14%), which at the time was about 22%. Since that time cover by seeded species has declined steadily while indigenous plant cover has increased. That is especially true of non-vascular plants. Lichens were not observed in 2002, they first measured at 0.6% ground cover in 2008 and have since expanded to 13.5% in 2019. Moss cover increased as well; from 1% in 2002 to 62.5% in 2012 and then back to 52.3% in 2019. Vascular plant cover declined from 7.3% in 2002 to 3.9% in 2019. However, most of that cover now comes from two indigenous species, alpine fescue (1.8%) and fireweed (1.7%). In 2019 litter cover was 7.2%, about half what was measured in 2002, likely related to the concurrent decline in cover by seeded grasses. Total ground cover rose rapidly from 2002 (22.3%) until 2012 (79.5%) and appears to have stabilized at roughly that level, measuring 76.9% in 2019.

Table 2.4-1: Vegetation Performance over Time on Old Camp Road

Cover Type	Mean Percent Ground Cover			
Graminoid	**2002**	**2008**	**2012**	**2019**
Tundra bluegrass (*Poa glauca*)	6.3	4.0	3.5	0.3
Creeping red fescue (*Festuca rubra* var Arctared)	0.7	0.9	0.6	0.1
Polargrass (*Arctagrostis latifolia* var Aleyska)	tr	-	-	-
Alpine fescue (*Festuca brachyphylla*)	-	-	-	1.8
Total Graminoid Cover	7.0	4.9	4.1	2.2
Herbaceous				
Fireweed (*Epilobium angustifolium*)	0.3	0.2	0.2	1.7
Licorice root (*Hedysarum Mackenzii*)	tr	-	-	-
Total Herb Cover	0.3	0.2	0.2	1.7
Total Vascular Plant Cover	7.3	5.1	4.3	3.9
Mosses and biological soil crust	1.0	20.2	62.5	52.3
Lichens	-	0.6	2.4	13.5
Total Non-vascular Plant Cover	1.0	20.8	64.9	65.8
Total Live Cover	8.3	25.9	69.2	69.7
Litter	14.0	7.4	10.3	7.2
Total Cover	22.3	33.3	79.5	76.9

Note: Dashes indicate no data recorded

2.4.4 Conclusion and Recommendations

Two small pullouts along Old Camp Road were seeded with native grass cultivars and fertilized in the summer of 1996. In summer 1997, seed from two native legumes was broadcast on one of those pullouts. When that pullout was first monitored 2002 the plant community was dominated by seeded grasses. Limited amounts of fireweed and mosses were also present, but the legumes failed to establish. Litter provided the majority of the total ground cover which, at the time, was 22.3%. No lichen was observed. Since then total ground cover has increased to 76.9% in 2019 and appears to have stabilized. That change is mostly due to growth of mosses and lichen that, together, amounted to 69.7% in 2019. Over that same time cover by seeded grasses declined and 2 indigenous plant species now provide the majority of vascular plant cover. As observed elsewhere on coarse textured, nutrient poor substrates around the mine site seeded species do well when fertilized but die off as those nutrient supplies diminish and over time native species establish.

Plant community development on Old Camp Road provides a proxy for other roads on the mine site and continued, periodic, monitoring of it is recommended.


View along Old Camp Road in 2008


View along Old Camp Road in 2019

Photo 2.4-1: View along Old Camp Road in 2008 and 2019.

2.5 Misery Topsoil Stockpile

2.5.1 Introduction

The Misery topsoil stockpile was built in 1999 with surface soil salvaged during development of infrastructure associated with Misery Pit. It is located along the western side of the Misery waste rock storage area (WRSA; Figure 2.5-1). It was not left in a free dump state but was levelled and recontoured. To help maintain biological processes it was seeded with native grass cultivars and fertilized in 2002 (Photo 2.5-1). Martens (2013) reported that in 2012 a thick sward of grasses and litter covered the stockpile to such an extent that establishment of indigenous native species was inhibited. In 2015 the stockpile was partially covered with free dumped surface material salvaged from the Lynx Pit and Misery crusher pad while those areas were being developed (Photo 2.5-1). That new material was seeded in 2016. Since then the stockpile has been levelled and the southeasterly 2/3 to 3/4 of it appear to have been capped with 1.5 to 2 m of highly compacted mineral material. Native vegetation is establishing on the remaining, exposed portion of the stockpile and no seeding is currently planned in that area.
The motivation behind the apparent capping of the topsoil is unknown.

2.5.2 Monitoring Activities

This site was monitored 4 times after 2002 (when the original stockpiled material was seeded and fertilized) until 2012. Monitoring of the material deposited in 2015 and seeded in 2016 was planned for 2019 but it was then discovered that most of the stockpile had been levelled and buried. Nonetheless, one permanent transect was established and monitored on the remaining, exposed portion.

2.5.3 Results and Discussion

Native vegetation has begun to establish on the uncapped portion of the Misery topsoil stockpile despite the short interval since it was levelled. Four indigenous plant species were recorded along the transect (Table 2.5-1) and nine additional species were observed growing nearby (Photo 2.5-2). Total live plant cover was 11.1%, comprised of 5% vascular and 6.1% non-vascular plants (mosses). Litter is also accumulating and contributed 9.3% of the 20.4% total ground cover measured. No vegetation was observed growing on the compacted southeasterly portion of the stockpile.

Figure 2.5-1: Misery Topsoil Stockpile Location

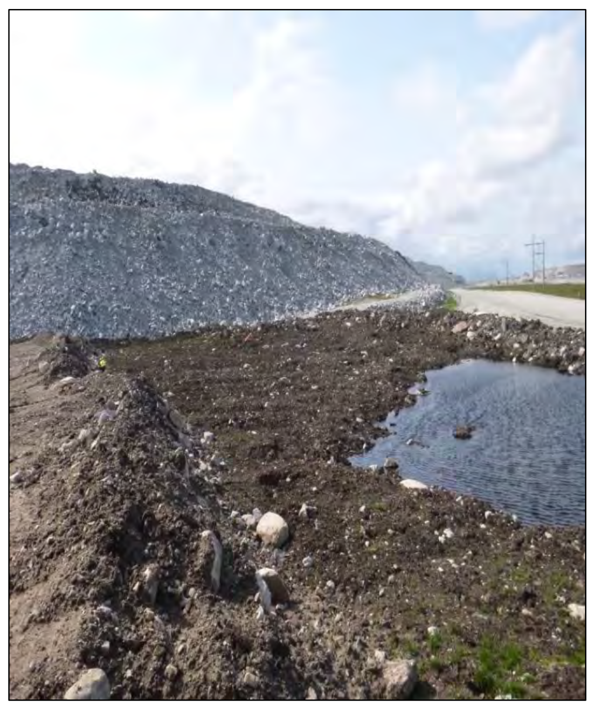
Table 2.5-1: Mean Percent Ground Cover on the Exposed Portion of the Misery Topsoil Stockpile, September, 2019

Cover Type	Mean Percent Ground Cover
Graminoid	
Bigelow's sedge (*Carex Bigelowii*)	0.5
Tussock cotton grass (*Eriophorum vaginatum*)	0.9
Herbaceous	
Fireweed (*Epilobium angustifolium*)	3.5
Shrub	
Dwarf birch (*Betula glandulosa*)	0.1
Total Vascular Plant Cover	**5.0**
Mosses	6.1
Total Live Cover	**11.1**
Litter	9.3
Total Cover	**20.4**

Misery Topsoil in 2012 showing vigorous grass growth.

Misery Topsoil Stockpile in 2016 with material salvaged and added in 2015 in the background.

Levelled and compacted portion of the Misery Topsoil Stockpile in 2019.



Exposed portion of the Misery Topsoil Stockpile in 2019.

Photo 2.5-1: Misery Topsoil Stockpile site photos.

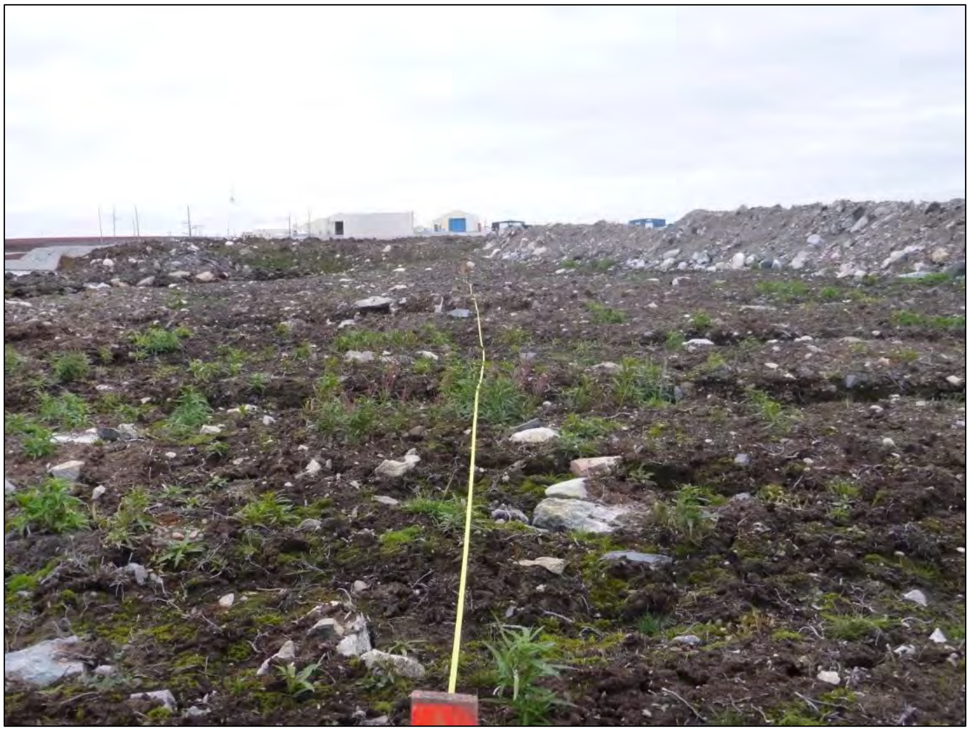


Photo 2.5-2: View along the transect on the uncovered portion of the Misery topsoil stockpile, September 2016.

2.5.4 Conclusion and Recommendations

The Misery topsoil stockpile was originally constructed in 1999 with surface material salvaged during development of infrastructure associated with Misery pit. It was levelled then seeded and fertilised in 2002 and a thick cover of native grass cultivars and litter subsequently developed (Martens 2005, 2009, 2011, 2013). Free dumped material salvaged from Lynx Pit and the Misery crusher pad was added to the stockpile in 2015, partially covering the original pile. That new material was seeded in 2016. When the site was revisited for monitoring in 2019 it was found to have been levelled and the majority buried under 1.5 to 2 m of highly compacted mineral material, possibly till. The remaining uncovered portion was found to support a developing native plant community and should be monitored again in 2020.

Topsoil is a valuable future resource at the Ekati mine site and every effort should be made to conserve and store it in as healthy condition as possible. Working the soil with large, heavy machinery (e.g., D-10 dozer) results in serious compaction which ultimately disrupts natural biological processes both on and within it and will render it a far less viable growth medium when the time comes to deploy it. Burying topsoil is even less desirable. Buried or heavily compacted material is also more difficult to retrieve from the stockpile and spread. Observations of other topsoil stockpiles on the mine site that were left in the free dump state and now support relatively diverse native plant communities (e.g., Beartooth) indicate that that is the better handling option. Using low ground pressure machinery (e.g. LGP D-6 dozer) is preferred whenever topsoil must be handled.

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APPENDIX G
2019 AQMP Executive Summary

EXECUTIVE SUMMARY

The Air Quality Monitoring Program (AQMP) at the Ekati Diamond Mine is a requirement under Article VII of the Environmental Agreement. In accordance with that agreement and commitments made, an AQMP was initiated to support the management of air quality throughout the life of the Ekati Diamond Mine operations.

The 2019 AQMP Report provides and assesses results of meteorological and air quality monitoring data collected in 2019 as well as the emissions of greenhouse gases and air contaminants. The components summarized and discussed in this report include:

1. Meteorological monitoring;
2. Ambient air quality monitoring including:
    - Partisol particulate sampling, and
    - Continuous air monitoring (CAM);
3. Dustfall monitoring; and
4. Air contaminant and greenhouse gas (GHG) calculations.

In 2019, seasonal trends in temperature were evident. Temperatures above 0°C were recorded in early June, marking the start of the open-water season, and daily temperatures dropped below 0°C by early October, marking the end of the open-water season. The total precipitation in 2019 was 40 mm lower than the 1994 to 2019 average of 329 mm. Winds at the Ekati Diamond Mine area were omni-directional, with the most common wind speeds ranging from 3.0 to 5.0 m/s.

There were no total suspended particulate (TSP) exceedances of the 24-hour Government of the Northwest Territories (GNWT) standard of 120 μg/m^3 measured at the Partisol stations or the continuous air monitoring building (CAMB) in 2019. The annual mean TSP concentrations at the CAMB and Partisol stations were below the GNWT annual TSP standard of 60 μg/m^3. The daily and annual average particulate matter less than 2.5 microns ($PM_{2.5}$) concentrations measured at the CAMB and Partisol stations were generally low when compared to applicable GNWT standards.

The hourly, daily, and annual concentrations of nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) measured at the CAMB in 2019 were below the applicable GNWT standards. The 1-hour, 24-hour, and annual GNWT standards for NO_2 are 400, 200, and 60 μg/m^3, respectively. GNWT standards for SO_2 are 450 μg/m^3 (1-hour), 150 μg/m^3 (24-hour), and 30 μg/m^3 (annual). SO_2 and NO_X (nitrogen oxides; NO and NO_2) concentrations were higher in the winter compared to the summer, likely in response to seasonal fuel usage for heating.

Dustfall sampling was conducted at 31 monitoring locations in 2019, two of which were used as control sites. Dustfall was greater close to the haul roads, and decreased with distance from the roads, with dustfall rates generally approaching background levels (dustfall concentrations at off-site stations AQ-49 and AQ-54) at approximately 300 m. All seasonal averages of dustfall concentrations at 300 m from the roads were below the GNWT interim dustfall objective of 1.53 mg/dm^2/d.

Acid deposition was calculated from nitrate and sulphate concentrations. The highest annual median value from all sites in 2019 was 191 equivalent per hectare per year (eq/ha/yr) (Sable-U30; based on three months of data), which is below the established critical soil load for provinces in eastern Canada and the Alberta potential acid input (PAI) load standard of 250 eq/ha/yr. The maximum observed metal deposition value among all stations sampled in 2019 was 1.3 mg/dm^2/d (silicon). All metal deposition values measured at the two background monitoring stations were below 0.014 mg/dm^2/d. The metals measured included aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, mercury, molybdenum, nickel, phosphorus, potassium, selenium, silicon, silver, sodium, strontium, thallium, tin, titanium, uranium, vanadium, and zinc. Currently, there are no provincial or federal standards/guidelines to compare the metal deposition values measured at the Ekati Diamond Mine.

A total of 165.5 ktCO_2e (kilotonnes of CO_2 equivalent) of GHG emissions were estimated to have been released from the Ekati Diamond Mine in 2019. This is about 25% lower than the estimated GHG emissions during the 2018 reporting period. The sources of GHG emissions at the Ekati Diamond Mine include combustion of diesel used for power generation, building heat, operating mobile equipment, and blasting; combustion of Jet fuel, and emissions from waste and wastewater facilities.

APPENDIX H
2019 WEMP Executive Summary

EXECUTIVE SUMMARY

Dominion Diamond Mines ULC (Dominion) implements a number of environmental plans and programs, all of which are interrelated (Figure 1). The results and components of the Wildlife Effects Monitoring Program (WEMP) and other environmental plans are driven directly and/or indirectly by the plans in place each with the overarching goal to protect land, air, water and wildlife. The following report presents the results of the 2019 Wildlife Effects Monitoring Program conducted at the Ekati Diamond Mine to meet the requirements of the Environmental Agreement (Article V1(a) and Article VII) and the *Wildlife Act* (subsection 95(1)). The WEMP reports on wildlife monitoring activities and documents wildlife effects resulting from mining development and associated activities at the Ekati Diamond Mine. The WEMP also assesses the effectiveness of wildlife mitigation and management efforts. The program focuses on animal species identified as potentially experiencing residual effects from some aspect of the project, termed Valued Ecosystem Component or VECs (e.g., caribou, grizzly bear, wolf, wolverine, breeding birds, and raptors). This report covers the period from January 1, 2019 to December 31, 2019 (hereafter the 2019 reporting period).

Habitat Alteration and Loss

During the 2019 reporting period an additional 78.9 hectares (ha) of habitat were lost due to continued development of Lynx, Pigeon, and Sable Pits and associated Waste Rock Storage Areas. Underground mining at Misery Underground was also active during this reporting period. The amount of direct habitat loss caused by the project footprint since 1997 is 3,897.7 ha or 2.5% of the total pre-development habitat in the study area.

Wildlife Attractants and Waste Management

Waste is managed to minimize the presence of wildlife attractants throughout the Ekati site. As part of the WEMP, the site landfill is surveyed once or twice per week. The percentage of surveys detecting food packages at the landfill was 34% in 2019, an increase from 2018 (28%) and 2017 (21%) and lower than 2016 (43%). Improper disposal of waste is an ongoing challenge that Dominion considers a management priority and the responsibility of all personnel to address. Strategies employed include: regular education efforts that stress the dangers posed to wildlife and personnel from improperly discarded waste; increased communication with the Waste Management Department to isolate the origin of any reported misdirected waste; provision of on the ground training to individual departments; and timely cleanup of improperly discarded waste.

Dominion acknowledges that ongoing efforts are required to achieve further improvement, and staff will continue to further develop site wide management efforts and wildlife attractant awareness programs. To demonstrate its commitment to this issue, Ekati's composter system allowed for 125,055 kg of wet and dry biodegradable material to be composted rather than incinerated, saving an estimated 333,597 L of diesel fuel. Dominion also backhauled an estimated 102,431 kg of solid waste, and 161,700 L of liquid waste off-site in 2019. Dominion will continue to actively pursue alternatives for managing its waste at the Ekati Diamond Mine.

Wildlife Management

During the 2019 reporting period, 804 general wildlife management actions were implemented in response to wildlife activity at the Ekati Diamond Mine, including actions directed at caribou (385), grizzly bear (252), wolf (103), wolverine (18), fox (12), moose (8), and raptors (4). The remaining wildlife management actions (22) were general to all wildlife, or a combination of species, encountered. Management actions followed a successive hierarchy, starting with site wide notifications, followed by presentations, wildlife notice signs, road closures and/or work stoppages, including blasting postponement. On 15 occasions in 2019 blasting was postponed or cancelled due to the presence of caribou in the area. Dominion continues to explore effective mitigation actions to reduce potential interactions with wildlife.

Figure 1: Environmental Protection through Environmental Management Program and Plans

The Caribou Road Mitigation Plan (CRMP), a three level hierarchy of management and mitigation above the regular Operational Level response to wildlife interactions with roads at the Ekati Diamond Mine, was applied to Misery Road and Sable Road beginning in mid-2016. The 2019 reporting year represents the third full year that the CRMP was implemented. In 2019, CRMP alert levels beyond the Operational Level were triggered for the entire year due to caribou occurrences near the Sable or Misery roads. Level 2 (Orange – medium risk) was initiated for three periods for a total of 62 days and Level 3 (Red – high risk) was triggered on three occasions for a duration of 303 full days. Reporting management activities that adhere to the CRMP will continue to be a component of future iterations of the WEMP report.

Wildlife-Vehicle Interactions

During the 2019 reporting period, there were nine vehicle related wildlife mortalities and two likely vehicle-related mortalities reported at the Ekati Diamond Mine: 7 arctic hares, 1 red fox, 1 Canada goose, and 2 greater white-fronted geese. Mitigation efforts to reduce wildlife conflicts with aircraft and ground traffic include a variety of measures: always giving wildlife the right of way, employee education, speed limits, site wide notifications about wildlife observations, road closures, and the use of Inuksuit (traditional rock structures) to discourage wildlife from approaching high traffic areas. In 2019, caribou were observed at or near the Misery, Sable, Long Lake Containment Facility (LLCF), Jay, Fox, Lynx, Falcon Lake, and Grizzly roads; there were no vehicle-related caribou mortalities.

Vehicles were used on eight occasions along Sable Road (August 10 [3 occasions], August 11 [3 occasions], August 12, and August 15) to gently deter caribou from roads for the following reasons: medical emergency of a staff member, shift changes required to occur, and a polar explosives truck required to take cover from a thunder storm due to safety concerns. To ensure additional wildlife safety, visual monitoring, temporary road closures, site-wide notifications, and/or wildlife signs were implemented while caribou and other wildlife were adjacent to or crossing mine roads. Use of Traditional Knowledge to inform construction of accessible road crossing ramps and implementation of the Caribou Road Mitigation Plan are key measures in limiting wildlife-vehicle interactions.

Non-Vehicle Wildlife Mortalities and Incidents

During the 2019 reporting period there were 10 wildlife mortalities reported at the Ekati Diamond Mine. They included seven caribou killed by wolves between February and December, one American tree sparrow and one ptarmigan (unidentified species). The causes of death were not known for either bird. During the 2019 reporting period, a total of 43 wildlife incidents were reported, including four VEC species: grizzly bear, which accounted for the majority (35, one of which also involved a wolverine, and another of which involved a fox) of the VEC related incidents; 3 incidents involving wolves; and 1 incident with a caribou. The caribou incident involved an animal observed in apparent pain over several days that resulted in ENR officers and a Wildlife Advisor using a lethal shot to euthanize the animal; the tenth non-vehicle wildlife mortality. There were 4 other incidents with foxes, one of those including a fox and a common raven.

Incidents were related to interactions with mine infrastructure (34) and personnel (9). Dominion has implemented a number of mitigation practices to help minimize the occurrence of wildlife attractants on site and minimize the occurrence of wildlife on site, including waste management education and awareness programs. Deterrents are used during wildlife interactions with field crews and mine infrastructure; in 2019 deterrents were used on 39 occasions.

Wildlife-Power Line Interactions

In the 2019 reporting year, caribou were observed during the power line surveys on 61 occasions over 294 survey days; a total of 4,430 caribou were observed. Caribou observations occurred year-round between, January 21 and December 31, 2019. The number of caribou observed in 2019 was notably higher than all previous years of power line monitoring, including the second highest year in 2016 when 785 caribou were observed on 35 occasions over 77 survey days after the power line became operational. The largest groups observed in 2019 was more than 1,000 caribou seen on two occasions (November 16 and December 25, 2019). Eighty-two percent of observations consisted of fewer than 50 individuals, most groups of caribou observed exhibiting a mixture of behaviours including walking, feeding, bedding down, and standing alertly.

To date, no caribou injuries or deaths have been attributed to the power line. Observations of caribou near the power line and crossing beneath the power line suggest that the power line does not impede caribou movement or change caribou behaviour.

Caribou

There were 269 incidental observations of caribou reported during the 2019 reporting period, totaling 9,507 animals (note that incidental observations likely include the same caribou individuals or groups on multiple occasions rather than indicating that 9,507 different individuals were observed). The majority of caribou observed incidentally in 2019 were recorded during the two winter periods combined (January 1 to April 14, and November 1 to December 31, 88%) and spring migration (9% of caribou observed). Of the 9,507 caribou observed, sex and age classification was made for 196 individuals; 32% were identified as bulls, 56% as cows, 1% as calves and 11% as yearlings.

Information from satellite collared female caribou collected by Environment and Natural Resources (ENR) indicates that the Bathurst herd has seasonal ranges that historically have overlapped with the Ekati Diamond Mine wildlife study area. This trend continued in 2019, though some of the seasons of overlap have changed. The fixed kernel 50% Utilization Distributions representing core ranges, and the broader seasonal range extent (described by the 95% kernel Utilization Distribution) were determined from 2019 radio-telemetry data acquired from satellite collared caribou. For the seasonal ranges analysed (all except spring migration, when caribou are less sedentary), the 50% and 95% Utilization Distributions indicate that only the 2018/2019 95% winter ranges for female Bathurst and Beverly/Ahiak caribou overlapped with the Ekati Diamond Mine. Incidental caribou observations at the Ekati Diamond Mine in 2019 corroborate the kernel Utilization Distribution maps that indicate the majority of caribou were observed at the Ekati Diamond Mine during the winter period, including the winter of 2018/2019.

Caribou Behaviour: Activity Budgets and Response to Stressors

During 2019, the focal behaviour observations of 8 adult caribou (3 females, 5 males), indicated that female caribou at the Ekati Diamond Mine spent their time running (46%), bedded (33%), or feeding (12%) while males spent their time bedded (30%) or feeding (28%). In addition, 34 behavioural scan surveys were summarized for the 2019 reporting period; scan surveys distances ranged from 0 metres (m) to 2,000 m away from mine infrastructure. On average, the greatest percentages of individuals were observed feeding, followed by being bedded. Compared with other groups, a greater percentage of individuals in the male only groups were observed engaged in alert behaviour (14%), followed by mixed groups (8%) and mixed groups with young (5%). Alert behaviour was not consistently observed following stressor events; on three occasions, stressors (vehicles) elicited a running response by caribou, while four groups became alert following events, and another group walked away from the road after vehicles had passed.

Thirty-one caribou scan surveys conducted by Diavik Diamond Mine Inc. (Diavik) permitted a comparison to the results presented in this report. Diavik survey results also suggested that a large percentage of caribou individuals spend time feeding, bedded, and walking. The results from focal surveys at Diavik in 2019 include alert behaviour following stressor events on 15 of 53 occasions (28%). Together the results collected at the Ekati Diamond Mine and those conducted by Diavik are consistent with a comprehensive analysis of survey data collected from 2011 to 2013. They suggest some tolerance for areas in close proximity to the mine (< 1 km from infrastructure).

Long Lake Containment Facility (LLCF) Monitoring

During the 2019 reporting period, there were eight observations of 1,721 caribou on six separate days at the LLCF. Prior to 2019, a total of 694 caribou had been observed within the LLCF since 2000. The 2019 observations represent 71% of all caribou observed since monitoring began. The majority of past observations were predominately solitary individuals that exhibited travelling behaviours (i.e., walking, trotting, and running) more often than feeding, bedding, or standing. In 2019, there were four groups of at least 100 caribou observed in the LLCF, including a group of approximately 1,000 animals observed on Cell A on March 29. Evidence from tracks and observed caribou behaviour suggests that the processed kimberlite does not inhibit caribou movement, nor does it appear to be acting as an attractant.
Other wildlife and their tracks were also observed in the LLCF including grizzly bear, wolf, arctic hare, red fox, and fox of undetermined species (either arctic or red fox), suggesting wildlife species are using the LLCF. Bird species recorded during LLCF surveys included Canada goose, common raven, greater white-fronted goose, gyrfalcon, herring gull, and tundra swan.

Road Surveys

In 2019, road surveys along Sable, Misery, Jay, and Lynx Roads were completed on 304 days. Caribou were observed on 121 occasions over 304 survey days; a total of 6,969 caribou were reported.
The largest groups, greater than 1,000 caribou, were observed along Misery and Sable Roads in November and December. The CRMP alert levels beyond the Operational Level were triggered for the entire year due to caribou occurrences near the Sable or Misery roads. Level 2 (Orange – medium risk) was triggered on three occasions for a duration of 62 full days, and Level 3 (Red – high risk) was triggered on three occasions for a duration of 303 full days.

Camera Trapping

A total of 89 infrared motion-triggered cameras were deployed around the Ekati Diamond Mine in 2019. As a result of logistical constraints in data processing time, analyses of 2019 photographs was not complete at the time this report was prepared. Because of the logistical delays in processing camera data and the relatively low detection rates of caribou in any one year, Dominion believes that the next camera report will be most informative and robust if the report includes the 2017 to 2019 camera data. As such, Dominion has delayed the preparation of the next camera report until 2020. A preliminary review of photographs from the 2018 to 2019 monitoring year included 289 caribou photographed by the first camera along the Jay road east of Misery Camp and 151 caribou photographed by a camera the north of Jay Road near the esker in the area. Caribou were also photographed at the Lac du Sauvage Narrows. As observed in 2018, the photographs indicate continued passage of caribou across the Jay Road near the esker east of Misery Camp.

Zone of Influence Monitoring (ZOI)

In 2019, Dominion and ERM undertook a study to re-examine the ZOI at the Ekati-Diavik mine complex using aerial survey data. The study used an alternative analytical approach that differed from an earlier method applied to the same data. Specifically, the new examination of the data incorporated: an underlying assumption that caribou distribution occurs in a complex manner that relates to distribution of higher quality habitat (i.e., heath tundra); and the use of a technique that allowed for an unequal distribution of caribou relative to the mine that is not accounted for by habitat alone. The current model predicted caribou occurrence peaks at several distances from the mine complex, as expected based on habitat distribution: 8 km, 16 km, and 27 km. Most importantly, the current model suggests that the distribution of caribou near the mine complex can be accounted for by habitat variables alone rather than requiring a mine-related ZOI. Dominion will provide a technical report documenting these new findings in summer 2020.

Grizzly Bear

There were 161 grizzly bear sightings during the 2019 reporting period, totaling 252 grizzly bears on 74 separate days near the Ekati Diamond Mine. The earliest sighting in the year was on May 4, 2019 and the latest sighting was on October 26, 2019.

Multiple animals or family groups were observed on 48 occasions in 2019; a female with two cubs (38 occasions). Other family group compositions included 3 sightings of a female with 1 cub, 1 sighting of a female adult with a bear of unknown sex and age, 1 sighting of an adult of unknown sex with a bear of unknown sex and age, and 1 sighting of 2 bears of unknown sex and age. The remaining 113 grizzly bear observations in 2019 were of solitary animals, presumably adults, most of which were of unknown sex. In 2019, 244 management activities were conducted in response to grizzly bear observations on Misery and Sable Road and other locations near the Ekati Diamond Mine. As in past years, grizzly bear site wide notifications were delivered following the first evidence of grizzly bear activity of the season. A safety alert was also delivered on August 24, 2019, to advise personnel about high levels of bear activity near Main Camp, to indicate the general area of bear activity, and to remind personnel about remaining vigilant for the presence of wildlife at the site. In addition, there were 16 bear awareness training presentations given between May and July, 2019, an increase since past years.

The number of grizzly bear sightings and family groups observed in 2019 is the highest number in the last 19 years. An increase in the number of sightings in August 2019 was due to interactions with wildlife attractants whereas overall increases in recent years are likely due to personnel travelling over a larger area around site, with the addition of Sable and Jay roads. The high number of observations of family groups with two cubs is indicative of a healthy grizzly bear population near the Ekati Diamond Mine.

Wolf

During the 2019 reporting period, there were 117 incidental wolf sightings, totaling 212 wolves on 77 separate days near the Ekati Diamond Mine. The 117 observation are the highest number recorded since documentation began in 2001. Together, the 2016 to 2019 period are the four years with the highest numbers of incidental wolf observations (2016 [95 observations], 2017 [93], 2018 [79], and 2019 [117]). An active den was confirmed next to the airstrip on July 13, 2019 after an observation of 2 adult wolves with 2 wolves of unknown sex and age.

Wolverine

In 2019, there were 23 incidental observations of lone wolverines recorded on 18 separate days near the Ekati Diamond Mine. Dominion has implemented adaptive mitigation measures to reduce the likelihood of attracting wolverines to site, including a proactive waste management program, increased educational awareness, improvements and regular examination and maintenance to the accommodation structures that inhibit possible access to buildings by wolverines, and proactive management activities that include site wide notifications about wolverine and other carnivore species near infrastructure.

Fox

During the 2019 reporting period, there were 113 incidental sightings of 148 individual foxes on 80 separate days near the Ekati Diamond Mine. The majority of observations (124 individuals) were red fox, 2 were arctic foxes, and the remainder (22) were unidentified species. Fox sightings were distributed among Misery Road, Sable Road, and the Ekati Diamond Mine Main Camp.

Fewer fox observations were recorded incidentally during the 2019 reporting period compared to the previous seven years, and 2019 is the second lowest year in terms of number of incidental fox observations since recording fox activity began in 2007. During baseline studies in the Ekati Diamond Mine study area, arctic foxes were more commonly reported than red foxes. Currently, however, the red fox appears to be more common near the Ekati Diamond Mine, accounting for 98% of fox observations in 2019. Two active fox dens were confirmed at the Ekati Diamond Mine in 2019. One den was confirmed at the Ekati Main Camp and a second active fox den was confirmed at Lynx Road, a location where active fox dens have been observed in past years. A possible third den was reported on the 440 bench of Misery Pit on June 29, 2019, when 2 kits were observed walking on the bench.

There were no suspected cases of rabies observed in 2019.

Raptors

During the 2019 reporting period, there were 22 incidental sightings of 33 individual raptors over 20 separate days near the Ekati Diamond Mine. Five species of cliff-nesting raptors and one ground-nesting raptor species were observed incidentally, including bald eagle (7), common raven (11), peregrine falcon (4), gyrfalcon (1), rough-legged hawk (3), and northern harrier (1). In 2019, there was a common raven nest observed on fuel tank #1 at Sable where 2 adults were observed feeding 3 young in the nest. Additionally, there were two active common raven nests observed on the Incinerator Building that were presumed successful.

Dominion monitors pits at the Ekati Diamond Mine to identify raptor nesting activity, as a variety of bird species (including common ravens, peregrine falcons, rough-legged hawks, and gyrfalcon) will use pit walls as nesting habitat. In 2019, there was nesting activity confirmed at the following inactive or underground pits: Fox, Koala, Koala North, Panda, and Misery Pits. One or more successful nests were confirmed or suspected to have been raised at these pits. The majority of pit wall raptor survey effort was directed towards daily raptor monitoring at the active, open pits in 2019 (Lynx, Pigeon, and Sable Pits). Several additional pairs of raptors attempted to establish nests in these active pits, but the deterrence methods were successful at preventing raptors from establishing more active nests within the Lynx and Sable Pits. A peregrine falcon nest was established on June 12, 2019 at the active Pigeon Pit, despite substantial efforts made by personnel to actively deter nest establishment. After consultation with the GNWT, a nest relocation was attempted; however, the nest was abandoned by adults during the incubation phase.

Migratory Birds

The North American Breeding Bird Survey (NABBS) was conducted for the 17th year at the Ekati Diamond Mine in 2019. The NABBS is a standardized method for surveying birds that is conducted at over 400 locations across Canada. The data, which are compiled by the Canadian Wildlife Service, assists in the identification of trends in avian distribution and abundance on a continental scale. During the survey, 409 individuals of 26 species were recorded to species. Five species of conservation concern were observed during the 2019 breeding bird survey: red-necked phalarope, long-tailed duck, Harris's sparrow, yellow-billed loon and northern pintail. Red-necked phalarope, listed as a VEC species, is listed as "Sensitive" in the Northwest Territories and is assessed as species of Special Concern by COSEWIC in November 2014 and was listed on the SARA, Schedule 1 as Special Concern in May 2019. Long-tailed duck, yellow-billed loon, and northern pintail are also listed as "Sensitive" in the Northwest Territories. Harris's sparrow is listed as "Threatened" by COSEWIC and is under consideration for addition on the SARA Schedule 1. During the 2019 reporting period, there were 38 incidental bird sightings. The sightings were of 126 individual birds from 17 species or species groups.

Other Wildlife Observations

In 2019, there were twenty-three incidental sightings of moose recorded (in groups of 1 to 4 animals) over 18 separate days near the Ekati Diamond Mine, all of which occurred < 500 m from infrastructure. Observations of moose have become more common in recent years at the Ekati Diamond Mine, with a total of 68 moose individuals recorded between 2013 and 2019. A drill crew reported a sighting of a group of 10 animals on November 27, 2019 that they believed to be muskox; species identification was unconfirmed.

APPENDIX I
2019 Geotechnical Inspection Report

EXECUTIVE SUMMARY

Tetra Tech Canada Inc. (Tetra Tech) completed the annual geotechnical inspection of the water control structures at the Ekati Diamond Mine (Ekati) during July 16 to 19, 2019. Ten structures were visually assessed during the 2019 inspection including Panda Diversion Dam, Long Lake Outlet Dam, Intermediate Dike B, King Pond Dam, Waste Rock Dam, Desperation Pond Cofferdams, Bearclaw Diversion Dam, Intermediate Dike C, Two Rock Dam and, Two Rock Filter Dike. Each review consisted of visual observations and collection and review of ground temperatures and settlement survey data where possible.

The Panda Diversion Dam is in good condition with ground temperature data indicating that the core is well below freezing due to the thermosyphons. No effort is required at this time to maintain the dam's continued performance.

The Long Lake Outlet Dam is in good condition, and its core remains cold due to the thermosyphons installed through the dam in the original creek area. Dike B is in good condition. The repair area on the west side of Dike C continues to show some settlement; however, flow through the base of the dike has been visibly reduced. Additional wave related erosion and exposed filter was noted on the east side of the dike.

The Bearclaw Dam is in good condition; previously noted erosion in the intake jetty has not worsened from previous inspections. The diversion pipeline and outfall blanket are all functioning as intended. The dam core remains cold due to the thermosyphons.

The King Pond Dam, Waste Rock Dam, and Desperation Pond Cofferdams at the Misery site are in good condition. The water levels in the Waste Rock Pond and Desperation Pond should be lowered prior to freeze-up in 2019, as required, to an elevation consistent with the recommendations in the respective design reports for the structures. Water elevations in King Pond should also be lowered over winter to reduce heat loading on the dam foundation.

The Two Rock Dam is in generally good condition. The filter dike is in generally good condition but has some tension cracking at the north abutment. The cracking is likely a result of some initial settlement after completion of construction. The cracks should be filled in and monitored.

The frequency of ground temperature monitoring of all water control structures at the Ekati and Misery mines was reduced to four times per year (April, July, September, and November) after 2005. The survey monitoring data for the dam structures was also reviewed in 2005. In 2005 and earlier, the horizontal component of the movement for all structures only indicated apparent movements that were the result of the tolerance of the survey equipment and monument installation methods. Accordingly, it was recommended that the survey should only collect vertical movement data in the future. This has been the case for the settlement surveys completed since 2006. The frequency of the survey data collection was reduced to annual measurements.

APPENDIX J
2018 Annual Report Responses to Comments

Comment ID	Topic	Comment	Recommendation	Dominion Response
GNWT 1	Waste totals	It is unclear how Section 4.6 relates to Figure 2 (2018 Ekati Diamond Mine Solid Waste Summary). For example: • Figure 2 notes that 1,829,366 wet metric tonnes (wmt) of solid waste was produced from Lynx to Lynx WRSA while Section 4.6 notes 2,004,732 wmt of Lynx solid waste; • Figure 2 states 7,423,672 wmt from Pigeon Open Pit to Pigeon WRSA and Section 4.6 notes 4,085,455 mwt of Pigeon solid waste; • Similar for Sable and MUG.	The Government of the Northwest Territories (GNWT) requests that Dominion clarify why inconsistencies exist between Figure 2 and Section 4.6 relates to waste volumes.	Section 4.6 reports "Summary of Operational Activities for the Next Reporting Year". The values from Section 4.6 are projected values for 2019 and the values reported in Figure 2 are for the reporting year, 2018.
GNWT 2	Appendix A – SNP Summary	Appendix A seems to lacking information. For example, WL requirements at 1616-30a include TSS, major ions, metals, etc. but the report only includes a few parameters (p. 80). As well, 1616-30b appears to not be included at all as well as several other stations that are listed as "Active" in the water licence but are absent from the report. If active SNP stations were not sampled or were not reported, this should be explained in the summary.	The GNWT requests that Dominion clarify why all parameters and active SNP locations are not included in the Appendix A summary.	For Appendix A, historically Dominion has only reported parameters that have a corresponding applicable EQC in Water Licence W2012L2-0001. Full reporting for all parameters is released monthly as part of the SNP Report. Dominion is open to expanding Appendix A to include all parameters if reviewers would find the additional information useful. Not all "active" SNP locations are triggered in any given year. Depending on the "Sampling Frequency" and the "Rationale for Station" provided in the SNP, some sampling in "active" stations may not be necessary. For example, the sampling frequency for 1616-30b reads "*On the first day of Discharge, weekly during periods of Discharge, and on the final day of Discharge*." No Discharge occurred for this station in 2018, and thus no sampling was triggered. The SNP also lists some stations as "active" that are no longer applicable, such as 0008-Sa1 for monitoring the quality of water entering the receiving environment from Sable Lake. Sable Lake has been dewatered and is now Sable Pit, so this station is no longer relevant. Dominion recognizes the opportunity to work with the Board to update the SNP based on current operations.

GNWT 3	Hardness	Water Licence W2012L2-0001 includes an accommodation for hardness as a toxicity modifying factor for several monitoring parameters. During the review of the 2017 Annual Report, the GNWT Department of Environment and Natural Resources (GNWT-ENR) and the Independent Environmental Monitoring Agency (IEMA) requested that the reporting of these hardness values would be beneficial. In response, Dominion notes that in future reports the hardness values used for calculation the EQC would be specified in Appendix A. Of note, the following hardness values are relevant in relation to Water Licence W2012L2-0001: • Chloride, nitrate and sulphate at SNP Station 1616-30 (LLCF) based on hardness from the effluent at the same time; • Cadmium, chloride, nitrate and sulphate at SNP Station 161643 (King Pond) based on hardness from receiving environment, Cujo Lake (1616-48) during open water; • Nitrate and sulphate at SNP Station 1616-47 (Desperation Pond) based on hardness of most recent open water sample from effluent from most recent sample during open water; • SNP Station Jay 0005-a is not active but uses hardness in Lac du Sauvage. Hardness is supplied for 1616-30a LLCF Cell E Upstream of Leslie Lake. Of note, 1616-30b is also a compliance point in the water licence but information is not provided for hardness or other data for that point. Hardness has been provided for Cujo Lake but no information has been provided for 1616-47 related to Desperation Pond.	The GNWT requests clarification on whether sampling occurred at 1616-30b and 1616-47. If so, data should be provided in the summary including hardness.	As per Dominion's response to Comment "GNWT 2", 1616-30b and 1616-47 were not triggered in 2018 and no sampling took place. Any water movement in these areas would have been noted in Figure 1 of the Annual Report.

GNWT 4	Chloride	The GNWT notes that the chloride EQC for several locations (as outlined above) are hardness dependent. Of note, Appendix A notes the calculated limits for chloride at King Pond Settling Facility are 558.19 mg/l maximum average and 1116.39 mg/L maximum grab. While the GNWT is aware that the actual concentrations in the effluent (<5 mg/L) did not approach this value, these calculated values appear to be quite high and could potentially be classified in the brackish range should they occur. As well, it is unclear should concentrations reach the calculated maximum limits if there would be any potential for acute lethality.	The GNWT requests that Dominion discuss their confidence that there would be no acute lethality in the King Pond Settling Facility effluent should concentrations reach the hardness adjusted EQC for chloride.	There was an error in the maximum concentration of any grab sample (maximum grab) result noted in the report (1116.39 mg/L). The maximum grab result is the minimum of 2 calculations (Water Licence PART H Condition 21(b)) The maximum result was presented in the report instead of the minimum. The minimum result that should have been used as a Max Grab for 2018 is 753 mg/L. As noted by the GNWT, the actual concentration in the effluent did not approach this value (< 5 mg/L).
GNWT 5	Closure	Appendix F includes closure report dated January 2, 2018 but based on content (2018 reporting) ENR assumes that is a typo and should be 2019.	The GNWT requests that Dominion confirm that the closure report contained within Appendix F is related to 2018 and was submitted in January 2019 as opposed to January 2018.	Dominion confirms that this cover letter for the 2018 Closure and Reclamation Progress Report should have been dated January 2, 2019.
GNWT 6	Bearclaw Lake	Under water management, there is reference that "A total of 195,454 m3 of water was pumped from Bearclaw lake to North Panda Lake from July 26 to September 9, 2018." The GNWT's understanding is that this discharge was authorized in the past but it is unclear if it was requested in 2018 or reported in Dominion's SNP Reports.	The GNWT requests that Dominion clarify if water was pumped from Bearclaw Lake to North Panda Lake in 2018 and if so, how this was reported and/or authorized.	After discussions with the Inspector, it was determined that formal authorization for this internal movement of water from one freshwater body to another was not necessary. Dominion manages water elevation within Bearclaw Lake to resemble natural water elevation. The movement of water between Bearclaw Lake and North Panda Lake was first reported in this Annual Report.
GNWT 7	Format	Overall, it was somewhat difficult to navigate the annual report. Future reports should include bookmarks for such a large document. While some of the table of contents were linked, it was still difficult to navigate once in the middle of the document, especially when referencing appendices.	The GNWT recommends that future reports include additional bookmarks for each section and the appendices to assist reviewers in referencing during review.	Thank you for this suggestion. Dominion will consider including additional bookmarks to make it easier to navigate future reports.

GNWT 8	Seepage Surveys	Section 3.2 provides a summary of seepage surveys. The GNWT notes that there were a total of 26 new seeps this year which more than typical. This would be worth noting in the summary in the body of the report.	The GNWT recommends that future reports include a summary of the amount of new seeps that were identified and commentary of how this relates to previous years.	Dominion can include this information in the body of the report in the future. Table 11.1 of the 2018 Seepage Survey report indicates the monitoring stations which were established in 2018.
GNWT 9	Seepage Surveys	The GNWT notes that “seeps of potential concern” classification regarding the seepage survey was implemented in 2018. While mentioned in the executive summary in the appendices, it would have been worth noting the summary in the body of the report, as well as a comment that there were 4 new seeps of potential concern in 2018 for a total of 8.	The GNWT recommends that future reports include a summary of the amount of seeps of potential concern that were observed in the previous year and how this relates to the total amount on site.	Dominion can include a summary of amount of the seeps of potential concern in future reports.
GNWT 10	Waste Rock	The GNWT notes that Section 3.2 contains limited information regarding waste rock. Additional information such as the number of samples per area could have been beneficial to reviewers.	The GNWT recommends that future reports include the number of geochemical samples of waste rock that have occurred for each area of interest.	Dominion can include the number of geochemical samples of waste rock that have occurred for each area of interest in future reports. This information is available under section 2.1.1 of the 2018 Seepage Survey report.
GNWT 11	Surveillance Network Program (SNP)	Section 4.5.1 lists a number of missed SNP samples but it is unclear as to the reason they were missed. The references September 12, 2018 letter may contain that information and if so it should have been summarized or attached.	The GNWT recommends that future reports include rationale for any missed sampling.	In future reports, Dominion will provide rationale for any missing sampling, or provide links to applicable letters to the Inspector.
GNWT 12	Response Plans	Appendix A of Appendix D contains summaries of response plans that have been ongoing to date under the Aquatics Effects Monitoring Program.	Of note, the GNWT-ENR has been involved through the WLWB process in review and comments on these plans and will continue to do so as required.	Acknowledged.
GNWT 13	Spills	Spill summary should also include a “cause” column, e.g. malfunction, weather, human error. An additional column could be created or information could be included in the final column.	The GNWT recommends that future reports include a brief description of “cause” in the spill summary table.	Dominion will add a “cause” column to the spill summary table in future reports.

GNWT 14	Ammonium Nitrate Building	In Section 3.2 (Management Plans and Activities, Spill Contingency Plan and Hydrocarbon-Impacted Materials Management Plan referred to in part 1 of this Licence), the last sentence of the first paragraph of this section states "Version 12.0 incorporated the Incident Management Team (IMT) into the Plan; and also incorporated the outdoor storage of ammonium nitrate bulk bags adjacent to the Ammonium Nitrate Building." The Ammonium Nitrate Building is located within the Lease 76D10-2-2 boundaries. The GNWT notes that outdoor storage of ammonium nitrate is not technically allowed. The inspector granted Dominion permission for temporary storage for the 2018-2019 season only. Therefore, the GNWT finds the sentence misleading.	The GNWT recommends that future reports provide clarification, such as rewording the sentence to read "…also incorporated the temporary outdoor storage of ammonium nitrate bulk bags adjacent to the Ammonium Nitrate Building for the 2018-2019 season only."	If applicable, Dominion will make this clarification in future reports.
GNWT 15	Ammonium Nitrate Building	In section 4.5.2 Ammonium Nitrate Building of the annual report, Dominion reports that "One additional externally reportable spill of 63 kg took place several weeks later on April 20th." The GNWT notes that section Page 251 shows that spill 18-117 "has been clean up. Followed up to confirm clean up." It is unclear who confirmed the clean-up. The Inspectors April, May, and June Inspection reports normally contain a record of spill reports. Spill 18-117 is not accounted for in these 2018 inspection reports. Most spills of a certain volumes/mass are reportable to the 24 hour spill line, but not all of them. However, all spills of any size are reportable and should be closed.	The GNWT recommends that in future reports the summary of spill reports include closure of spill reporting and highlight where and when spills have been reconciled with the appropriate authority (i.e. LUP or WL Inspector).	In future reports Dominion will include which Inspection Reports from the GNWT Department of Lands Inspectors include details on the official closure of the spills with the GNWT Spill Line.
GNWT 16	Surface Leases and Mining Leases	Section 4.1.1 Surface Leases and Mining Leases – The first paragraph notes that Dominion holds 282 mineral leases and 10 surface leases issued subject to the *Territorial Lands Act*.	The GNWT recommends that future reports add a note that as of April 1, 2014, the Ekati leases became subject to the *Northwest Territories Lands Act* and the *Northwest Territories Lands Regulations*.	Acknowledged. This wording will be updated in future reports.

GNWT 17	Lease Size	Section 4.1.1 Surface Leases of Mining Leases – Table 11 Surface Leases: Row 76D/9-11-1 indicates a size of 173 hectares (ha). According to the Territorial Lands Administration records, the size of 76D/9-11-1 is 173.1 ha.	The GNWT recommends that future reports clarify the size of 76D/9-11-1. Therefore, the GNWT requests the Surface Lease size total also be corrected accordingly.	Acknowledged, this slight discrepancy will be addressed.
IEMA 1	Section 3.2(j)	Section 3.2(j) states "*Tabular summaries of data and information generated under the Surveillance Network Program and graphical summaries of parameters in the effluent quality criteria under Part H at the points of compliance (SNP stations 1616-30, 1616-43, 1616-47, 0008-Sa3, Jay-0005a/b) in an electronic format acceptable to the Board.*" Some of the tabular information is provided in Appendix A. This is a compliance issue since the graphical summary of EQC parameters is not provided.	Dominion provide the graphical summaries as required.	Dominion will resubmit the Annual Report with the graphical summaries in the coming weeks.
IEMA 2	Section 3.2 (n)(vi)	Section 3.2 (n)(vi) asks for updated geochemical test work that has been done. The section does not present any data, it simply references the tables that can be found in the WROMP. It also goes on to provide a very brief selective summary of results. This is a compliance issue because Dominion has not presented the data required under the WL. This concern was also raised by the Agency in last year's report.	Actual data be presented in the body of the document or as an Appendix, accompanied by discussion results.	This geochemical test work is highly technical and is already discussed in great detail in the WROMP. Directing the reader to the WROMP is an effective method to provide the data without attempting to oversimplify the results. In the future, Dominion would be willing to provide direct links to the WROMP within the Annual Report.

IEMA 3	Term Non-Potentially Acid Generating	Section 3.2 (n)(vi) states that one key geochemical characterization result is that "The majority of rock types mined at the Ekati mine are not potentially acid generating or have low acid generating potential.". The use of total neutralizing potential vs. effective neutralizing potential represents a very optimistic best possible case in which all of the neutralizing potential is available. This does not occur under field conditions. Over the last several years the Agency and other reviewers have raised this concern. Dominion continues to use total neutralizing potential instead of determining the effective neutralizing potential. Best practices described in the Prediction Manual for Drainage Chemistry from Sulfuric Geologic Materials (MEND 2009) clearly outlines how effective NP should be used to determine the NP/AP ratio. This ratio is used to determine how rock is classified. Ratio <1 is potentially acid generating, ratio between 1-2 are uncertain and ratios over 2 are classified as non-PAG. These ratios are based on the use of effective NP not total NP. Therefore, since Dominion is not using effective NP in its calculations it cannot claim that a sample is or is not potentially acid generating.	Dominion not use the term non-acid generating or non-potentially acid generating in the annual report. This can only be determined once the calculations are made with effective NP rather than total NP.	Dominion has initiated a comprehensive evaluation to reconcile the effective neutralization potential and effective acid potential of waste rock at the Ekati Mine. This program is currently underway. The effective NP evaluation takes into account the main factors that can contribute to effective NP, in order to derive recommendations with respect to site-specific effective NP at the Ekati Mine. The ongoing Ekati Mine geochemical testing program, which forms the basis of the Ekati Mine geochemical dataset, has been carried out in accordance with the recommendations in MEND (2009). The program has been developed, implemented, and refined by several geochemical subject matter experts since 1997. The geochemical program is consistent with the recommendations in the Global Acid Rock Drainage Guide (GARD Guide; INAP (2009)). The GARD Guide was developed by an international consortium of industry, academic and consulting subject matter experts in the field of acid rock drainage. To date, the results of static tests and humidity cell tests have been used to make inferences with respect to acid generation potential of waste rock, using these widely applied industry standard methods. The results of laboratory testing are supplemented by field monitoring data, which have been collected over a period of 20 years. Until such time that the results of the effective NP evaluation are available to support a site-specific definition of effective neutralization potential, Dominion will continue to use the guidelines recommended by MEND (2009) and INAP (2009) (including the use of "total" NP) for interpreting acid base accounting results.

IMEA 4	Section 4.3.3 and Appendix H: Wildlife Effects Monitoring Program	The Wildlife Camera Monitoring Study initiated by Dominion in 2011 uses motion-triggered cameras to better understand how caribou respond to mine infrastructure and in particular to roads. Eighty-nine infrared motion-triggered cameras were deployed in 2018 along Misery, Sable and Jay roads, as well as at the Narrows between Lac du Sauvage and Lac de Gras. A few preliminary results from cameras located in 2018 near Misery/Jay are included in the 2018 WEMP but due to "logistical delays in processing camera data", no comprehensive analyses were presented from 2017 or in 2018 (the 2017 WEMP promised an addendum report by summer 2018), and now Dominion states they will next produce a camera report in 2020. In response to the Agency review of the 2017 WEMP Dominion stated that the camera program measures the success of the caribou road crossing ramps. Since the last report of camera data covered to 2015, it appears that there is limited real-time monitoring and analysis of the success of the ramps and the permeability of the mine site to caribou. The EA and WL report states "The WEMP also assesses the effectiveness of wildlife mitigation and management efforts" (s 4.3.3, pg. 4-15). Given the high caribou use of the area between the main camp and Sable pit and concerns from the current depressed state of caribou numbers, the Agency considers understanding the success of the ramps and thus the permeability of the mine site of paramount importance.	Dominion should provide an updated camera program report by fall 2019 with detailed analysis and synthesis of the data collected to date.	As stated in a letter dated December 20, 2018 notifying parties that the camera report submission would be deferred, the next camera report will be produced in 2020. There is no possibility that the report can be produced in the fall of 2019.

IEMA 5	Site Permeability	The highest density of caribou observations using aerial and ground methods tends to occur along the Sable Road, emphasizing the importance of this area to caribou habitat and movement. Although the WEMP provides data on wildlife management actions emanating from incidental surveys, road surveys and the Caribou Road Mitigation Plan (CRMP), there is no analysis integrating the monitoring data to determine how effective these management actions are on overall site permeability. The camera data (when reported) may provide an indication of crossing success at the fine scale once caribou are at designated and monitored camera locations, but do not provide the larger-scale picture of how caribou may be moving through the mine site.	The WEMP should provide an analysis of caribou movement through the mine site. This could include use of the geofence collars to track individual collar movements. These analyses should be reported in the EA and WL report.	Dominion agrees that there is value in understanding the larger-scale picture of how caribou may be moving through the mine site. To date, Traditional Knowledge about caribou migration pathways have played a key role in understanding large-scale movement patterns through the Ekati mine site and other WEMP surveys (incidental data, camera program, snow track surveys, behavioural surveys, road and power line surveys) have assessed smaller-scale movements and interactions with roads and other infrastructure. Combining all these different data in a way that produces ecologically relevant results is an extremely complicated process to undertake. Dominion is open to suggestions from IEMA regarding processes by which all of this information could be integrated to provide results that would inform the assessments of the effectiveness of mitigations or provide ecologically meaningful results to inform onsite and range-wide management of caribou. While Dominion has provided financial support for the installation of 50 geo-fenced collars to collect information on caribou movement specific to the Ekati Diamond Mine, the geo-fenced collar data on its own does not provide the context for finer scale animal-movement decisions (i.e., the predator landscape, terrain, or habitat/vegetation). Further interpretation about how a specific caribou interacts with site and chooses its specific path of motion near the mine is required in order to interpret the geo-fenced collar data in a meaningful and accurate way. The Government of Northwest Territories (GNWT) is currently tasked with determining larger-scale regional analysis and interpretation options for this data, with financial support from Dominion. Furthermore, with only a small proportion of the population marked with collars (maximum of 50 individuals) and a potentially smaller proportion fitted with geo-fenced collars, sufficient time is required in order to generate enough data points/interactions with the mine site to produce meaningful results. Until there is enough data and an agreed approach for the analysis of geo-fenced collar data, Dominion will continue to assess

				caribou interactions with the mine through other data sources (i.e., incidental surveys, road surveys, Caribou Road Mitigation Plan (CRMP), Remote Camera Program). The next analysis of site permeability will be provided in the 2020 camera report and in a Zone of Influence Report. Dominion plans to continue to engage with GNWT and the Wek'èezhìi Renewable Resources Board to determine the most effective ways to support initiatives in caribou re-covery at a regional scale. Dominion would like to request that IEMA provides references when making statements like "The highest density of caribou observations using aerial and ground methods tends to occur along the Sable Road, emphasizing the importance of this area to caribou habitat and movement." Without proper references it is difficult for Dominion to be certain if IEMA is stating opinion or data supported facts. While it is accurate that the proportion of suitable caribou habitat generally increases to the north of the mine site, that trend does not necessarily correlate with increases in the relative abundance of caribou in a predictable and consistent manner year to year or season to season.

IEMA 6	AEMP Results – Fish	The AEMP section describing potential impacts to fish in the Koala watershed states: *Mine-related changes in three fish tissue metals were identified (increase in mercury, selenium, and strontium concentrations). Potential mine-related changes were detected for four biological fish indicators (decrease in Slimy Sculpin catch-per-unit-effort, Lake Trout condition, and Round Whitefish egg count, and an increase in Round Whitefish internal parasites) and two fish tissue metals (increase in mercury and molybdenum concentrations). These changes will continue to be monitored as part of the annual AEMP to assess whether they are indeed mine-related.* The section has a similar treatment of contaminants in fish of the King-Cujo watershed. Descriptions of fish monitoring in these watersheds are very brief and do not go into any detail regarding the fish tissue results. Mine related increases of Mercury, Selenium and Strontium in fish tissues are important findings that should have much greater explanation. The Environmental Agreement states the Annual Report shall contain results and findings of studies and research conducted and also actions taken or planned to address impacts (p.11). Even though this is the plain language report it should still go into greater detail in terms of describing what these changes in concentrations mean. For example, it should include fish species, detailed results and what work is being implemented to address these results. In addition, the last sentence of this paragraph is misleading. Changes in fish metrics and contaminants are said to be monitored in the annual AEMP. However, fish are only monitored every 3 (sculpin) and 6 years (harvestable species). So a reader, interested in fish effects from the Ekati mine, who only reads the EA & WL Annual Summary Report may get the mistaken impression that further fish monitoring results will be available in 2020 and 2021.	In order to comply with the Environmental Agreement, Dominion should resubmit the plain language report to provide greater detail in regards to the increases of metals in fish tissues including what work is being done to address the concern. Dominion should revise the last sentence in these AEMP fish section paragraphs to state plainly that changes in fish will continue to be monitored in 3 and 6 years	A high-level summary of results from the AEMP is provided in the Annual Report, in accordance with the direction provided in the Environmental Agreement. The high-level summary includes fish species (i.e., Lake Trout and Round Whitefish) in addition to the Action Level exceedances and an update on the associated Response Plan which address what work is being done based on the exceedances. Monitoring, analyses, and review of fish tissue metals and biological characteristics of fish is highly complex and is described in detail within the AEMP Annual Report and Fish Response Plan. Providing more detail in a plain language report without the appropriate technical information and context for support, could confuse and mislead readers. In addition, the fish component of the AEMP is one of a multitude of important components included within the AEMP Annual Report and as such, the same level of information is provided. Therefore, an appropriate level of detail has already been included in the plain language report so as not to confuse readers with insubstantial explanations without the corresponding technical support. Direction has been provided to readers, should they wish to read the comprehensive detailed AEMP Annual Report, Response Plans and the comments and responses as part of the review process. As per GNWT direction, Dominion will resubmit the Plain Language Summary in the coming weeks.

IEMA 7	Response Plans	The AEMP section identifies phosphorus as exceeding a site-specific benchmark in both the Koala and King-Cujo watersheds, but it does not give an analysis of how that might affect the ecology in the affected lakes, nor state what actions if any the company is taking to mitigate it.	Dominion give a fuller account of the possible effects and mitigative actions to address exceedance of phosphorus measured in AEMP lakes in 2018.	As per the response to IEMA 6, a high-level summary of results from the AEMP is provided in the plain language report, in accordance with the direction provided in the Environmental Agreement. The high-level summary includes a comparison to benchmarks, in addition to the Action Level exceedances and an update on the associated Response Plans. Similar to fish, monitoring, analyses, and review of total phosphorus is highly complex and is described in detail within the AEMP Annual Report and Total Phosphorus Response Plan. Providing more detail in a plain language report without the appropriate technical information and context for support, could confuse and mislead readers. Therefore, an appropriate level of detail has already been included in the plain language report so as not to confuse readers with insubstantial explanations without the corresponding technical support. Direction has been provided to readers, should they wish to read the comprehensive detailed AEMP Annual Report, Response Plans, and the comments and responses as part of the review process.
IEMA 8	Non PAG Waste Rock	The 2018 Plain Language Summary states that "The testing results indicated that the geochemical characteristics of waste rock in 2018 were similar to previous years – which showed that the majority of rock types stored in waste rock piles (including granite) at the Ekati Diamond Mine are not potentially acid generating or have low acid generating potential" (p-26). As stated in the technical report comments above the Agency does not feel that it is appropriate for Dominion to continue to refer to rock at Ekati as non-PAG until it has been able to present the calculation using effective NP.	Dominion not use the term non-acid generating or non-potentially acid generating in the annual report. This can only be determined once the calculations are made with effective NP rather than total NP.	See response to IEMA 3.