DOMINION DIAMOND

APPENDIX 3A

MINE WATER MANAGEMENT PLAN

October 10, 2014

DOMINION DIAMOND EKATI CORPORATION
LAC DU SAUVAGE
NORTHWEST TERRITORIES
CANADA

Jay Project
Mine Water Management Plan

Submitted to:
Dominion Diamond Ekati Corporation
PO Box 2190
Yellowknife, Northwest Territories
X1A 2P6

Attention: Mr. Mats Heimersson

REPORT

Reference Number: 1313280041-E14056-R-Rev0-2020

Distribution:

1 Electronic Copy - Dominion Diamond Ekati Corporation
1 Hard Copy - Dominion Diamond Ekati Corporation
2 Hard Copies - Golder Associates Ltd.

Golder Associates

Study Limitations

Golder Associates Ltd. (Golder) has prepared this document in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this document. No warranty, express or implied, is made.

This document, including all text, data, tables, plans, figures, drawings and other documents contained herein, has been prepared by Golder for the sole benefit of Dominion Diamond Ekati Corporation. It represents Golder's professional judgement based on the knowledge and information available at the time of completion. Golder is not responsible for any unauthorized use or modification of this document. All third parties relying on this document do so at their own risk.

The factual data, interpretations, suggestions, recommendations and opinions expressed in this document pertain to the specific project, site conditions, design objective, development and purpose described to Golder by Dominion Diamond Ekati Corporation, and are not applicable to any other project or site location. In order to properly understand the factual data, interpretations, suggestions, recommendations and opinions expressed in this document, reference must be made to the entire document.

This document, including all text, data, tables, plans, figures, drawings and other documents contained herein, as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder. Dominion Diamond Ekati Corporation may make copies of the document in such quantities as are reasonably necessary for those parties conducting business specifically related to the subject of this document or in support of or in response to regulatory inquiries and proceedings. Electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore no party can rely solely on the electronic media versions of this document.

Table of Contents

STUDY LIMITATIONS i

ABBREVIATIONS 1

UNITS OF MEASUREMENT 1

1.0 INTRODUCTION 2

1.1 Concordance with Project General Requirements 3

2.0 PHYSICAL SETTING 4

2.1 Site Characteristics 4

2.2 Climate 4

2.3 Wind 6

2.4 Permafrost 6

2.5 Groundwater 7

3.0 WATER MANAGEMENT 8

3.1 Definitions 8

3.2 Water Management Objectives and Strategies 8

3.3 Water Management Facilities 9

3.4 Water Management Plan 10

3.4.1 Construction Phase 14

3.4.1.1 Turbidity Management during Dike Construction 14

3.4.1.2 Diked Area Dewatering 15

3.4.1.3 Sub-Basin B Stream Flow Diversion 18

3.4.2 Operations Phase 18

3.4.2.1 Jay Waste Rock Storage Area 19

3.4.2.2 Jay Dike Seepage 19

3.4.2.3 Haul Roads 19

3.4.2.4 Sub-Basin B Stream Flow Diversion 19

3.4.2.5 Lynx Pit 20

3.4.3 Closure and Post-closure Phase 20

4.0 DESIGN OF WATER MANAGEMENT FACILITIES 21

4.1 Water Management Design Basis 21
4.2 Jay Dike 23
4.3 Sub-Basin B Diversion Channel 24
4.4 Lynx Pit 25
4.5 Misery Pit 25
4.6 Jay Runoff Sump and Mine Inflows Sump 26
4.7 Pumping and Pipeline 26
4.8 Diffuser Outfall 28
4.9 Changes in Hydrologic Conditions 28
4.10 Additional Water Management Considerations 29

5.0 MINE CLOSURE AND RECLAMATION 31

5.1 Closure Back-Flooding 31
5.2 Waste Rock Storage Area 33
5.3 Dike, Channel, and Sumps 33
5.4 Buildings, Roads, and Infrastructure 34

6.0 WATER BALANCE 35

6.1 Conceptual Water Balance Framework 35
6.2 Water Balance Assumptions 35
6.3 Water Balance Results 36

7.0 WATER QUALITY 38

7.1 Model Inputs and Simulations 39
7.2 Model Results 40
7.2.1 Operations 40
7.2.2 Post-closure 42
7.2.2.1 Misery Pit 42
7.2.2.2 Jay Pit Monimolimnion 44
7.2.2.3 Jay Waste Rock Storage Area 44

8.0 MINEWATER MONITORING AND ADAPTIVE MANAGEMENT PLAN 45

8.1 Minewater Monitoring Program 45
8.1.1 Pre-development Stage 45

8.1.2 Construction Stage ... 46
8.1.3 Operations Stage ... 46
8.1.4 Closure Stage ... 46
8.1.5 Post-closure Maintenance and Monitoring ... 47
8.2 Receiving Environment Monitoring Program and Aquatic Response Framework ... 47
8.3 Adaptive Management ... 47
9.0 CLOSURE ... 49
10.0 REFERENCES ... 50

TABLES

Table 2-1: Summary of Average Annual Climate Data for the Jay Project Site ... 5
Table 2-2: Derived Annual Precipitation under Extreme Conditions ... 5
Table 2-3: Derived 24-hour Extreme Rainfall ... 6
Table 3-1: Mine Development Sequence ... 12
Table 3-2: Dewatering Volumes and Duration ... 16
Table 3-3: Summary of Dewatering Strategy ... 17
Table 4-1: Average Annual Groundwater Inflow Quantity and Quality Predicted for the Jay Open Pit ... 22
Table 4-2: Sub-Basin B Diversion Channel – Design Characteristics ... 25
Table 4-3: Pipeline Design Characteristics ... 27
Table 5-1: Proposed Closure Back-Flooding Summary ... 32
Table 6-1: Water Balance Model Summary ... 37
Table 7-1: Projected Misery Pit Discharge Water Quality during Operations ... 41
Table 7-2: Maximum Jay Project Discharge Water Quality during Post-closure ... 43

FIGURES

Figure 1-1: General Location Plan
Figure 3-1: Construction Summer 2016
Figure 3-2: Construction Summer 2017
Figure 3-3: Construction Summer 2018
Figure 3-4: Dewatering Phase
Figure 3-5: Operations Phase
Figure 3-6: Conceptual Closure Plan

Figure 3-7: Conceptual Post-closure Plan

Figure 6-1: Water Balance Flow Chart

Figure 6-2: Misery Pit Inflows – Dewatering, Operations, and Closure

Figure 6-3: Misery Pit Outflows – Dewatering, Operations, and Closure

Figure 6-4: Diked Area Inflows – Dewatering, Operations, and Closure

Figure 6-5: Diked Area Outflows – Dewatering, Operations, and Closure

Figure 6-6: Jay Pit Inflows – Dewatering, Operations, and Closure

Figure 6-7: Jay Pit Outflows – Dewatering, Operations, and Closure

Figure 7-1: Projected Misery Pit Discharge Water Quality – Operations

Figure 7-2: Projected Misery Pit Discharge Water Quality – Post-closure

APPENDICES

APPENDIX A
Back-Flooding Recommendations for Closure

APPENDIX B
Water Balance Inputs

ABBREVIATIONS

Abbreviation	Definition
AEMP	Aquatic Effects Monitoring Program
ANFO	ammonium nitrate fuel oil
ARF	Aquatic Response Framework
Cl	Chloride
CSB	cement soil bentonite
CSP	corrugated steel pipe
DAR	Developer's Assessment Report
Dominion Diamond	Dominion Diamond Ekati Corporation
Golder	Golder Associates Ltd.
ICRP	Interim Closure and Reclamation Plan
MWMP	Mine water management plan
MVRB	Mackenzie Valley Review Board
n/a	not applicable
NO_3	Nitrate
NWT	Northwest Territories
TDS	total dissolved solids
TP	total phosphorus
TSS	total suspended solids
WRSA	waste rock storage area

UNITS OF MEASUREMENT

Unit	Definition
%	percent
°C	degrees Celsius
in	inch
km	kilometre
km^2	square kilometre
km/h	kilometres per hour
m	metre
m^3/day	cubic metres per day
m^3/hr	cubic metres per hour
masl	metres above sea level
mg/L	milligrams per litre
mg N/L	milligrams nitrogen per litre
mm	millimetre

1.0 INTRODUCTION

Dominion Diamond Ekati Corporation (Dominion Diamond) has retained Golder Associates Ltd. (Golder) to conduct a pre-feasibility study for the mining the Jay kimberlite pipe deposit (Jay Project) at its Ekati Diamond Mine (Ekati Mine) in the Northwest Territories (NWT).

The Jay Project involves the development of the Jay kimberlite pipe, which is located beneath Lac du Sauvage, approximately 300 kilometres (km) northeast of Yellowknife and 200 km south of the Arctic Circle. The dewatering of part of Lac du Sauvage (diked area) and the diversion of headwater flows are required before commencing mining activities. The dewatered area will be maintained throughout the life of the mining operations by pumping.

The kimberlite ore will be mined from the Jay pipe using an open pit mining method. The kimberlite ore from the Jay pipe will be processed at the existing Ekati Mine facilities. The current mine plan indicates that approximately five million tonnes of ore will be annually mined from the Jay pipe over a nominal 10-year mine life (Dominion Diamond 2014a, Section 3). There is a potential to mine additional reserves with underground mining methods after the open pit is complete, and this could add approximately six years to the mine life.

The main proposed mine facilities in the Jay Project area include a containment dike, an open pit, roads, pumping and pipeline systems, ore transfer pads, a waste rock storage area (WRSA), and a diversion channel. A location plan of the Jay Project is shown in Figure 1-1. As part of the pre-feasibility study, Golder has been requested to develop a mine water management plan (MWMP) for the Jay Project. The MWMP describes the strategies proposed for water and sediment management throughout the main stages of project development: construction, operations, and closure/post-closure.

The MWMP is focused on the Misery-Lac du Sauvage area where new mine infrastructure is introduced by the Jay Project. Existing water management structures at the Ekati site will be used as part of the Jay Project (e.g., Panda Diversion Channel, Grizzly Lake and other licenced water sources, and runoff collection sumps in the main camp and Panda/Koala areas). The layout and operations of these structures will not be modified by the Jay Project. A description of these facilities is provided in Section 3 of the Developer's Assessment Report (DAR) (Dominion Diamond 2014a).

The MWMP has been prepared to a preliminary design stage. The proposed infrastructure layout is conceptual; final alignments and dimensions will be confirmed during next stages of design and may be subject to change based on ongoing data collection, regulatory and community engagement, and design iteration. The MWMP will be reviewed and updated as the Jay Project proceeds into detailed design, construction, operations and closure, and as additional information becomes available from field investigation programmes and monitoring activities.

The MWMP is presented in the following sections of the report:

- a brief summary of the physical setting at the mine site (Section 2);
- a description of the proposed water management at the Jay Project site (Section 3);
- a summary of the design of the main water management infrastructure (Section 4);
- a discussion on the mine closure and reclamation (Section 5);
- a presentation of the water balance model and its results (Section 6);

- a presentation of the site water quality model and its results (Section 7); and,
- a description of the monitoring plan and adaptive management plan (Section 8).

This report has been prepared in accordance with the “Study Limitations,” which are presented at the beginning of the report. The reader’s attention is specifically drawn to this information for reference during use of this report.

1.1 Concordance with Project General Requirements

The purpose of this document is to address the general requirements in the Terms of Reference issued by the Mackenzie Valley Review Board (MVRB) for the Jay Project (Dominion Diamond 2014a, Appendix 1A), and specifically those relating to mine water management. The Terms of Reference for the Jay Project, including DAR section and page number referencing, are summarized in the main DAR concordance table (Dominion Diamond 2014a, Appendix 1D).

2.0 PHYSICAL SETTING

2.1 Site Characteristics

Located in the Canadian sub-Arctic, the general physical setting of the Jay Project is typical of a remote northern environment. Cold winter conditions dominate the site, with only approximately four months of spring/summer/fall where daily temperatures are above freezing. Winters are long, and daily temperatures often fall below -30 degrees Celsius (°C) during winter months.

The Jay Project is located in the Lac du Sauvage basin, which has a drainage area of 1,461 square kilometres (km^2) and is the largest single tributary to Lac de Gras. The Lac de Gras drainage basin is located at the headwaters of the Coppermine River, which flows north into the Arctic Ocean at the hamlet of Kugluktuk. The topography across the site is generally flat with local surface reliefs rising up only 20 metres (m). Elevation ranges from approximately 416 to 465 metres above sea level (masl). The local terrain is characterized by boulder fields, tundra, and lakes/wetlands. The terrestrial vegetation is composed of species adapted to freezing temperatures, low nutrient levels, and localized areas of drought and standing water.

2.2 Climate

Climate characteristics presented herein were extracted from the Hydrology Baseline Report for the Jay Project (Dominion Diamond 2014a, Annex X). Long-term climate records for the Jay Project extending from 1959 to 2013 derived from regional and local climate stations were used to characterize the Jay Project climate. The site is located in a subarctic environment that experiences extreme winter conditions, with an annual average air temperature of -9.6°C. The monthly mean temperature ranges from -29.3°C in January to +12.5°C in July, with above-freezing means for only four months of the year (i.e., June to September).

The annual average total precipitation at the mine site is 344.5 millimetres (mm)/year and falls almost equally as snow and rainfall. Average annual evaporation for small water-bodies in the Jay Project area is estimated to be 272 mm between June and September. The average annual loss of snowpack to sublimation and snow redistribution is estimated be 30 percent (%) of the total precipitation for the winter period and occurs between October and May. A summary of the estimated precipitation, evaporation, and temperature characteristics at the Jay Project site is presented in Table 2-1.

Table 2-1: Summary of Average Annual Climate Data for the Jay Project Site

Month	Total Snowfall (mm)	Total Rainfall (mm)	Total Precipitation (mm)	Average Temperature (°C)	Total Evaporation (mm)
January	12.5	0.1	12.6	-29.3	0.0
February	12.2	0.0	12.2	-27.9	0.0
March	15.7	0.1	15.9	-24.6	0.0
April	16.8	1.0	17.8	-14.9	0.0
May	16.8	7.8	24.6	-4.0	0.0
June	4.8	26.2	31.0	7.4	65.8
July	0.3	43.5	43.8	12.5	105.0
August	2.3	55.3	57.5	10.6	68.6
September	18.2	29.0	47.2	3.8	32.6
October	36.2	3.7	39.9	-6.1	0.0
November	25.7	0.0	25.7	-18.8	0.0
December	16.3	0.0	16.3	-25.4	0.0
Annual	177.8	166.7	344.5	-9.6	272.0

Source: Dominion Diamond (2014a, Annex X).
mm = millimetre; °C = degrees Celsius.

A frequency analysis of the derived datasets provided estimates of extreme annual rainfall, snowfall, and total precipitation, under wet and dry conditions (Table 2-2). The Gumbel probability distribution best fit the rainfall data, the Normal probability distribution best fit the snowfall data, and the Pearson III probability distributions best fit the total precipitation data.

Table 2-2: Derived Annual Precipitation under Extreme Conditions

Conditions	Return Period (years)	Rainfall (mm)	Snowfall (mm)	Total Precipitation[a] (mm)
Wet	500	420	296	541
	200	379	284	519
	100	348	274	500
	50	317	263	481
	20	275	246	452
	10	243	232	427
	5	209	214	397
Median	2	158	180	343
Dry	5	121	146	291
	10	105	129	265
	20	92.9	114	244
	50	81.0	97.6	221
	100	73.7	86.6	206
	200	70.1	81.2	199
	500	68.0	78.0	194

Source: Dominion Diamond (2014a, Annex X).
a) High rainfall years may not be coincident with high snowfall years, so the sum of the rainfall and snowfall columns is not expected to equal the value in the total precipitation column.
mm = millimetre.

Extreme 24-hour rainfall depths were derived for the Jay Project and are summarized in Table 2-3. The Gumbel probability distribution was fit to the datasets.

Table 2-3: Derived 24-hour Extreme Rainfall

Duration	Rainfall Depths (mm)					
	2 Years	5 Years	10 Years	25 Years	50 Years	100 Years
24 hours	22.6	32.7	39.3	47.8	54.0	60.3

Source: Dominion Diamond (2014a, Annex X).
mm = millimetre.

2.3 Wind

Wind affects lake circulation patterns, lake currents, wave heights, wave run-up, wind set-up, and potential lake shore ice ride-up and pile-up, as well as snow redistribution and sublimation. Wind also affects sensible heat transfer between the air and the earth surface. This in turn affects lake evaporation, basin evapotranspiration, snowmelt rate, lake ice freeze-up and break-up, and lake water temperature.

The dominant wind patterns change during the summer ice-free period, which occurs nominally between June and October, and the winter ice-bound period, which typically occurs between November and May. During the summer, the predominant wind direction is from the east-northeast, and there are a smaller percentage of winds observed from the northwest than seen in the full-year wind-rose. During the winter, winds from the east, east-northeast, west-northwest, and northwest dominate the wind pattern. Winds have been frequently recorded at speeds greater than 30 kilometres per hour (km/hr) (Dominion Diamond 2014a, Annex I).

2.4 Permafrost

The Jay Project site is located within a region of continuous permafrost. The layer of permanently frozen soil and rock generally extends deep below the ground surface and is overlain by a seasonally thawed active layer. The depth of the active layer in the Misery Pit area ranges from approximately 1 to 2.7 m. The depth of the active layer in the Jay Project area (on land facilities) is expected to be similar to that measured near the Misery Pit area. The Permafrost Baseline Report describes the permafrost conditions prior to the development of the Jay Project (Dominion Diamond 2014a, Annex IV).

The depth of permafrost beneath the land mass at the Jay Project site is estimated to be approximately 320 to 485 m based on thermistor installations. The estimated depth of zero annual amplitude from the temperature profiles range from 15 to 30 m. The temperatures at the depths of zero annual amplitude are in the range of -4.0°C to -6.1°C. The geothermal gradient is in the range of 0.012 degrees Celsius per metre (°C/m) to 0.018°C/m.

Unfrozen zones (talik zones) exist beneath larger waterbodies. The taliks can be open, where the ground beneath the lake is completely thawed, or closed, where at some depth permafrost exists beneath the lake. Areas with open taliks are connected to the deep groundwater flow regime. An open talik is expected to exist beneath the majority of Lac du Sauvage; therefore, the Jay Pit will be developed in an open talik.

Permafrost usually exists under the lake shoreline where the depth of water is less than about 1 m and winter lake ice freezes to the lake bottom. Although permafrost occurs under islands and adjacent to waterbodies, the permafrost depth is expected to be less than the depth under land located away from waterbodies. Variation in the depth of permafrost below islands and peninsulas in Lac du Sauvage is anticipated and will be partially dependant on their size.

2.5 Groundwater

It is expected that the Jay Pit will be excavated in unfrozen bedrock within the Lac du Sauvage open talik. Because bedrock surrounding the pit is predominantly made up of granitic and metasediments rock with relatively low hydraulic conductivity, it is expected that groundwater inflow to the Jay Pit will be largely controlled by enhanced permeability zone(s) created by structural features such as fractured rock zones and/or faults. Due to their genesis, kimberlite pipes are typically associated with structural discontinuities. These zones can provide pathways for groundwater flow, therefore increasing groundwater inflows to the Jay Pit.

Groundwater inflow to the Jay Pit will be composed of shallow and deep groundwater. Shallow groundwater will originate from Lac du Sauvage, in particular from areas immediately outside of the dewatered area. Excavation and dewatering of deeper portions of the pit will also lead to an upward flow of deep saline groundwater (known as saline upwelling) through the open talik. As a result of these separate groundwater inflow sources, water pumped from the open pit will be a mix of fresh water from Lac du Sauvage and saline groundwater, and therefore will be expected to contain elevated concentrations of chloride and other ions typical of deep saline groundwater. The upper levels of the excavation are not expected to encounter significant quantities of deep groundwater, but as the mining progresses towards the regional base of the permafrost, the quantity of deep groundwater, and therefore concentration of chloride ions, is likely to increase.

3.0 WATER MANAGEMENT

This section provides a description of the proposed MWMP for the Jay Project. Key water management terminology is defined in Section 3.1; the objectives and strategies of water management are described in Section 3.2; the proposed main water management facilities are briefly described in Section 3.3; and the proposed water management plan throughout the different stages of the Jay Project is described in Section 3.4.

3.1 Definitions

The *Wastewater and Processed Kimberlite Management Plan* (Dominion Diamond 2014b) provides a definition of minewater:

*"**Minewater** includes runoff from facilities associated with the project and all water or waste pumped or flowing out of any pit or underground mine."*

Minewater will need to be managed and monitored prior to discharge to the environment. The following main sources of minewater are identified:

- surface minewater
  - diked area runoff, including runoff from WRSA and portion of the roads, and Jay Dike seepage.
- open pit minewater
  - inflows to the Jay Pit (groundwater and runoff on pit walls).

Natural runoff is considered to be runoff water from natural catchments. Natural runoff will be diverted away from the Jay Project area where practical. For the Jay Project, natural runoff from Sub-Basin B (naturally draining towards the diked area) will be diverted away from the diked area via the Sub-Basin B Diversion Channel.

Discharge is considered to be direct or indirect release of any water or waste to the receiving environment. This definition is consistent with the Ekati Mine Water Licence.

3.2 Water Management Objectives and Strategies

The objective for the Jay Project MWMP is to enable safe and timely mining of the Jay kimberlite pipe, while preventing adverse negative impacts in the aquatic receiving environment in terms of water quantity, water quality, and aquatic life. The western area of Lac du Sauvage is the receiving environment for the Jay Project.

The following strategies are planned to achieve this objective:

- to the extent practicable, minimize the quantity of minewater for management and monitoring;
- to the extent practicable, intercept and divert runoff from natural catchments away from the mine site;

- plan for the safe discharge of water to the receiving environment such that adverse negative impacts are not anticipated or likely;
- utilize experience and data from the Ekati Mine and other similar mines to develop sound management plans; and,
- implement monitoring plans throughout the various stages of mine development to allow for development of adaptive management strategies if required.

3.3 Water Management Facilities

The mine area for the Jay Project is mainly located within and around the diked area, with roads and pipeline extending to the Misery site. Activities in the mine area will include open pit mining, local hauling, and disposal of waste rock. The extracted kimberlite will be hauled to the Ekati Mine for processing. The processed kimberlite will be stored within the mined-out Koala Pit and Panda Pit at the Ekati site. Also, some mine facilities at the Misery site will be used as part of the Jay Project, such as the Misery camp, the Misery Pit, the Lynx Pit, and roads.

The layout of the water management concept during construction, operations, and closure stage is provided in Figure 3-1 through Figure 3-6.

The following facilities are included in the water management concept:

- **Jay Dike –** A water retaining dike will be constructed around the Jay kimberlite pipe to isolate a portion of Lac du Sauvage and allow for the development of the pipe. The dike will be located on the south, east, and north sides of the Jay Pit. **Turbidity curtains** will be used during dike construction as part of the turbidity management plan. A brief description of the design characteristics of the Jay Dike is provided in Section 4.2.
- **Sub-Basin B Diversion Channel –** A diversion channel is proposed to intercept natural runoff from Sub-Basin B and divert it to Lac du Sauvage south of the Jay Dike. A brief description of the design characteristics of the Sub-Basin B Diversion Channel is provided in Section 4.3.
- **Lynx Pit –** The mined-out Lynx Pit will be used as a total suspended solids (TSS) management facility during the diked area dewatering phase. A brief description of the Lynx Pit as a water management facility for the Jay Project is provided in Section 4.4
- **Misery Pit –** The mined-out Misery Pit will be used as a TSS management facility during the diked area dewatering phase and as a total dissolved solids (TDS) management facility during mine operations. Once the Misery Pit has reached its maximum operational capacity, water will be discharged from the Misery Pit to Lac du Sauvage through a pumping system. A brief description of the Misery Pit as a minewater management facility for the Jay Project is provided in Section 4.5.

- **Jay Runoff Sump –** The Jay runoff sump will be located in a natural depression in the lakebed surface within the dewatered diked area to the west of the Jay Pit. Runoff to the diked area will naturally drain to the Jay runoff sump through a series of drainages and depressions within the diked area. Pumping systems may need to be installed in these depressions to facilitate transfer to the Jay runoff sump. Some seepage and runoff from the WRSA will also drain towards the Jay runoff sump. Jay Dike seepage will also be directed to the Jay runoff sump. The water collected in the Jay runoff sump will be pumped to the upper part of the Misery Pit for TSS management. A brief description of the characteristics of the Jay runoff sump is provided in Section 4.6.
- **Mine Inflows Sump –** The mine inflows sump will be located in a natural depression of the Lac du Sauvage lakebed within the diked area, near to the crest of the Jay Pit. Open pit minewater (groundwater inflows to the Jay Pit and pit wall runoff) will be collected at the bottom of the pit and pumped to the mine inflows sump before being pumped to the base of the Misery Pit. A brief description of the characteristics of the mine inflows sump is provided in Section 4.6.
- **Pumping and Pipeline Systems –** Water is proposed to be transferred between the different minewater management facilities and ultimately discharged to the environment by pumping and piping. A description of the design characteristics of the pumping and pipeline systems is provided in Section 4.7.
- **Diffuser Outfall –** An engineered diffuser outfall is proposed for the discharge of water from the Misery Pit to Lac du Sauvage. A description of the design characteristics of the diffuser outfall is provided in Section 4.8.

3.4 Water Management Plan

The mine development plan for the Jay Project comprises the following stages:

- **construction**, spanning a duration of approximately three years, when activities are mainly focused on the construction of mine facilities and dewatering of the portion of Lac du Sauvage within the containment dike;
- **operations**, spanning a duration of approximately 10 years, when activities are mainly focused on mining the Jay Pit, and construction activities as needed;
- **closure**, occurring following completion of Jay Pit mining, assumed to span approximately four years, when activities are mainly focused on reclaiming the areas affected by the Jay Project and back-flooding the Jay Pit and the diked area; and,
- **post-closure**, which is the period after closure, when activities are mainly focused on monitoring, as required.

The planned mine development sequence as it pertains to water management on site is summarized in Table 3-1 and Figures 3-1 to 3-7. The main water management infrastructure and activities throughout the different stages of the Jay Project include the following:

- construction stage
  - turbidity curtains during dike construction;

  - a diversion channel (Sub-Basin B Diversion Channel) to divert stream water from natural catchments upstream of the dike area, to the maximum feasible extent;
  - pumping and pipeline systems to allow dewatering of the portion of Lac du Sauvage within the containment dike; and,
  - mined-out Lynx Pit and Misery Pit to be used for management of elevated TSS water during later stages of dewatering.
- operations stage
  - collection sumps within the diked area to manage water reporting to the diked area;
  - pumps and pipelines for managing water reporting to the Jay Pit and diked area;
  - mined-out Misery Pit to be used for management of elevated TDS water; and,
  - operation of Sub-Basin B Diversion Channel.
- closure stage
  - pumps and pipelines for closure back-flooding;
  - reclamation of Sub-Basin B Diversion Channel; and,
  - dike breaches.
- post-closure stage
  - monitoring activities, as required.

During the construction to the closure/post-closure stage, the number of discharge points from the mine site to the receiving environment is limited to the following:

- construction stage
  - two discharge locations (total of three pipes, two discharging in one location, and one discharging in the other location) to Lac du Sauvage for the early stages of dewatering of the diked area, when TSS concentrations are suitable for direct discharge to the environment.
- operations stage
  - a diffuser outfall in Lac du Sauvage for the discharge of water from the Misery Pit during the second part of mine operations (i.e., after the Misery Pit has reached the proposed maximum operational capacity).
- closure and post-closure stage
  - discharge from the Misery Pit to Lac de Gras through natural outlet channel; and,
  - discharge from the Lynx Pit to Lac de Gras through natural outlet channel.

As required, the outlets will consist of engineered structures that will be designed to yield discharges to the receiving environment that meet defined water quality criteria and provide erosion protection.

Further details on the water management activities during construction, operations, and closure and post-closure are provided in Section 3.4.1, Section 3.4.2, and Section 3.4.3, respectively.

Table 3-1: Mine Development Sequence

Figure	Year	Mine Development and Water Management Activities
3-1	2016 (construction)	■ Road construction. ▪ Best Management Practices for water and sediment management will be implemented. ■ Dike construction will commence during summer 2016 in the northern abutment of the dike, and will continue along the entire length of the dike during the 2016/2017 winter (rockfill placement on ice). ▪ During summer construction, turbidity curtains will be installed near the portion of the alignment where dike construction will occur. The curtains will be removed prior to ice formation. ▪ During winter construction, the rockfill placement will proceed at a slow rate and from multiple placements fronts, to minimize turbidity generation. ■ Curtain grouting will commence. ■ Installation of pumping and pipeline systems will commence.
3-2	2017 (construction)	■ Dike construction will continue. ▪ Turbidity management will be as described above. ■ Fish-out of the isolated portion of Lac du Sauvage will commence. ■ Rockfill for construction of the dewatering ramps will commence to be placed. ■ Jet grouting will start. ■ Installation of pumping and pipeline systems will continue.
3-3	2018 (construction)	■ Dike construction will continue. ▪ Turbidity management will be as described above. ■ Fish-out will continue. ■ Rockfill for construction of the dewatering ramps will continue to be placed. ■ The Sub-Basin B Diversion Channel will be constructed. ■ Installation of pumping and pipeline systems will continue.
3-4	2019 (construction)	■ Dike construction is completed. ■ Installation of pumping and pipeline systems is completed. ■ Dewatering of the diked area of Lac du Sauvage will occur. ▪ Water with TSS concentration suitable for discharge will be discharged to Lac du Sauvage; remaining water will be pumped to the Lynx Pit and the Misery Pit for TSS management prior to discharge. ▪ The Sub-Basin B Diversion Channel will divert natural runoff away from the diked area.

Figure	Year	Mine Development and Water Management Activities
3-5	2020–2029 (operations)	■ Mining of the Jay Pit ▪ Mine inflows to the Jay Pit will be collected and pumped to the Misery Pit. ▪ Runoff reporting to the diked area will be collected and pumped to the Misery Pit. ▪ The Sub-Basin B Diversion Channel will divert natural runoff from reporting catchment away from the diked area. ▪ After the Misery Pit has reached maximum operational capacity, water will be discharged from the Misery Pit to Lac du Sauvage through pumps, pipeline and diffuser outfall located in Lac du Sauvage. ▪ Water quality in the Lynx Pit will be monitored and excess water, meeting discharge criteria will be allowed to overflow to Lac de Gras. ▪ Seepage through the Jay Dike reporting to the diked area will be managed as surface minewater
3-6	2030–2033[a] (closure)	■ Mining is complete, closure and reclamation will commence. ■ Closure back-flooding ▪ The top 60 m of the Misery Pit water will be pumped to the Jay Pit. ▪ The Misery Pit, the Jay Pit, and the diked area will be back-flooded with water from Lac du Sauvage. ▪ Water quality within back-flooded areas (Misery Pit and diked area) will be monitored. ▪ Infrastructure will be decommissioned. ■ Decommissioning and dike breaching ▪ The Sub-Basin B Diversion Channel will be decommissioned and original flow-paths re-established. ▪ The Jay Dike will be breached once water quality within diked area is suitable for mixing with neighbouring waters. ▪ Hydraulic connection between the Misery Pit and Lac de Gras is established, once water quality is suitable.
3-7	Post-closure	■ The diked area and Lac du Sauvage are hydraulically connected through the breaches. ■ The Misery Pit is discharging to Lac de Gras.

Note: The main bullets represent mine activities; secondary bullets represent water management activities.

a) Closure and reclamation activities are described in the Jay Project Closure and Reclamation Plan (Dominion Diamond 2014a, Appendix 3B).

TSS = total suspended solids; m = metre.

3.4.1 Construction Phase

The proposed water management plan during the Jay Project construction phase includes the following main activities:

- turbidity management during dike construction;
- diked area dewatering; and,
- Sub-Basin B stream flow diversion.

3.4.1.1 Turbidity Management during Dike Construction

Jay Dike construction activities may generate turbidity within Lac du Sauvage during construction. Turbidity will primarily be generated as a result of the following activities:

- rockfill placement;
- central trench excavation in shallow areas;
- lakebed sediment removal from deeper areas; and,
- placement of the fine and coarse filters.

As a result, measures will be implemented to monitor and control the areas over which elevated levels of TSS may occur during dike construction. As part of construction, rockfill will be placed during both the winter and summer months. Central trench excavation, removal of lakebed sediment, and backfilling activities will only occur during the open water summer construction season.

Winter

Due to ice cover during the winter, the deployment of turbidity curtains will not be possible. However, the ice cover will limit the transportation of disturbed sediments via wind and wave action. As a result, it is anticipated that rockfill placement can occur throughout winter period by controlling the rate of placement in accordance with the results of ongoing turbidity monitoring. A similar approach was used successfully in the construction of the Bay-Goose Dike at the Meadowbank Gold Project, Nunavut, as described in Esford et al. (2013).

The primary purpose of placing the upstream portion of the rockfill platform during the winter is to provide an anchoring point for upstream turbidity curtains and to provide protection to these curtains from wind, waves, and currents during the open water periods.

Summer

During the first summer of construction (summer 2016), turbidity curtains will be installed and anchored to islands and spot locations on the lakebed surface. A potential turbidity curtain deployment plan for the summer of 2016 is shown schematically in Figure 3-1.

During the summer of 2017 and 2018, turbidity curtains will be installed on both sides of the dike within Lac du Sauvage to limit the area potentially impacted by high levels of TSS generated by construction activities:

- **Upstream of the dike (within Lac du Sauvage)** – An inner line of turbidity curtains will be deployed in cells to form a primary line of protection. Each cell will be anchored to the crest edge of the upstream rockfill platform and extend out a minimum of 25 m from the toe of the dike. The bottom of the turbidity curtains will be anchored at spot locations to the lakebed. By using a cell formation for the inner barrier, the potential of a single breach in the turbidity curtains limits the overall release of suspended solids, and repairs can be carried out rapidly.

  An outer line of turbidity curtains will be deployed beyond the inner curtains, where feasible. The outer line will serve as a backup in the event that the inner barrier is breached.

- **Downstream of the dike (within isolated portion of Lac du Sauvage)** – Once the upstream rockfill platform is completed, a single line of turbidity curtains will also be installed downstream of the dike until fish-out of the isolated portion of the lake (i.e., the diked area of Lac du Sauvage) is complete.

Figures 3-2 to 3-3 depict a potential turbidity barrier deployment plan for the summer 2017 and summer 2018, respectively. The final turbidity barrier deployment plan will be developed during the detailed design phase of the Jay Project, prior to the initiation of construction.

Turbidity monitoring will be conducted at designated locations beyond the turbidity curtains.

3.4.1.2 Diked Area Dewatering

Once construction of the Jay Dike has been completed, dewatering of the portion of Lac du Sauvage inside the dike will begin. Dewatering will initially be accomplished by pumping water south to the undisturbed portion of Lac du Sauvage while TSS concentrations are expected to be low.

When TSS concentrations are too high for direct release to Lac du Sauvage, dewatering will be accomplished by pumping to the mined-out Lynx Pit and Misery Pit. The Lynx and Misery pits would function as TSS settling facilities. A storage contingency allowance will be maintained in the Lynx Pit to allow sufficient TSS settling time prior to commencing discharge to Lac de Gras through the natural outlet. Conversely, the anticipated dewatering volume would only occupy a small portion of the Misery Pit; the remaining storage capacity in the Misery Pit will be used for TDS management during the operations phase, as discussed in Section 3.4.2.

The total duration of diked area dewatering is assumed to be approximately six months, equivalent to an average dewatering rate of 6,500 cubic metres per hour (m^3/hr). The estimated total dewatering volume and dewatering rate are summarized in Table 3-2. Estimates are based on current dike configurations and bathymetry surveys, and include the waterbody volume to be dewatered plus the average snowmelt and rainfall (inflow volume) during the dewatering period. As the Jay Project proceeds to the next stages of design, the estimated dewatering duration will be revised and updated, if required.

Table 3-2: Dewatering Volumes and Duration

Dewatering Area	Initial Reservoir Volume (million m^3)	Inflow Volume (million m^3)	Total Dewatered Volume (million m^3)	Duration (months)	Average Dewatering Rate (m^3/hr)
Jay Pipe	27.0	2.6	29.6	6	6,500

Note: Actual pumped volume may be less than 29.6 million m^3 as some water will remain as ice or will be lost as evaporation (Table 3-3).
m^3 = cubic metres; m^3/hr = cubic metres per hour.

Bathymetric data for Lac du Sauvage indicate that the Jay kimberlite pipe is located in the deepest portion of the diked area; however, some small isolated basins will form in natural depressions in the lakebed surface as the water level is lowered (Figure 3-4). The volume of water that remains in these smaller basins will be stored as ice over the winter and removed when the ice melts. Two of the larger depressions will be used for management of the mine inflows and runoff draining to the diked area during operations (Section 3.4.2). Details on the management of water within the diked area will be further refined during detailed design.

The lake dewatering activities will be conducted to meet the following Jay Project requirements:

- initiation of dewatering of the isolated portion of Lac du Sauvage no later than May 2019;
- requirements set in the conceptual fish-out plan (Dominion Diamond 2014a, Appendix 9B); and,
- completion of dewatering of the isolated portion of Lac du Sauvage by November 2019 to permit open pit pre-stripping within the footprint of the Jay Pit.

Total Suspended Solids Management

Dewatering of Lac du Sauvage within the diked area may expose lake shoals composed of unconsolidated sediments, which may lead to local sedimentation and increased TSS within the impounded water. The introduction of sediments into the water column will depend on the type of material being exposed; the material properties, slope gradient, and timing (e.g., ice cover versus open water conditions); the prevailing weather conditions (e.g., wind speed and direction, wave action); and the rate at which the basin is dewatered.

Where submarine slopes are steep, there may be a thin layer of soft lake bottom sediments overlying till or bedrock. In these areas, slumping may occur as the lake is dewatered. Where submarine slopes are less steep, there may be thicker sequences of soft lake bottom sediments overlying till or bedrock, which may be prone to flow. It is not possible to accurately quantify areas that may be prone to slumping or flow other than in general terms.

The quality of water pumped from the diked area will be closely monitored to verify that it is acceptable for release to the receiving environment. Where necessary, additional TSS control practices may be used to limit the amount of TSS reporting to the dewatering pumps and increase the amount of water released directly to the environment without further TSS management. These additional TSS control practices may include the following:

- increasing pumping rates during under-ice dewatering in late spring, when TSS concentrations are expected to be lower (during initial dewatering, the pumping and pipeline systems would allow for maximum peak pumping rates 30% higher than the average dewatering rate);

- locating pump intakes in the deepest areas of the diked area;
- installing graded rockfill zones around pump intakes; and,
- installing silt curtains and/or baffles near exposed beaches to increase the flow path and limit the uptake of TSS laden water.

The discharge of dewatering water to Lac du Sauvage would occur at two locations to reduce flow velocities at the discharge and reduce risk of re-suspension of lakebed sediments. Additional erosion protection strategies (e.g., placement of rockfill at the pipe discharge locations, expansion of pipe diameter at the discharge) will be considered and implemented during the next stages of design, if deemed to be required.

As a preliminary estimate, approximately 50% of total water volume from the diked area is assumed to be of suitable quality for direct discharge to Lac du Sauvage without TSS management. This estimate is consistent with other similar mining operations in the North requiring dewatering of mining areas (e.g., Diavik Mine and Meadowbank Mine). When the water quality is no longer acceptable for direct discharge to Lac du Sauvage, pumping will be directed to the Lynx and Misery pits. Once pumped to either pit, the water will be left to allow TSS to naturally settle.

A preliminary estimate of dewatering volumes per destination, based on the above dewatering strategy, is provided in Table 3-3. An estimated total volume of 1.2 million cubic metres (million m^3) of water/ice will remain in natural depressions within the diked area, and may need to be manually removed to facilitate pit stripping and construction activities within the diked area. In addition, another 0.6 million m^3 of water will be lost to evaporation during the dewatering period.

Table 3-3: Summary of Dewatering Strategy

Dewatering Phase	Water Elevation (masl)	Dewatering Volume[a] (million m^3)	Point of Discharge	Notes
Initial Dewatering	416 to 411	15	Lac du Sauvage	Low TSS water will be discharged directly to Lac du Sauvage
Final Dewatering	411 to 380	12.8	Lynx Pit and Misery Pit	Higher TSS water will be pumped to the Lynx Pit and the Misery Pit until the completion of dewatering

a) Dewatering volume does not sum to 29.6 million m^3 as some water will remain as ice or will be lost as evaporation.
masl = metres above sea level; m^3 = cubic metres; TSS = total suspended solids.

Given the inherent uncertainties in TSS generation during dewatering, contingency scenarios of 40% and 60% direct discharge to the environment were also considered in the development of this minewater management plan. The water volume to be pumped to the Lynx and Misery pits under these contingency scenarios is estimated to be approximately 17.8 and 10.1 million m^3, respectively. This minewater management plan provides sufficient flexibility to manage these scenarios.

The existing King Pond Settling Facility is not considered a component of the Jay Project, but may be considered as a contingency measure for TSS management during final dewatering (Section 8.3). King Pond is a licensed facility at the main Misery site. It currently acts as a sedimentation cell for existing operations at the Misery site.

Pumping Requirements

The average pumping requirement for lake dewatering is preliminary estimated to be 6,500 m^3/hr based on the assumption of dewatering the diked area in approximately six months. Potential constraints on pumping include the following:

- available pumping capacity;
- limited dewatering during high-flow periods or extreme storm events to avoid negative impacts within Lac du Sauvage;
- discharge during the initial dewatering phase (i.e., for direct release to Lac du Sauvage) must not exceed maximum discharge criteria for TSS concentration; and,
- discharge during the initial dewatering phase must not generate excessive re-suspension of lakebed sediment.

3.4.1.3 Sub-Basin B Stream Flow Diversion

The Sub-Basin B Diversion Channel will be constructed prior to initiating the dewatering of the diked area. The channel will act to reduce the total amount of volume to be dewatered during the construction phase by diverting natural runoff away from the diked area. More information about the Sub-Basin B Diversion Channel is provided in Section 4.3 of this report and Section 3 of the DAR (Dominion Diamond 2014a).

3.4.2 Operations Phase

Water management during the operations phase will mainly include collection and management of minewater (surface and open pit minewater) and diversion of natural runoff from Sub-Basin B. For the Jay Project, open pit minewater represents the majority of the volume of minewater to be managed (additional details are provided in Section 4.1). A layout of the water management plan during the operations phase is provided in Figure 3-5.

Open pit minewater will be collected at the bottom of the Jay Pit, pumped to the mine inflows sump, and subsequently pumped to the base of the Misery Pit. Surface minewater draining towards the diked area will be collected in the Jay runoff sump and pumped to the top of the Misery Pit.

The use of separate discharge locations in the Misery Pit for the open pit minewater (bottom of the Misery Pit) and the surface minewater (top of the Misery Pit) is intended to assist in the creation of a TDS profile in the Misery Pit, resulting in lower TDS concentrations in the upper part of the Misery Pit at any given time. Water quality estimates and details about the TDS profile in the Misery Pit are provided in Section 7.0.

Once the Misery Pit has reached its proposed maximum operational capacity, water will be pumped from the top of the Misery Pit to Lac du Sauvage. The discharge to Lac du Sauvage will occur through a diffuser outfall at a location selected based on the results of the hydrodynamic modelling conducted as part of the Jay Project water quality assessment (Dominion Diamond 2014a, Appendix 8F).

Based on the results of the water balance developed for the Jay Project (Section 6.0), it is expected that discharge from the Misery Pit to Lac du Sauvage will commence during Year 5 of the mine life. Also, based on current results of the water quality modelling (Section 7.0), it is expected that the water from the Misery Pit will be of suitable quality for discharge to natural environment (through diffuser outfall) throughout the discharge period. Water quality monitoring will be conducted during the Jay Project operations stage to confirm water quality estimates and to develop and implement adaptive management strategies, as required. A description of the proposed minewater monitoring and adaptive management plan for the Jay Project is provided in Section 8.0.

Additional water management considerations during the Jay Project operations phase are described in the following sections.

3.4.2.1 Jay Waste Rock Storage Area

The toe of the Jay WRSA will be constructed a minimum of 100 m from Lac du Sauvage and a minimum of 30 m from all other waterbodies and streams so as to allow for attenuation of seepage and to provide space for construction of seepage management infrastructure, if required. Seepage runoff from the Jay WRSA will be monitored as an extension of the existing Ekati Mine monitoring program, leading to implementation of adaptive management responses if necessary.

3.4.2.2 Jay Dike Seepage

The Jay Dike is designed as a water containment structure with an impermeable dike core. However, some seepage through the Jay Dike is expected to report to the downstream toe of dike (diked area side). This seepage will be collected in ditches and sumps along the dike toe, and transferred to the Jay runoff sump to be managed with the surface minewater. Thus, dike seepage will ultimately be transferred to the top of the Misery Pit together with the surface minewater.

3.4.2.3 Haul Roads

A network of haul roads will connect the Jay Pit to the WRSA, ore transfer pad, and the Misery site. Runoff water will be attenuated on the tundra or follow natural local flow paths. The roads will be constructed of non-potentially acid generating, non-metal leaching waste rock from mining operations. Dust suppression measures will be applied as appropriate to active haul roads following practices established at the Ekati Mine.

3.4.2.4 Sub-Basin B Stream Flow Diversion

During the operations stage, the Sub-Basin B Diversion Channel will act to reduce the total amount of surface minewater to be managed by diverting natural runoff away from the diked area. More information about the Sub-Basin B Diversion Channel is provided in Section 4.3 of this report and Section 3 of the DAR (Dominion Diamond 2014a).

3.4.2.5 Lynx Pit

The Lynx Pit will remain inactive during the operations stage. During the early years of the operations stage, water quality in the Lynx Pit will be monitored. When water quality in the Lynx Pit is proven to be suitable, discharge from the Lynx Pit to Lac de Gras will occur through a natural outlet in accordance with the established Lynx Pit closure and reclamation plan.

The Lynx Pit may be used as water management contingency facility during the operations phase, as described in Section 8.0.

3.4.3 Closure and Post-closure Phase

Water management during the Jay Project closure phase would mainly consist of closure back-flooding of the Misery Pit, the Jay Pit, and the diked area.

Following completion of back-flooding, and upon confirmation that the water quality within the diked area is suitable, the Jay Dike will be breached and waters will be allowed to mix with the remaining portion of Lac du Sauvage. Dike breaching will occur at a few locations to 2 to 3 m below the average lake water level or to the original lakebed. During excavation of the dike breaches, silt curtains or other sediment/turbidity mitigation measures will be utilized where necessary to reduce risks to water quality. Also, excavated material will be locally placed for potential use by fish in the littoral areas of the dike.

Water management during the post-closure phase will mainly consist of water quality monitoring as part of the Aquatic Effects Monitoring Program (AEMP) for the Jay Project.

Details of the closure back-flooding and key closure activities are provided in Section 5.0.

4.0 DESIGN OF WATER MANAGEMENT FACILITIES

This section provides a description of the preliminary design of the main water management facilities described in Section 3.3. The water management design basis is presented in Section 4.1; a description of the main water management facilities is provided in Section 4.2 through Section 4.8; considerations for potential changes in hydrologic conditions are discussed in Section 4.9; and additional water management considerations for future stages of design are described in Section 4.10.

It is noted that the infrastructure sizing provided in this document is conceptual only and will be finalized during the next stages of design. Details about the infrastructure design are provided in Section 3 of the DAR (Dominion Diamond 2014a).

4.1 Water Management Design Basis

Water management for the Jay Project will consist of the collection and management of minewater and the diversion of natural runoff from Sub-Basin B (Sub-Basin B Diversion Channel).

Groundwater inflows to the Jay Pit represent the largest contributor of minewater for the Jay Project. The WRSA is designed to minimize runoff and infiltration as described in Section 3 of the DAR (Dominion Diamond 2014a), and the natural catchment draining to the diked area is relatively small due to construction of the Sub-Basin B Diversion Channel. Thus, surface minewater represents a minor contributor to minewater for the Jay Project. A small amount of groundwater inflow is also expected to report to the Misery Pit during the early years of the operations stage. An estimate of the volumes of minewater from the main sources is provided in Section 6.0. Preliminary predictions of groundwater inflow quantity and quality for the Jay Pit are shown in Table 4-1.

These preliminary predictions are based on a hydrogeological model that was developed in support of the mine permitting process (Dominion Diamond 2014a, Annex IX). Conservative assumptions have been made for model parameters such that they result in conservative (i.e., high) predictions of mine inflow quantity and quality, including travel times and saline upwelling (Dominion Diamond 2014a, Annex IX). Once the open pit bottom reaches its planned depth at elevation 45 masl at the end of mining, groundwater inflow is predicted to reach approximately 21,300 cubic metres per day (m^3/day), and the TDS concentration in the groundwater inflow is estimated to be about 7,300 milligrams per litre (mg/L). Groundwater originating as recharge from Lac du Savage is predicted to constitute approximately 56% of total groundwater inflow to the pit at this time.

The groundwater inflows to the Jay Pit represent approximately 65% of the total amount of minewater to be managed over the operations period (under average climate conditions). Thus, the minewater management system is only marginally affected by annual climate variations. It is noted that the minewater management system for the Jay Project is designed to manage water volumes from the different sources estimated based on the water balance assuming average climate conditions. Variations to these volumes due to climate variations will be managed within the safety allowances included in the design of the minewater management structures (i.e., pumping and pipeline systems). The design will also account for potential upset conditions generated by extreme events, such as extreme storms.

The key minewater management infrastructure will be designed to meet the following criteria:

- The Jay runoff sump will be sized to handle runoff from the 1:10-year, 24-hour precipitation (39.3 mm) event in excess of the normal operating capacity defined based on the results of the water balance model run for average year climate conditions.
- The mine inflows sump will be sized to provide a contingency storage equivalent to a minimum of three days of open pit minewater, throughout the entire operations phase.
- The maximum operational capacity of the Lynx Pit (during dewatering phase) will be set to allow for storage of approximately two years of natural net inflows to the pit, to allow sufficient sediment settling time prior starting natural discharge to Lac de Gras.
- The maximum operational capacity of the Misery Pit will be set to allow a contingency storage for minewater and natural inflows to the Misery Pit.

Table 4-1: Average Annual Groundwater Inflow Quantity and Quality Predicted for the Jay Open Pit

Phase	Final Pit Bench/ Re-flooding Elevation (masl)	Duration (Days)	Groundwater Inflow (m^3/day)		Jay Pit Groundwater Quality (mg/L)	Lake Water (%) in Total Inflow
			Jay Pit	Diked Area Around the Jay Pit		
Dewatering[(a)]	406	180	900	5,400	300	0
Stripping	390	90	10,400	300	400	0
Open pit mining Year 1	350	365	7,700	0	1,200	1
Open pit mining Year 2	325	365	9,500	0	2,000	16
Open pit mining Year 3	295	365	10,700	0	2,500	29
Open pit mining Year 4	270	365	12,100	0	3,000	37
Open pit mining Year 5	230	365	14,300	0	3,600	42
Open pit mining Year 6	205	365	15,700	0	4,200	48
Open pit mining Year 7	180	365	16,000	0	4,600	54
Open pit mining Year 8	150	365	17,000	0	5,000	58
Open pit mining Year 9	110	365	18,000	0	5,800	59
Open pit mining Year 10	45	365	21,300	0	7,300	56
Pit back-flooding	110	1,106	18,800	0	6,700	56
Pit back-flooding	150		15,800	0	5,200	59
Pit back-flooding	180		13,500	0	4,200	66
Pit back-flooding	205		11,700	0	3,500	71
Pit back-flooding	230		10,700	0	2,600	74
Pit back-flooding	270		8,100	0	1,300	78
Pit back-flooding	295		5,700	0	100	84
Pit back-flooding	325		3,500	0	100	90
Pit back-flooding	350		1,600	0	100	90
Pit back-flooding	390		-1,900	0	n/a	n/a
Pit back-flooding	406		-6,700	0	n/a	n/a
Diked area back-flooding	416.1	271	-2,300	-11,000	n/a	n/a

a) Dewatering starts at an elevation of 416.1 masl.

masl = metres above sea level; m^3/day; cubic metres per day; mg/L = milligrams per litre; % = percent; n/a = not applicable.

The Sub-Basin B Diversion Channel (Section 4.3) will be designed to divert the 1:100-year rainfall on snowmelt peak flow from the reporting catchment area, estimated based on the regional water balance (Dominion Diamond 2014a, Annex X), while providing 0.3 m of freeboard. This design event was selected based on the following considerations:

- The infrastructure is designed to be in service for the duration of the Jay Project and will be decommissioned as part of project closure.
- This design event is commonly used for mines in northern Canada.
- During the occurrence of higher events, any overflow will drain to the diked area and ultimately to the Jay Pit.

4.2 Jay Dike

A water retaining dike will be constructed around the Jay kimberlite pipe to isolate the portion of Lac du Sauvage containing the pipe to permit dewatering and kimberlite extraction. The Jay Dike will be located on the south, east, and north sides of the Jay Pit as shown in Figure 3-1 to Figure 3-5. The total dike length is approximately 5,050 m, with approximately 650 m of the dike crossing existing islands. Approximately 3,150 m of the dike length will be located in shallow water (less than 6 m), and approximately 1,250 m of the dike length in deep water (greater than 6 m).

The crest of the dike will be at elevation of 418.5 masl assuming an average water level in Lac du Sauvage of 416.1 masl and to allow for minimum freeboard requirements, estimated based on the method presented by the Canadian Dam Association (CDA 2007, 2013).

The dike will be constructed within the lake, prior to any dewatering, and will include the following general components:

- a broad rockfill shell;
- a central zone of crushed granular fine and coarse filters; and,
- a composite low permeability element composed of a combination of cement soil bentonite (CSB) cut-off wall, jet grouted columns extending from the base of the CSB cut-off wall to the bedrock contact, and grouting of the shallow bedrock and bedrock contact.

The rockfill shell will provide structural support for the dike and a working surface for the remainder of the dike construction. It will also provide an anchoring point for the deployment of turbidity curtains during construction activities. The rockfill shell will be placed in the lake to an elevation of 0.5 m above the lake average water elevation (416.1 masl). The width of the shell varies based on the depth to competent soil or bedrock depth.

The central zone of the dike will consist of fine filter in the middle and coarse filter on the upstream and downstream sides. The fine filter will be compacted to enable excavation of a slurry trench for the cut-off wall.

A 1 m wide trench will be excavated through the fine filter to bedrock or competent soil surface using slurry trench technology. The trench will be excavated from a platform about 2.5 m above the lake elevation to provide a positive hydraulic head between the trench and lake for further wall support. The CSB will be placed within the trench to form the cut-off wall.

Jet grouting will be carried out in the deeper areas where the fine filter is not founded on bedrock. Jet grouted columns will be constructed to extend the low permeability element from the base of the CSB cut-off wall to the bedrock contact.

A grout curtain will be used to extend the low permeability element into the shallow bedrock in both shallow and deep areas. The interface is considered a critical component of the grouting curtain to prevent erosion at the base of the cut-off or jet grout column under the expected seepage gradients. The depth of the grouting will vary based on the imposed hydraulic head and ground conditions.

4.3 Sub-Basin B Diversion Channel

The Sub-Basin B Diversion Channel is being designed to divert runoff flows from natural catchments west and south of the proposed Jay Pit to Lac du Sauvage outside of the dewatered area (Figure 3-4). The channel is sized to accommodate the 1:100-year rainfall on snowmelt peak flow from the reporting catchment area.

The Sub-Basin B Diversion Channel will be located to the southwest of the proposed Jay Pit, and will intercept natural flows in the Christine Lake outlet stream immediately before it crosses the proposed Jay Road North. The channel is anticipated to have a trapezoidal cross-section, with a base width of 1.5 m, a lined depth of 1.5 m, 2H:1V side slopes, and a 0.1% minimum longitudinal slope (to be confirmed during detailed design).

The channel will be excavated in natural ground with a maximum excavation depth of approximately 2.5 m. The assumed general overburden thickness along the channel alignment is 3 m, and therefore excavation is assumed to be entirely in overburden. It is proposed that the channel be lined with rip-rap, underlain by a 0.15 m thick drainage layer and non-woven geotextile.

The depth of the permafrost active layer ranges from 1.0 to 2.7 m in depth (Dominion Diamond 2014a, Annex IV). Overburden soil has been assumed to be ice poor, which will be confirmed by geotechnical investigation during next stages of design. If ice rich overburden soils are encountered, design considerations will include the possibility of adding an insulating layer in the channel lining to prevent slumping of the channel side slopes.

Three culvert crossings will be required along the Sub-Basin B Diversion Channel to cross Jay Project roads. Each culvert crossing is proposed to consist of two 1,200 mm diameter corrugated steel pipe. At each crossing, the pipe will be vertically offset by 600 mm to mitigate the risk of ice blockage occurring simultaneously in both barrels. Furthermore, during low flow periods the discharge will be conveyed in the lower culvert, which will facilitate fish passage.

The main design characteristics of the Sub-Basin B Diversion Channel are summarized in Table 4-2 (to be confirmed during detailed design).

Table 4-2: Sub-Basin B Diversion Channel – Design Characteristics

Parameter	Value
Channel base width (m)	1.5
Channel depth (m)	1.5
Channel length (m)	1,275
Minimum longitudinal slope (m/m)	0.001
Channel lining	D_{50} 150 mm rip-rap
Number of culvert crossing	3
Culvert crossing characteristics	2x1,200 mm CSP

m = metre; mm = millimetre; CSP = corrugated steel pipe.

4.4 Lynx Pit

The mined-out Lynx Pit will be used as a settling facility for TSS laden water during the final dewatering of the diked area of Lac du Sauvage (in conjunction with the Misery Pit). The Lynx Pit has an estimated maximum storage capacity of approximately 5.2 million m^3. However, only 4.9 million m^3 of TSS laden water will be pumped to the Lynx Pit. This provides approximately 3 m of freeboard or 300,000 m^3 storage allowance, which corresponds to approximately 2.5 years of natural net inflows to the Lynx Pit (Dominion Diamond 2013). This time is expected to be sufficient to allow for TSS settling within the Lynx Pit Lake. Once the storage capacity of the pit lake is filled, runoff reporting to the Lynx Pit Lake will discharge through the Lynx Lake outlet to Lac de Gras.

4.5 Misery Pit

The mined-out Misery Pit will be used as a settling facility for TSS laden water during the final dewatering of the diked area of Lac du Sauvage (in conjunction with the Lynx Pit). The Misery Pit has an estimated ultimate storage capacity of approximately 40 million m^3. Approximately 7.9 million m^3 of TSS laden water will be pumped to the Misery Pit during the dewatering phase.

During the operations phase, the Misery Pit will be used to manage minewater from the Jay Pit and diked area. Open pit minewater (TDS laden water) will be pumped to the base of the Misery Pit; surface minewater will be pumped to the top of the Misery Pit. This is expected to facilitate the creation of a TDS profile in the Misery Pit, resulting in lower TDS concentrations in the upper part of the Misery Pit. Water quality estimates and details of the anticipated formation of a TDS profile in the Misery Pit are provided in Section 7.0.

Minewater will be contained in the Misery Pit until approximately Year 5 of mine life, when the water level in the Misery Pit is expected to reach the maximum operational water level. At this point, water will be pumped from the top of the Misery Pit to Lac du Sauvage for discharge through a diffuser outfall.

The maximum operational water level in the Misery Pit is set to an elevation of 430 masl, approximately 10 m below the pit outlet elevation. This would allow for a contingency storage of approximately 3 million m^3, equivalent to approximately 1.1 years of open pit minewater during the first year of operations, and 0.4 years of open pit minewater during the last year of operations.

4.6 Jay Runoff Sump and Mine Inflows Sump

The Jay runoff sump will be located in a natural depression in the lakebed surface within the diked area, to the west of the Jay Pit. Runoff draining to the diked area will naturally drain to the Jay runoff sump through a series of drainages and depressions within the diked area. Jay Dike seepage will also be directed to the Jay runoff sump. Pumping systems will be installed in these depressions if required to facilitate transfer to the Jay runoff sump.

Water collected in the Jay runoff sump is expected to require only TSS management and will be pumped to the top of the Misery Pit for settlement.

The mine inflows sump will be located in a natural depression in the lakebed surface within the diked area, near the crest of the Jay Pit. Open pit minewater will be pumped from the base of the Jay Pit to the mine inflows sump for subsequent transfer to the base of the Misery Pit.

The pumping systems in the Jay runoff sump and in the mine inflows sump will be operated to typically maintain low water levels in the sumps, allowing for contingency storage. The Jay runoff sump is sized to provide a contingency storage sufficient to store the runoff from the 1:10-year, 24-hour storm event (39.3 mm), estimated to be approximately 220,000 m^3. The mine inflows sump is sized to provide a contingency storage sufficient to store three days of open pit minewater, throughout the entire operations phase. This storage contingency is estimated to be approximately 63,000 m^3. The need for small containment berms around the sumps to provide the minimum design storage volume will be determined based on actual lakebed surface conditions encountered during construction and dewatering.

Details on the management of water within the diked area will be further refined during detailed design.

4.7 Pumping and Pipeline

The pumping and pipeline systems for the Jay Project will be advanced during the following mine stages:

- initial dewatering;
- final dewatering;
- operations; and,
- closure.

Three pumping and pipeline systems are proposed for transferring minewater throughout the above stages, named PS1, PS2, and PS3. A temporary pumping and pipeline system will be installed at the Misery site to boost water to the Lynx Pit during the final dewatering stage. The design flows for the pumping and pipeline systems during the stages listed above were derived from the water balance assuming average climate conditions (Section 6.0).

The pumping system PS1 will be used during initial and final dewatering to pump water to Lac du Sauvage and to the Misery Pit, respectively. During operations, the pumping system PS1 will be moved to the mine inflows sump and will be used to pump open pit minewater to the base of the Misery Pit.

The pumping system PS2 will be used during initial and final dewatering to pump water to Lac du Sauvage and to the Misery Pit, respectively. During operations, the pumping system PS2 will be moved to the Jay runoff sump and will be used to pump surface minewater to the top of the Misery Pit.

The pumping system PS3 will be used during initial and final dewatering to pump water to Lac du Sauvage and to the Misery Pit, respectively. During operations, the pumping system PS3 will be moved to the Misery Pit and will be used to pump water from the top of the Misery Pit to Lac du Sauvage once the storage capacity within the Misery Pit is exhausted.

The pumping systems will consist of vertical turbine pumps. During the dewatering stage, the pumps will be installed on floating barges, connected to the dike through dewatering ramps extending in to the diked area. To reduce the flow velocities at the discharge to Lac du Sauvage, PS1 and PS2 will discharge separately from PS3. Additional erosion protection strategies (e.g., placement of rockfill at the pipe discharge locations, expansion of pipe diameter at the discharge) will be considered and implemented during the next stages of design, if deemed to be required.

During the operations stage, PS1 and PS2 will be installed in the water management sumps; PS3 will be installed on floating barges in the Misery Pit. The pumping system PS3 will discharge to Lac du Sauvage through a diffuser outfall (Section 4.8).

During the closure stage, PS3 will initially be used to pump water from the upper part of the Misery Pit to the Jay Pit. Subsequently, PS1, PS2, and PS3 will be relocated to Lac du Sauvage and will be used to pump water from Lac du Sauvage to create a freshwater cap in the Misery Pit and the Jay Pit and to back-flood the diked area. Details of closure back-flooding are provided in Section 5.1.

A summary of the pipeline characteristics is provided in Table 4-3 (to be confirmed during detailed design).

Table 4-3: Pipeline Design Characteristics

Pumping System	Phase	From	To	Flow Rate (m^3/hr)	Pipeline Size (in)	Length (m)
PS1	Initial dewatering	Diked area	Lac Du Sauvage	1,350[(a)]	20	700
	Final dewatering	Diked area	Misery Pit – Top	1,350		7,200
	Operations	Pit sump	Misery Pit – Bottom	1,230		9,700
PS2	Initial dewatering	Diked area	Lac Du Sauvage	1,600[(a)]	24	500
	Final dewatering	Diked area	Misery Pit – Top	1,600		6,100
	Operations	Runoff sump	Misery Pit – Top	1,350		6,100
PS3	Initial dewatering	Diked area	Lac Du Sauvage	3,550[(a)]	30	700
	Final dewatering	Diked area	Misery Pit – Top	3,550		7,200
	Operations	Misery Pit	Lac Du Sauvage	2,000[(b)]		7,800
Misery to Lynx System	Final dewatering	Misery site	Lynx Pit	2,500	24	5,300

a) During initial dewatering, the pumping and pipeline systems would be capable of approximately 30% higher flow rate, due to lower losses (shorter pipeline length).

b) The PS3 pumping system has a maximum capacity of 3,000 m^3/hr during the operations phase.

m^3/hr = cubic metres per hour; in = inch; m = metre; % = percent.

4.8 Diffuser Outfall

During the operations phase of the Jay Project, mine effluent will be discharged from the Misery Pit to Lac du Sauvage through a multi-port diffuser outfall located in Lac du Sauvage (location provided in Figure 3-5). The geometry of the diffuser outfall was established from a mixing model (i.e., CORMIX by Doneker and Jirka 2007), which predicted effluent concentrations in Lac du Sauvage based on the characteristics of that waterbody (i.e., lake average depth at the point of discharge, current velocity, water density, and ice cover thickness) and of the mine effluent (i.e., effluent discharge rate and water density). The selected geometry of the diffuser outfall achieves a mixing ratio for which effluent concentrations at the edge of the mixing zone meet or are below the water quality discharge objectives for the Jay Project. Details on the modelling of effluent mixing in Lac du Sauvage and on the establishment of the diffuser geometry can be found in Appendix 8F of the DAR (Dominion Diamond 2014a).

The diffuser outfall is proposed to discharge mine effluent through 10 ports set in series along the diffuser pipeline. The geometry of the diffuser outfall is proposed to have the following characteristics (to be confirmed during detailed design):

- lake bottom depth at the location of the outfall: 8 m;
- space between ports: 5 m from one port to another;
- diffuser outfall length: 45 m from the first to the last port;
- port diameter: 0.084 m;
- angle of port discharge: 45 degrees from the horizontal; and,
- port discharge height: 1 m above lake bottom.

4.9 Changes in Hydrologic Conditions

The sizing of the water management infrastructure and estimation of water volumes from the water balance (Section 6.0) were based on the existing hydrologic conditions derived from available historical climate data as described in Annex X of the DAR (Dominion Diamond 2014a). Changes to these hydrologic conditions may occur during the life of the Jay Project, possibly as a result of changes in climate conditions in the Jay Project area over time.

Change in hydrologic conditions as a result of climate change can be summarized as lower or higher water volumes at the mine site than those estimated in the water balance in Section 6.0. For the Jay Project, open pit minewater (inflows to the Jay Pit) represents the majority of the total amount of minewater to be managed. Thus, the minewater management system would be only marginally affected by changes to climate conditions. In addition, any changes in hydrologic conditions during operations can be addressed within the minewater management plan through adaptive management.

4.10 Additional Water Management Considerations

This section provides a description of viable options that may be considered during the next stages of design and during Jay Project development to account for conditions specific to the sub-Arctic/permafrost environments.

The design of the surface water control structures will consider the existing geotechnical surface, subsurface, hydrological, hydrogeological, and seasonal temperature conditions such that adequate measures are taken.

The importance of control and prevention of icing within and adjacent to drainage structures will be acknowledged in the detailed engineering design of these structures and will include the assessment of the degree of drainage required, hydrologic data, and the effects of, and impacts on, the permafrost thermal regime. Standard techniques for addressing icing of structures and facilities in cold regions will be employed during the design phase of the Jay Project. These will include such standard techniques as avoidance, control, and prevention.

The collection of surface minewater and open pit minewater will apply appropriate, cost-effective engineered solutions to minimize soil erosion, sediment entrainment, and seepage loss of collected water from the facilities. In areas where fine- to coarse-grained soils are encountered overlying weathered to intact bedrock, design measures will be taken to limit soil erosion and seepage losses from the drainage channels and collection sumps using natural means supplemented with engineered solutions. In areas where the soil and/or bedrock are of sufficiently low permeability to limit seepage losses, drainage measures will consider erosion protection and sediment control measures only. In areas where the soil and/or bedrock permeability is comparatively high, additional measures will be considered to limit seepage losses from the water control structures.

Depending on the actual ground conditions encountered within and around the perimeter of the infrastructure development, some engineered solutions that may be considered during detailed design and construction include the following, where applicable:

- increasing the channel gradients to minimize ponding of water;
- excavating the drainage channel inverts and sumps to underlying intact bedrock;
- providing perimeter seepage containment by maintaining permafrost conditions down gradient of the water control structures by construction of a thaw stable fill embankment to insulate the ground from seasonal active thaw and to encourage re-freezing of the ground above the drainage channel inverts; and,
- applying surface treatments to the channel and sump excavation surfaces as necessary to seal the exposed subgrade surface to a condition where the hydraulic conductivity is suitably reduced using site-appropriate engineered materials.

The appropriate and active management of water within the Jay Pit will be a critical component of mining activities, as it relates to operational considerations and slope stability. Experience in open pit mining in hard rock has shown that seepage from the pit walls can generally be allowed to drain over the benches and catch-berms without causing erosion or stability problems. Water inflow to the pit will be collected in sumps at the bottom of the pit and pumped to collection sump(s) within the diked area.

The sumps will generally be operated with a low water level to provide temporary storage capacity in case of emergency such as possible breakdowns, or power failures at the pump stations. The pumping equipment and infrastructure will be selected and designed to accommodate the sub-zero temperatures. This may entail heat tracing of the pump intakes and providing self-priming pumps and increased monitoring during these periods.

Pumping of the sumps will likely be possible to temperatures down to -10°C during late winter or early spring. Other options would be to pump the sumps dry prior to freeze-up, or to break and remove ice manually or mechanically. Further standard techniques of control and prevention of ice buildup will be investigated during detailed engineering design of the sumps.

Environmental monitoring of the water control system field performance will be carried out during the regular collection of groundwater and temperature data and annual geotechnical site inspections completed as part of the environmental monitoring program. Results of the data collection and site inspections will be used to assess and improve where necessary the field performance of the water control structures.

5.0 MINE CLOSURE AND RECLAMATION

The reclamation goal for the Ekati Mine, as approved by the Wek'èezhìı Land and Water Board through the Interim Closure and Reclamation Plan (ICRP) report (BHP Billiton 2011, 2012), is "to return the Ekati Mine site to viable, and wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment, human activities, and the surrounding environment." The reclamation goal is supported by specific objectives and completion criteria for each type of development (e.g., open pits, underground workings, roads). Reclamation of the Jay Project developments will be designed to fit into this established framework.

The summary of the closure and reclamation plan for the Jay Project presented in this section is focused on the closure activities proposed for the new project facilities and infrastructure. The reader is referred to the Closure and Reclamation Plan report for a complete description of the proposed conceptual closure plan (Dominion Diamond 2014a, Appendix 3B).

A description of the closure back-flooding of the Misery Pit, the Jay Pit, and the diked area is presented in Section 5.1; a summary of the closure plan for the WRSA is provided in Section 5.2; a summary of the closure activities for dike, channel, and sumps is provided in Section 5.3; and a summary of the proposed closure plan for buildings, roads, and infrastructure is provided in Section 5.4.

5.1 Closure Back-Flooding

A description of the proposed conceptual back-flooding strategy for the Jay Project is presented in this section; additional details are provided in Appendix A of this report. A layout during the closure back-flooding is provided in Figure 3-6.

At completion of mining the Jay pipe, and as part of the closure measure for the Misery Pit, the water level in the Misery Pit will be lowered to approximately 60 m below the final overflow elevation (approximately 16.75 million m^3). This water is expected to have elevated concentrations of TDS and will be pumped into the mined-out Jay Pit, where it will occupy the lower half of the pit (based on elevation). Once this has been completed, the remaining volume in the Misery Pit, the Jay Pit, and the diked area will be back-flooded with water to facilitate creation of a freshwater cap and to re-establish natural water levels in the diked area. Water for back-flooding will come from a combination of runoff, precipitation and from Lac du Sauvage. Water from Lac du Sauvage will be pumped over the dike in a controlled manner to control the generation of TSS. Once water quality within the back-flooded area is demonstrated to be suitable for mixing with the natural lake water, the dike will be locally breached and the Sub-Basin B Diversion Channel will be re-graded to promote natural drainage.

A 60 m cap of fresh water will be created above the high TDS water in the Misery Pit, using runoff, direct precipitation, and water pumped from Lac du Sauvage. The remaining high TDS laden water will remain in the lower part of the Misery Pit following the creation of the freshwater cap due to density stratification. Consideration may be given during future stages of design to pumping fresh water from Lac de Gras instead. Once the freshwater cap is created and water quality has been demonstrated to be suitable for discharge, a hydraulic connection to the natural channel to Lac de Gras will be re-established to allow for discharge of water overflows from the surface of the Misery Pit Lake to the environment.

The proposed closure back-flooding procedure was modelled using the GoldSim Technology Group's software GoldSim™ to establish flooding rates and the expected time for back-flooding (GoldSim 2014). The existing regional water balance model (Dominion Diamond 2014a, Annex X) and local water balance model (Section 6.1) developed for the Jay Project were used to model the recommended closure procedure. It is assumed that, during the back-flooding period, the Sub-Basin B Diversion Channel will remain in place and will discharge into Lac du Sauvage; therefore, water from Sub-Basin B will not be used for back-flooding. It has also been assumed that back-flooding can occur year round (to be confirmed during future stages of design). Flow rates for back-flooding were based on the pumping capacity available at site at the end of operations (PS1, PS2, and PS3). Also, maximum withdrawal rates from Lac du Sauvage were set for the different stages of the closure back-flooding and for the different seasons to reduce impacts on natural water levels and discharge flows from Lac du Sauvage. A detailed description of the assumptions made to set the maximum withdrawal rates from Lac du Sauvage is presented in Appendix A of this report.

Based on the modelling results available to date, back-flooding would be achieved in about four years (assuming average conditions) and is expected to have acceptable minimal impacts to the level and local hydrological regime in Lac du Sauvage and Lac de Gras. The results for the proposed back-flooding procedure are summarized in Table 5-1.

Table 5-1: Proposed Closure Back-Flooding Summary

Area	Estimated Time for Back-Flooding[a, b]	Back-Flooding Volume (million m^3)	Pumped Volume (million m^3)	Other Inflows (million m^3)[c]
Jay Pit	1,135 Days (Approx. 3 years, 1 month)	93.84	85.17	8.67
Diked Area	247 Days (Approx. 8 months)	26.64	25.02	1.62
Total	1,382 Days (Approx. 3 Years, 9 months)	120.48	110.20	10.28

a) Based on pumping rates described above with closure commencing on January 1, 2030.

b) The volume for the top 60 m of the Misery Pit (to be filled with fresh water) is approximately 16.75 million m^3. It is expected that this volume will be pumped from Lac du Sauvage in 443 days.

c) Other Inflows include local precipitation, seepage, and local runoff.

m^3/s = cubic metres per second; m^3 = cubic metres.

During next stages of the development of the Jay Project, additional modelling will be carried out for the proposed closure back-flooding procedure to better define the water transfer rates. In particular, the modelling will indicate whether reduced transfer rates will be required at certain times to limit impacts on the downstream hydrological regime during low flow periods, and also the likelihood that increased transfer rates are possible during freshet periods or during high flow periods. The modelling will be conducted with support from fish and fish habitat specialists to identify strategies that could be implemented to reduce impacts of the closure back-flooding to key components, such maintenance of fish passage, rate of change in water depths from late summer to winter, and changes to extension of lake surface area (due to changes in water level).

5.2 Waste Rock Storage Area

The Jay WRSA has been designed to remain in place after operations and it will be reclaimed in a manner similar to the existing WRSAs at the Ekati site. The Jay WRSA has been designed to be an inherently and physically stable structure, both during mine operations and in the long term. It has also been designed and will be constructed to minimize runoff and encourage permafrost formation through placement sequence of materials. The intent is that water infiltrating the waste rock will encounter permafrost conditions and freeze within the pile. This will limit runoff to the outer surface of the waste rock (i.e., the active layer).

Placement of the encapsulating cover will be completed during mine operations. Final reclamation may include levelling of the upper surface to discourage snow accumulation to continue aggradation of permafrost in the pile over the long term. Access/egress ramps for wildlife will be constructed as part of the closure stage.

If WRSA seepage during the operations stage of the Jay Project requires active management, construction of seepage management structures (sumps and channels) may be required. These structures will be decommissioned once water quality monitoring results from the WRSA demonstrate that water quality is acceptable. Channels will be re-graded to promote natural drainage, and sumps will be backfilled with local soils to prevent dusting and erosion.

Natural colonization will most likely come from lichen colonization over time.

5.3 Dike, Channel, and Sumps

Once the water quality within the back-flooded area of Lac du Sauvage has been demonstrated to be suitable for direct mixing with the natural lake, the dike will be strategically breached in local areas. A layout of the proposed dike breaching locations is provided in Figure 3-7. Considerations for the breaches are as follows:

- The water level on the Lac du Sauvage side of the dike cannot be lowered to enable the breaching work to be completed “in-the-dry.” Therefore, water levels will be approximately equalized on both sides of the dike by back-flooding the dewatered area in a controlled manner prior to dike breaching.
- During excavation of the breaches, silt curtains or other sediment/turbidity mitigation measures will be used to reduce risks to water quality, where necessary.
- The dike will be breached to a depth of approximately 2 to 3 m below the minimum water level at Lac du Sauvage to account for ice formation, fish passage, and navigable water requirements. Excavated materials (crushed granite rock) will be locally placed to extend shallower areas on the residual sides of the dike and breaches.
- Rockfill material from the breach excavation, or other appropriate erosion mitigation measures, will be installed as necessary to provide for long-term physical stability of the dike breach slopes.

The riparian (shoreline) and littoral (shallow) areas within the diked area will be reclaimed where necessary to enable natural regrowth of riparian and aquatic vegetation. The reclamation work is envisioned to include localized repair of erosion, and re-vegetation of select areas with aquatic and riparian plants. This work will be based on experience gained through operations and closure of other areas of the Ekati Mine.

The Sub-Basin B Diversion Channel will be re-graded to promote drainage through the natural drainage pattern to Lac du Sauvage once the water quality in the back-flooded area meets closure criteria for discharge. The reclaimed diversion channel will be made safe for movement of wildlife, particularly caribou, and people.

The Jay runoff and mine inflows sumps will be back-flooded during the back-flooding of the diked area.

5.4 Buildings, Roads, and Infrastructure

The reclamation of these facilities will be carried out following procedures described in the existing approved ICRP. A layout of the reclamation of these facilities is provided in Figure 3-6.

Roads will be finally decommissioned once they are no longer required for post-closure monitoring and maintenance. Access roads will be re-graded to promote natural drainage, and culverts will be removed.

Reclamation of pads will be completed after the above ground structures have been removed, and an environmental site assessment has been completed where appropriate (i.e., known hydrocarbon or other spills). Revegetation may be completed in areas with physical characteristics suitable to establish and support vegetation, as required.

Power poles, pipelines, and pumping systems will be reclaimed by removal for salvage or disposal at the existing Ekati on-site landfills, in accordance with existing Ekati waste management strategies.

6.0 WATER BALANCE

A water balance model was developed to assist in the evaluation of the proposed water management infrastructure under average climate conditions over the life of the mine and into closure. The model includes a daily water balance along with a mass balance of geochemical parameters.

The water balance model for the Jay Project was developed using GoldSim, a highly graphical program for carrying out dynamic, probabilistic simulations to support decision-making (GoldSim 2014). GoldSim is especially well suited to simulating a dynamic, computationally intensive but well-defined networked model such as a water balance. GoldSim has been used to build water and mass balance for numerous mines, including for the Ekati Mine Koala watershed.

The proposed mine and water management infrastructure was formulated into the model, which then simulated the conveyance and storage of water within the mine site from the construction to the post-closure phases of the Jay Project. A mass balance module was included within the model to predict water quality (i.e., parameter concentrations) at mine and water management infrastructure, from the construction to the post-closure phases of the Jay Project.

6.1 Conceptual Water Balance Framework

The conceptual water balance framework developed for the water balance model is presented in Figure 6-1. The water balance is focused on the Misery-Lac du Sauvage area, which represents the area where new flow paths are introduced by the Jay Project. The existing water balance for the Koala watershed (Ekati site) would remain applicable for the processing facilities and processed kimberlite deposition.

6.2 Water Balance Assumptions

The water balance model for the Jay Project focuses on minewater management infrastructure and areas that have been physically or chemically affected by mining activities. Therefore, it is not impacted by water levels in the neighbouring waterbodies.

The model is based on the following assumptions and considerations:

- Evaporation only occurs from June to September.
- Snow accumulates throughout the months of October to May and thaws in June using a day degree melt model.
- The model is run for average year climate conditions only.
- Groundwater seepage into the Misery Pit is assumed to be negligible for the purpose of estimation of annual water volume exchanges.
- The collection sumps within the diked area are empty at the start of the simulation.
- The mine inflows sump is not specifically modelled within the GoldSim model; open pit minewater is assumed to be pumped from the Jay Pit directly to the Misery Pit.

- The Jay runoff sump is included in the model.
- The Lynx Pit has not been modelled during operations and closure. Closure of the Lynx Pit is described in Dominion Diamond (2013).
- Contingency storage allowances in the Lynx Pit (during dewatering stage only) and the Misery Pit are included in the model.

A brief description of the input parameters and assumptions used in the water balance model are provided in Tables B.1 to B.5 in Appendix B of this report.

The following section presents a summary of the water balance results. Results from the mass balance portion of the model are provided in Section 7.0.

6.3 Water Balance Results

The results of the water balance are summarized in Table 6-1. Time series of the water balance results for key water management facilities are presented on Figures 6-2 to 6-7. The following presents some key water balance results:

- The dewatering from the diked area of Lac du Sauvage will pump approximately 7.9 million m^3 of elevated TSS water to the Misery Pit and 4.9 million m^3 to the Lynx Pit, during approximately the last three months of dewatering.
- For the operations phase, the model results indicate that the Misery Pit will be able to hold all minewater flows from the dike area (open pit minewater and surface minewater) and direct precipitation and runoff until the summer of 2024 or approximately 4.5 years of operations. Once the water level in the Misery Pit reaches the maximum operating level, water from the surface of the Misery Pit will be pumped to Lac du Sauvage assuming year round pumping (Figure 6-2 and Figure 6-3).
- The Jay runoff sump will be operated in such a manner to minimize the amount of water stored within the facility. The pumping system in the Jay runoff sump is designed to handle expected peak inflows. This would limit the amount of water that will be stored within the sump, maximizing the storage capacity available for potential upset conditions (extreme climate events) and providing contingency for temporary shutdown of the pumping system. Any excess water from the Jay runoff sump will be directed into the Jay mine inflows sump, if required; however, this is not predicted to occur.
- The mine inflows sump will be operated in such a manner to minimize the amount of water stored within the facility. The pumping system in the mine inflows sump is designed to handle the maximum expected open pit minewater. This limits the amount of water that will be stored within the sump maximizing the storage capacity available for contingency for temporary shutdown of the pumping system. Any excess water from the mine inflows sump will report to the Jay Pit, if required; however, this is not predicted to occur.
- Closure back-flooding would occur in approximately four years as described in Section 5.1.

Table 6-1: Water Balance Model Summary

Flow Description	Flow Component (Figure 6-1)	Dewatering		Stripping		Year 1 - 2020		Year 2 - 2021		Year 3 - 2022		Year 4 - 2023		Year 5 - 2024		Year 6 -2025		Year 7 - 2026	
Jay Pit Reservoir		Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)
R3 Runoff	R3	0		0		198,872		200,476		200,476		200,476		200,682		200,476		200,477	
S4 Groundwater	S4	0		946,400		2,784,400		2,911,600		2,771,844		2,773,976		3,037,100		2,974,170		2,685,000	
S3 Groundwater from Lac Du Sauvage	S3	0		0		36,500		544,600		1,141,956		1,641,129		2,194,500		2,754,928		3,154,697	
S5 from Jay Runoff Sump	S5	0		0		0		0		0		0		0		0		0	
P5 Pump Misery to Jay Pit	P5	0		0		0		0		0		0		0		0		0	
O2 Overflow Jay Runoff Sump to Mine Inflows Sump	O2	0		0		0		0		0		0		0		0		0	
P8 From Lac du Sauvage	P8	0		0		0		0		0		0		0		0		0	
Jay Pit Ice Melt	Ice Melt	0		0		0		0		0		0		0		0		0	
E3 Evaporation	E3		0		0		645		645		645		645		645		645		645
S5 Jay Pit to Groundwater	S5		0		0		0		0		0		0		0		0		0
P4 Mine Inflow Sump to Misery	P4		0		946,400		3,019,127		3,656,031		4,113,632		4,614,930		5,431,640		5,928,930		6,039,530
Jay Pit Ice Freeze	Ice Freeze		0		0		0		0		0		0		0		0		0
Sub-Total		0	0	946,400	946,400	3,019,772	3,019,772	3,656,676	3,656,676	4,114,276	4,114,277	4,615,581	4,615,575	5,432,282	5,432,285	5,929,574	5,929,575	6,040,174	6,040,175
Change in Storage		0		0		0		0		-1		6		-3		-1		-1	
Diked Area		Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)
R4 Runoff	R4	1,537,265		10,187		1,739,559		1,292,333		1,287,244		1,287,244		1,288,665		1,287,241		1,287,242	
R4 Waste Rock Runoff	R4 WSRA	0		0		17,308		386,756		447,691		503,005		505,445		504,912		504,912	
S1 Groundwater from Lac Du Sauvage	S1	135,900		900		0		0		0		0		0		0		0	
S2 Groundwater	S2	820,800		32,700		300		0		0		0		0		0		0	
P8 From Lac du Sauvage	P8	0		0		0		0		0		0		0		0		0	
Ice Melt	Ice Melt	0		0		1,175,647		0		0		0		0		0		0	
E4 Evaporation	E4		622,183		994		22,949		7,005		7,005		7,005		7,021		7,005		7,005
S5 Seepage to Groundwater	S5		0		0		0		0		0		0		0		0		0
S6 Seepage to Groundwater	S6		0		0		0		0		0		0		0		0		0
O2 Overflow Jay Runoff Sump to Mine Inflows Sump	O2		0		0		0		0		0		0		0		0		0
P1 Pumping to Lac du Sauvage	P1		14,976,000		0		0		0		0		0		0		0		0
P2 Pumping to Lynx Pit	P2		4,992,000		0		0		0		0		0		0		0		0
P3 Pumping to Misery Pit	P3		3,744,000		4,054,233		2,909,867		1,672,080		1,727,930		1,783,240		1,787,090		1,785,150		1,785,150
O3 Overflow to Lac du Sauvage	O3		0		0		0		0		0		0		0		0		0
Ice Freeze	Ice Freeze		0		1,175,647		0		0		0		0		0		0		0
Sub-Total		2,493,965	24,334,183	43,787	5,230,874	2,932,814	2,932,816	1,679,089	1,679,085	1,734,935	1,734,935	1,790,249	1,790,245	1,794,110	1,794,111	1,792,153	1,792,155	1,792,154	1,792,155
Change in Storage		-21,840,218		-5,187,087		-2		4		0		4		-1		-2		-1	
Misery Pit		Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)	Inflows (m^3)	Outflows (m^3)
R5 Runoff	R5	110,479		893		172,608		173,669		174,718		175,672		176,806		177,059		177,059	
P4 Mine Inflow Sump to Misery	P4	0		946,400		3,019,127		3,656,031		4,113,632		4,614,930		5,431,640		5,928,930		6,039,530	
P3 Pumped from Jay Runoff Sump	P3	3,744,000		4,054,233		2,909,867		1,672,080		1,727,930		1,783,240		1,787,090		1,785,150		1,785,150	
P7 Pumped from Lac du Sauvage	P7	0		0		0		0		0		0		0		0		0	
Ice Melt	Ice Melt	0		0		122,301		241,780		296,594		352,510		400,944		463,715		464,245	
E5 Evaporation	E5		2,430		81		41,264		51,906		61,529		70,836		79,817		82,638		82,645
P6 Pumped to Lac Du Sauvage	P6		0		0		0		0		0		0		2,142,944		7,802,901		7,917,895
P6 Overflow to Lac de Gras	Overflow		0		0		0		0		0		0		0		0		0
P5 Pumped to Jay Pit	P5		0		0		0		0		0		0		0		0		0
Ice Accumulation	Ice Accumulation		0		122,301		241,780		296,594		352,510		400,944		463,715		464,245		464,358
Sub-Total		3,854,479	2,430	5,001,526	122,382	6,223,903	283,044	5,743,560	348,500	6,312,874	414,039	6,926,352	471,780	7,796,480	2,686,476	8,354,854	8,349,784	8,465,984	8,464,898
Change in Storage		3,852,049		4,879,144		5,940,859		5,395,060		5,898,835		6,454,572		5,110,004		5,070		1,086	

Flow Description	Flow Component (Figure 6-1)	Year 8 - 2027		Year 9 - 2028		Year 10 - 2029		Year 11 - 2030 (Closure)		Year 12 - 2031 (Closure)		Year 13 - 2032 (Closure)		Year 14 - 2033 (Closure)	
Jay Pit Reservoir		Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)
R3 Runoff	R3	200,476		200,682		200,476		200,476		200,476		200,850		0	
S4 Groundwater	S4	2,622,700		2,701,610		3,457,370		2,843,730		1,581,750		277,370		0	
S3 Groundwater from Lac Du Sauvage	S3	3,581,310		3,885,380		4,313,830		1,295,910		311,270		37,190		0	
S5 from Jay Runoff Sump	S5	0		0		0		0		0		0		568,100	
P5 Pump Misery to Jay Pit	P5	0		0		0		13,692,000		0		0		0	
O2 Overflow Jay Runoff Sump to Mine Inflows Sump	O2	0		0		0		0		442,273		1,817,190		0	
P8 From Lac du Sauvage	P8	0		0		0		16,920,000		22,032,000		31,594,030		1,476,000	
Jay Pit Ice Melt	Ice Melt	0		0		0		0		476,247		665,915		0	
E3 Evaporation	E3		645		645		645		73,635		111,852		159,287		0
S5 Jay Pit to Groundwater	S5		0		0		0		0		0		447,432		786,764
P4 Mine Inflow Sump to Misery	P4		6,403,830		6,787,040		7,971,030		56,100		0		0		0
Jay Pit Ice Freeze	Ice Freeze		0		0		0		0		0		0		0
Sub-Total		6,404,486	6,404,475	6,787,672	6,787,685	7,971,676	7,971,675	34,952,116	129,735	25,044,016	111,852	34,592,544	606,719	2,044,100	786,764
Change in Storage		11		-13		1		34,822,381		24,932,164		33,985,825		1,257,336	
Diked Area		Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)
R4 Runoff	R4	1,287,240		1,288,650		1,287,250		1,310,450		1,393,210		1,432,680		1,851,200	
R4 Waste Rock Runoff	R4 WSRA	504,913		505,444		504,913		517,682		517,682		518,215		517,682	
S1 Groundwater from Lac Du Sauvage	S1	0		0		0		0		0		0		0	
S2 Groundwater	S2	0		0		0		0		0		0		0	
P8 From Lac du Sauvage	P8	0		0		0		0		0		0		25,069,040	
Ice Melt	Ice Melt	0		0		0		0		889,753		1,120,564		1,120,563	
E4 Evaporation	E4		7,005		7,019		7,005		36,199		117,978		133,703		596,136
S5 Seepage to Groundwater	S5		0		0		0		0		0		0		568,443
S6 Seepage to Groundwater	S6		0		0		0		0		0		0		2,723,574
O2 Overflow Jay Runoff Sump to Mine Inflows Sump	O2		0		0		0		0		442,273		1,817,190		0
P1 Pumping to Lac du Sauvage	P1		0		0		0		0		0		0		0
P2 Pumping to Lynx Pit	P2		0		0		0		0		0		0		0
P3 Pumping to Misery Pit	P3		1,785,150		1,787,080		1,785,150		0		0		0		0
O3 Overflow to Lac du Sauvage	O3		0		0		0		0		0		0		65,037
Ice Freeze	Ice Freeze		0		0		0		889,753		1,120,564		1,120,563		4,617,197
Sub-Total		1,792,153	1,792,155	1,794,094	1,794,099	1,792,163	1,792,155	1,828,132	925,952	2,800,645	1,680,816	3,071,459	3,071,456	28,558,485	8,570,387
Change in Storage		-2		-5		8		902,180		1,119,829		3		19,988,098	
Misery Pit		Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)	Inflows (m3)	Outflows (m3)
R5 Runoff	R5	177,061		177,249		177,071		174,967		177,255		178,129		177,944	
P4 Mine Inflow Sump to Misery	P4	6,403,830		6,787,040		7,971,030		56,100		0		0		0	
P3 Pumped from Jay Runoff Sump	P3	1,785,150		1,787,080		1,785,150		0		0		0		0	
P7 Pumped from Lac du Sauvage	P7	0		0		0		7,236,000		9,432,000		0		0	
Ice Melt	Ice Melt	464,358		464,736		465,114		466,361		390,650		501,670		501,669	
E5 Evaporation	E5		82,672		82,703		82,816		63,524		85,503		90,807		90,806
P6 Pumped to Lac Du Sauvage	P6		8,279,370		8,664,660		9,837,230		21,300		0		0		0
P6 Overflow to Lac de Gras	Overflow		0		0		0		0		45,487		81,182		77,453
P5 Pumped to Jay Pit	P5		0		0		0		13,210,480		0		0		0
Ice Accumulation	Ice Accumulation		464,736		465,114		466,361		390,650		501,670		501,669		501,669
Sub-Total		8,830,399	8,826,779	9,216,105	9,212,477	10,398,365	10,386,407	7,933,428	13,685,954	9,999,905	632,660	679,799	673,658	679,613	669,928
Change in Storage		3,621		3,628		11,958		-5,752,526		9,367,245		6,141		9,685	

7.0 WATER QUALITY

A water quality model was developed for the conceptual design of the water management plan for the Project during operations. A water quality module was built directly into the site water balance model (Section 6.0) using the GoldSim (2014) contaminant transport module.

The Jay Project model was designed to predict water concentrations on a daily timestep at each discharge source during operations and post-closure for the Jay Project. Water qualities were simulated for the following discharges that could influence water quality downstream in Lac du Sauvage and Lac de Gras:

- Operations
  - Misery Pit discharge to Lac du Sauvage.
- Post-closure
  - Misery Pit overflow to Lac de Gras;
  - Misery Pit seepage to Lac de Gras;
  - water displacement from the Jay Pit monimolimnion (the lower, dense stratum of a meromictic [multi-density layer] lake that does not mix with waters above) to Lac du Sauvage; and,
  - WRSA drainage.

The closure phase of the Jay Project is included in the water quality model; however, this period is defined as the refilling of the Misery and Jay open pits and no discharge occurs from the Jay Project to the receiving environment during this time.

In GoldSim, each flow that could influence the water quality of the above discharges was itemized and assigned a source term chemical profile based on geochemical testing of waste rock materials, observed mine site facility drainage at the Ekati operations, and baseline surface and groundwater quality monitoring data. Mine site facilities that accumulate water (e.g., the Misery Pit, the Jay Pit) were treated as distinct reservoirs within the model. Inflow volumes and concentrations were included as inputs to each reservoir to account for chemical loadings from natural areas, disturbed areas, mine rock runoff and seepage, wall rock runoff, and groundwater inflows to project the discharge chemistry from each mine site facility.

The model was designed to track the chemistry of the following parameters:

- conventional Parameters: TDS and hardness;
- major ions: calcium (Ca), chloride (Cl), fluoride (F), magnesium (Mg), potassium (K), sodium (Na) and sulphate (SO_4);
- nutrients: nitrate (NO_3), ammonium (NH_4), and total phosphorus (TP); and,
- total and dissolved metals: aluminum (Al), antimony (Sb), arsenic (As), barium (Ba), beryllium (Be), bismuth (Bi), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), lithium (Li), manganese (Mn), mercury (Hg), molybdenum (Mo), nickel (Ni), selenium (Se), silicon (Si), silver (Ag), strontium (Sr), thallium (Tl), tin (Sn), titanium (Ti), uranium (U), vanadium (V) and zinc (Zn).

Detailed water quality modelling results for the complete list of parameters included in the water quality model are provided in Appendix 8E of the DAR (Dominion Diamond 2014a). This report focuses on the projected concentrations of the following parameters: TDS, chloride, nitrate, and total phosphorus, which, based on experience at the Ekati Mine and consistent with Golder's experience at diamond mines in the NWT, have occurred as parameters of concern and can be used as representative of water quality for the purpose of this report. The reader is referred to Appendix 8E of the DAR for a detailed discussion of the comprehensive list of modelled water quality parameters (Dominion Diamond 2014a).

The following subsections provide an overview of the water quality model results for the Jay Project. A detailed description of the model development, inputs, assumptions, and results is provided in Appendix 8E of the DAR (Dominion Diamond 2014a).

7.1 Model Inputs and Simulations

To assess the range of variability that could occur in Jay Project discharges to Lac du Sauvage and Lac de Gras, stochastic model inputs were developed for the following mine site drainages:

- Jay wall rock runoff;
- Jay WRSA drainage; and
- Misery wall rock runoff.

Natural runoff and groundwater quality inputs were entered into the model deterministically. Predicted TDS concentrations were estimated based on a conservative groundwater quality profile. Therefore, applying a constant value to the TDS source term introduces conservatism in the model for TDS and parameters that are correlated to TDS (i.e., concentrations of these parameters are biased towards the upper bound). Median deterministic values were selected to represent the quality of natural runoff and groundwater parameters that do not demonstrate a correlation to TDS (Dominion Diamond 2014a, Appendix 8E).

The water quality model was designed to estimate discharge concentrations on a daily timestep from Year -1 of the mine life, which corresponds to dewatering and pre-stripping of the diked area, to Year 210, which is 200 years after the back-flooding of the Misery and Jay pits (i.e., the post-closure period). The model was run iteratively for 200 realizations. Therefore, at each timestep, a unique value was calculated based on randomly selected values for each of the stochastic inputs 200 times. Following the model run, average and 99^{th} percentile discharge concentrations were calculated based on the 200 values calculated at each timestep. To facilitate results presentation, maximum daily average and maximum daily 99th percentile values were calculated for each of the following model snapshots:

- operations – Misery Pit discharge period (2024 to 2030); and
- post-closure (after July 1, 2032).

For the purpose of discussing the model results, model sensitivities are referred to as the average and 99th percentile scenarios in this document. There is no discharge from the Misery Pit before 2024. As such, results are not presented for this period of operations.

7.2 Model Results

This section provides a description of the model results during operations and post-closure stage.

7.2.1 Operations

During operations, water reporting to the diked area and the Jay Pit will be pumped to the Misery Pit. Water balance modelling indicates the total volume of water that needs to be managed through the Misery Pit during the life of mine exceeds the design capacity of the pit. Excess water stored in the Misery Pit will be discharged to Lac du Sauvage to accommodate additional storage from inflows to the Jay Pit and the diked area.

The majority of the water that will be managed through the Misery Pit originates from groundwater inflows to the Jay Pit (open pit minewater). Groundwater inflows and TDS concentrations increase throughout the mine life as shown in Section 4.1. To minimize TDS concentrations in the discharge to Lac du Sauvage, water pumped from the mine inflows sump will be piped to the bottom of the Misery Pit. In this manner, a density gradient will form within the Misery Pit such that lower TDS water will be present at the surface of the Misery Pit for discharge to Lac du Sauvage.

Water stored in the surface layer of the Misery Pit will be mixed with water from the following sources:

- direct precipitation;
- water displaced from vertically from the bottom of the pit as a result of pumping Jay Pit inflows to the bottom of the Misery Pit;
- diked off area catchment runoff (surface minewater pumped to the surface of the Misery Pit); and;
- Misery Pit natural catchment.

Water balance modelling indicates approximately five years will be required to fill the Misery Pit to the design storage capacity prior to discharge being required. Projected operational discharge concentrations from the Misery Pit are presented in Figure 7-1, and maximum discharge concentrations for select years during the mine life are presented in Table 7-1.

Simulated discharge concentrations to Lac du Sauvage from the Misery Pit are seasonal for all parameters. For example, peak discharge concentrations occur during the winter months as result of ice formation concentrating the chemical load in the upper layer of the Misery Pit. Concentrations decrease as a result of ice melt during freshet, and are lower during the open water season. This phenomenon is well established and well documented at the Ekati Mine.

Table 7-1: Projected Misery Pit Discharge Water Quality during Operations

Parameter	Units	Operations							
		Misery Pit Discharge							
		1-Jan-2024 to 31-Dec-2024		1-Jan-2027 to 31-Dec-2027		1-Jan-2029 to 31-Dec-2029		Maximum Simulated Value	
		Under Ice	Open Water	Under Ice	Open Water	Under Ice	Open Water	Under Ice	Open Water
Average									
Total Dissolved Solids (TDS)	mg/L	314	248	1,464	1,018	2,925	2,091	2,925	2,091
Chloride (Cl)	mg/L	90	53	799	527	1,712	1,196	1,712	1,196
Nitrate (NO_3)	mg N/L	9.0	7.6	15	12	20	16	20	16
Total Phosphorus (TP)	mg/L	0.072	0.054	0.17	0.13	0.21	0.16	0.22	0.16
99th Percentile									
Total Dissolved Solids (TDS)	mg/L	528	462	1,547	1,135	2,977	2,183	2,977	2,183
Chloride (Cl)	mg/L	107	69	808	538	1,719	1,204	1,719	1,204
Nitrate (NO_3)	mg N/L	67	57	46	39	44	37	67	57
Total Phosphorus (TP)	mg/L	0.14	0.12	0.21	0.17	0.23	0.19	0.23	0.20

mg/L = milligrams per litre; mg N/L = milligrams nitrogen per litre.

During operations, the Jay Pit groundwater inflows and TDS concentration increase as shown in Table 4-1.

Since the Jay Pit groundwater inflows account for approximately 65% of the total water managed through the Misery Pit during operations, TDS concentrations in the Misery Pit also demonstrate an associated increase, with maximum concentrations occurring during the final year of the mine life (Figure 7-1). Maximum TDS concentrations in the discharge from the Misery Pit are projected to be 2,925 mg/L under ice and 2,091 mg/L during the open water season in the last year of mining (Year 10) for the average model scenario. Maximum projected under ice and open water discharge concentrations from the Misery Pit slightly increase to 2,977 mg/L and 2,183 mg/L, respectively, for the 99th percentile model scenario (Table 7-1).

Chloride is directly correlated to TDS and also continually increases during the life of mine with maximum concentrations occurring during the last year of mining. For the average scenario, peak under ice average and open water chloride concentrations were projected to be 1,712 mg/L and 1,196 mg/L, respectively, in the Misery Pit discharge. Chloride concentrations were marginally higher than the average scenario during under ice (1,719 mg/L) and open water (1,204 mg/L) conditions in the 99th percentile scenario.

Projected concentrations of nitrate also increase during the life of mine (Figure 7-1). Although nitrate is a component of TDS, it is not directly correlated to TDS at the Jay Project. Nitrate originates from wastage of ammonium nitrate fuel oil (ANFO) during blasting misfires and powder spills while loading blast holes. Development of waste rate assumptions can introduce uncertainty into predictions of nitrate concentrations; therefore, the median nitrate concentration (22.6 mg/L) observed in Ekati Mine pit sumps was assigned as a surrogate source term to minewater pumped from the Jay Pit to the Misery Pit. Since groundwater inflows increase through operations (Table 4-1), nitrate concentrations in the Misery Pit demonstrate an associated increase (Figure 7-1). Maximum average scenario under ice (20 milligrams nitrogen per litre [mg N/L]) and open water (16 mg N/L) nitrate concentrations occur during the last year of mining.

The Misery Pit discharge nitrate concentrations are sensitive to the WRSA drainage, which is pumped to the upper layer of the Misery Pit via the diked area. As indicated in Section 7.1, the WRSA runoff quality was entered as stochastic input. The 99th percentile drainage quality from this facility is 300 mg N/L, versus the mean value of 33.8 mg N/L. As a result, the 99th percentile scenario nitrate concentrations increase to 67 mg N/L under ice and 57 mg N/L during the open water season (Table 7-1).

Total phosphorus was also not observed to be correlated to TDS in the groundwater dataset selected for the Jay Project (Dominion Diamond 2014a, Appendix 8E). The groundwater chemical profile had the maximum total phosphorus concentration (0.4 mg/L) in comparison to all other model source terms. Therefore, as the groundwater inflows increase as mining of the Jay Pit advances, total phosphorus loadings to the Misery Pit increase resulting in a gradual increase in total phosphorus concentrations in the Misery Pit discharge (Figure 7-1). Maximum under ice and open water total phosphorus concentrations were projected to be 0.22 mg/L and 0.16 mg/L, respectively, for the average scenario and 0.23 mg/L and 0.2 mg/L, respectively, for the 99th percentile scenario (Table 7-1).

7.2.2 Post-closure

7.2.2.1 Misery Pit

During closure, the water level in the Misery Pit will be lowered to 60 m below the final overflow elevation. The volume of the top 60 m of the Misery Pit is approximately 16.75 million m^3. The volume of water pumped from the Misery Pit to the Jay Pit will be replaced with fresh water pumped from Lac du Sauvage to produce a 60 m low density freshwater cap (mixolimnion) over denser saline water with elevated concentrations of TDS (monimolimnion). The post-closure period for the Misery Pit commences following back-flooding of the pit. At that time, the mixolimnion will overflow to Lac de Gras. An allowance for a small amount of seepage (54 m^3/day) from the bottom of the pit (monimolimnion) to the regional groundwater system has been incorporated into the model. This seepage will eventually report to Lac de Gras.

Hydrodynamic modelling (Dominion Diamond 2014a, Appendix 8G) indicates that a small amount of the dense water stored in the bottom of the Misery Pit may mix by diffusion into the overlying surface layer. Therefore, during the post-closure period, water stored in the surface layer of the Misery Pit (i.e., the outflow from the Misery Pit Lake) is modelled as a mixture of the following water sources:

- concentrations of higher density elements diffused upwards from the bottom layer;
- water pumped from Lac du Sauvage during the closure period;
- wall rock runoff;
- natural runoff; and,
- direct precipitation.

Projected maximum post-closure results for the Misery Pit surface layer (mixolimnion) concentrations are presented in Table 7-2 and in Figure 7-2. Concentrations of all parameters increase during the post-closure period to maximum long-term steady state concentrations approximately 200 years into the post-closure period (Figure 7-2). Although concentrations increase during the post-closure period, the maximum concentrations are much less than the peak concentrations observed during operations (Table 7-2).

Table 7-2: Maximum Jay Project Discharge Water Quality during Post-closure

Parameter	Units	Post-closure			
		Misery Pit Surface Discharge		Misery Pit Seepage	WRSA Drainage
		Under Ice	Open Water		
Average					
Total Dissolved Solids (TDS)	mg/L	435	422	5,520	349
Chloride (Cl)	mg/L	235	228	3,359	24
Nitrate (NO_3)	mg N/L	1.6	1.5	22	34
Total Phosphorus (TP)	mg/L	0.059	0.057	0.18	0.12
99th Percentile					
Total Dissolved Solids (TDS)	mg/L	479	465	5,520	1,517
Chloride (Cl)	mg/L	257	250	3,359	95
Nitrate (NO_3)	mg N/L	1.6	1.5	22	300
Total Phosphorus (TP)	mg/L	0.15	0.14	0.19	0.41

WRSA = waste rock storage area; mg/L = milligrams per litre; mg N/L = milligrams nitrogen per litre.

The bottom layer of the Misery Pit (monimolimnion) contains residual water pumped from the Jay Pit during operations. As such, projected concentrations in the bottom layer are much higher than in the surface layer (mixolimnion). Hydrodynamic modelling indicates that meromictic conditions (i.e., stratification) will develop and will permanently isolate the two layers. Maximum post-closure concentrations in the bottom layer are presented in Table 7-2.

The walls of the Misery Pit will be surrounded with permafrost, and hydrogeological modelling indicates there will be no groundwater inflows to the pit during the post-closure period. Therefore, the modelled seepage lost from the base of the Misery Pit will be replaced with water stored in the surface layer (mixolimnion), effectively reducing the capacity of the monimolimnion and increasing the capacity of the freshwater cap. As a result, concentrations in the bottom layer of the pit (monimolimnion) will decrease to the projected long-term steady state concentrations in the surface layer mixolimnion (Table 7-2) as mass is lost from the bottom of the pit to the regional groundwater system. However, the reduction of concentrations in the bottom layer of the Misery Pit was not considered in the water quality model development to provide a conservative estimate of post-closure discharges to Lac de Gras (Dominion Diamond 2014a, Appendix 8F).

7.2.2.2 Jay Pit Monimolimnion

As discussed in Section 7.2.2.1, the water in the upper part of the Misery Pit (maximum volume of 16.75 million m^3; the exact volume will depend on the water level in the Misery Pit at the end of operations) will be pumped to the mined-out Jay Pit. The total capacity of the Jay Pit is approximately 120 million m^3, including the diked area in Lac du Sauvage. The water pumped from the Misery Pit to the Jay Pit is mixed with water from the following sources:

- water pumped from Lac du Sauvage;
- groundwater inflows;
- wall rock runoff;
- natural catchment runoff; and,
- direct precipitation.

Hydrodynamic modelling of the Jay Pit (Dominion Diamond 2014a, Appendix 8G) indicates meromictic conditions will develop following refilling of the Jay Pit, permanently isolating approximately 38.3 million m^3 from the lower density fresh water stored in the surface layer of the pit (mixolimnion) in the diked of area of Lac du Sauvage.

Prior to the development of meromictic conditions, the hydrodynamic model also indicates some water stored in the bottom layer of the Jay Pit (monimolimnion) will mix with the overlying surface layer (mixolimnion). The volume of water from the bottom layer of the pit mixing with the surface layer was assigned the maximum projected concentrations in the bottom layer. This exchange of mass is accounted for in the Lac du Sauvage hydrodynamic water quality model. The reader is referred to Appendix 8F of the DAR for details related to simulated mixolimnion and lake water concentrations (Dominion Diamond 2014a).

7.2.2.3 Jay Waste Rock Storage Area

The WRSA will drain directly to Lac du Sauvage during post-closure. A chemical profile was assigned to drainage from the WRSA. This way, the concentration does not change in response to climate variations (i.e., freshet), and the runoff concentration is independent of the volume of water draining from the WRSA. As indicated in Section 7.1, a statistical distribution was developed based on WRSA monitoring results at the Ekati Mine to account for variability in WRSA runoff quality. In GoldSim the distribution was randomly sampled at each timestep to assign a WRSA runoff water quality. The model was run for 200 realizations so representative mean and 99th percentile runoff water qualities could be calculated for the WRSA drainage. Simulated runoff water qualities are presented in Table 7-2.

Nitrate in the WRSA originates from use of ANFO in the development of the open pit. Since ANFO is highly soluble, it is expected that it will be leached from the WRSA through time. Depletion of nitrogen was not considered in the water quality model to provide a conservative source term to the Lac du Sauvage aquatic effects assessment but it is expected that long-term WRSA nitrate concentrations will be much lower than the value (34 mg/L) presented in Table 7-2.

8.0 MINEWATER MONITORING AND ADAPTIVE MANAGEMENT PLAN

Water balance and water quality models described in the previous sections are based on assumptions derived from data from field investigation programmes conducted to date and from experience on other mining projects in similar environments. Water quantity and quality monitoring is an important part of the MWMP to confirm these assumptions, verify the predicted minewater quantity and quality trends, and define adaptive management strategies should differing trends be observed.

This section provides a summary of the proposed minewater monitoring (Section 8.1), a brief summary of the proposed conceptual receiving environment monitoring program and aquatic response framework (Appendix 9CB of the DAR, Dominion Diamond 2014a) (Section 8.2) and a description of possible adaptive management concepts (Section 8.3).

8.1 Minewater Monitoring Program

Minewater monitoring will be established to monitor the water quantity and quality of main minewater sources. The program's objective is to verify assumptions made during the development of the water quantity and quality models and apply targeted adaptive management strategies where required to meet established performance standards.

Data will be collected, compiled, and managed internally by Dominion Diamond and will be used to define on-site adaptive management requirements if necessary to meet the Jay Project-related performance standards in the receiving environment. Data collected as part of the minewater monitoring program will be reported to the required parties.

The minewater monitoring program will be initiated at the pre-development stage (i.e., continued baseline studies) and will continue during construction, operations, and closure. This section provides a summary of the key components of the minewater monitoring program. Details of the minewater monitoring program (e.g., frequency, methods, and parameters to be monitored) will be defined during the next stages of Jay Project development and will be developed as a complementary extension of the existing monitoring program for the Ekati site (i.e., the Surveillance Network Program conducted under the Ekati Mine Water Licence). Additional monitoring stations may be established at select locations to further monitor or qualify water quality and quantity trends observed in the data collected under the minewater monitoring program.

8.1.1 Pre-development Stage

During the pre-development stage, monitoring would consist mainly of conducting additional measurements of baseline groundwater and surface water quality and quality. This information will be used during the next stages of the Jay Project design to confirm and refine the minewater quantity and quality models completed for the DAR (Dominion Diamond 2014a).

8.1.2 Construction Stage

During the construction stage, TSS concentrations within the diked area and of the pumped dewatering outflow will be monitored regularly to identify when discharge to Lac du Sauvage would be terminated and pumping systems re-arranged to discharge to the Lynx Pit and the Misery Pit. A threshold level of TSS concentrations would be pre-defined in the dewatering plan that is anticipated to be a future requirement of the Water Licence. This approach would be consistent with past and current practice at the Ekati Mine.

8.1.3 Operations Stage

During the operations stage, minewater monitoring will be an important part of overall minewater management. Minewater quality and quantity monitoring will occur at the following main locations:

- Lynx Pit;
- Jay runoff sump (surface minewater);
- mine inflows sump (open pit minewater);
- WRSA seepage;
- Misery Pit; and,
- Misery Pit discharge to Lac du Sauvage (when discharging).

Monitoring in the Lynx Pit will be focused on TSS concentrations in the upper part of the pit. The data collected will be used to identify when discharge to the natural environment can start and hydraulic connection between the Lynx Pit and Lac de Gras can be established.

Monitoring in the Jay runoff sump will include water quantity and quality, including TSS concentrations. Monitoring in the mine inflows sump will include water quantity and quality.

Seepage from the WRSA (quantity and quality) will be monitored during spring and fall as an extension of the established seepage monitoring program at the Ekati Mine. Samplers walk the toe of the WRSA and sample seepage streams that are observed.

Monitoring in the Misery Pit will include regular water quality monitoring in the upper part of the pit and periodic depth profiles through the water column. Once discharge to Lac du Sauvage begins, the final effluent water will be monitored for compliance against the effluent quality criteria defined in the Water Licence.

8.1.4 Closure Stage

During closure, back-flooding stage monitoring would occur in the Misery Pit and diked area. The data collected in the Misery Pit and the Jay Pit will be used to confirm the formation of freshwater caps in the pits and to assess need for additional adaptive management if trends differ from expectations. Water quality data collected in the diked area will be used to assess when dike breaching may begin.

8.1.5 Post-closure Maintenance and Monitoring

Monitoring for physical and chemical stability and maintenance of the reclaimed facilities will be required after closure and post-closure until closure objectives and criteria are met (ultimate closure conditions are reached). The schedule and program for monitoring, maintenance, and engagement will be consistent with the Ekati Mine ICRP. The program for the Jay Project components will use the monitoring programs from the operations stage as a basis and it will be adapted to meet closure-specific needs.

It is expected that the requirement for monitoring of the physical stability of the dike will cease once the dike is breached. Water quality monitoring will be required at Lac du Sauvage for a period after the dike is breached.

8.2 Receiving Environment Monitoring Program and Aquatic Response Framework

Monitoring will be conducted in the aquatic receiving environment. This will be an extension of the Aquatic Effects Monitoring Program (AEMP) that is conducted under the Ekati Mine Water Licence. Reporting the data collected from this program will occur annually, per the established practice at the Ekati Mine and other mines. The Jay AEMP is likely to include the same components as the current AEMP (i.e., water quality, flow, primary and secondary producers, fish) with monitoring locations in Lac du Sauvage and, if appropriate, Lac de Gras. The details for the Jay AEMP are anticipated to be determined as part of the (future) Water Licence issuance/regulatory approvals that would follow successful completion of environmental assessment.

The Aquatic Response Framework (ARF) for the Ekati Mine will also be expanded to incorporate the Jay Project. The overall objective of the ARF is to link the results of the AEMP with actions necessary to ensure that Jay Project-related effects in the receiving environment remain within acceptable range. An ARF for the Ekati Mine has been developed which currently under review by the Wek'èezhìı Land and Water Board (Dominion Diamond 2014c).

8.3 Adaptive Management

Data collected as part of the monitoring program will be used to assess the need for adaptive management should trends in minewater quantity and quality differ from expectations. Adaptive management strategies may involve improvement or modifications of the proposed minewater management plan, or temporary use of the contingency allowances included in the design (Section 4.0). Possible adaptive management strategies that would be considered include the following:

- maintaining a storage contingency allowance in the existing King Pond throughout the construction and operations stage for use as an additional TSS management facility during construction and operations phase, or for short-term emergency minewater storage;
- maintaining the contingency storage in the Misery Pit (approximately 3 million m^3) throughout the operations stage for use as emergency minewater storage;

- maintaining pumping and a pipeline between the Misery and Lynx pits throughout the operations stage to allow for lowering of the Lynx Pit water level to generate additional contingency minewater storage if required;
- increasing storage capacity in the Jay runoff sump and mine inflows sump (e.g., constructing containment berms around the sumps) to augment temporary minewater storage capacity within the diked area;
- direct discharge to the environment from the Jay runoff sump if water is found to meet established discharge criteria (the discharge locations used during the final stages of dewatering would be used; see Section 3.4.1.2);
- use of storage capacity available at the Ekati site (e.g., construction of pumping and pipeline system from the Misery site to the Ekati site); and,
- treatment of parameters of concern prior to discharge to Lac du Sauvage.

These strategies, together with others that would be developed at that time based on the circumstances at hand would allow for adjustments to the minewater management plan if necessary to maintain compliance with the Water Licence. In the unlikely event of water quantity and quality trends differing significantly from expectations; these strategies would also allow sufficient time to develop and implement additional adaptive management strategies, without significantly impacting mine operations and/or discharging to the environment.

9.0 CLOSURE

We trust this report satisfies your current requirements. If you have any questions or require further assistance, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Mike Paget, B.Sc., P.Eng. (BC)
Water Resources Engineer

ORIGINAL SIGNED & SEALED

Dan Walker, Ph.D., P.Eng.
Principal, Hydrotechnical/Water Resources Engineer

ORIGINAL SIGNED

John Cunning, P.Eng.
Principal, Senior Geotechnical Engineer

ORIGINAL SIGNED

Ermanno Rambelli, P.Geo. (BC)
Associate, Senior Engineering Geologist
Project Manager

MLP/PC/DRW/JCC/ER/rs/it

o:\final\2013\1328\13-1328-0041\1313280041-e14056-r-rev0-2020\1313280041-e14056-r-rev0-2020-jay mine wmp 10oct_14.docx

THE ASSOCIATION OF PROFESSIONAL ENGINEERS, GEOLOGISTS and GEOPHYSICISTS OF THE NORTHWEST TERRITORIES
PERMIT NUMBER
P 049
GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

REFERENCES

Dominion Diamond (Dominion Diamond Ekati Corporation). 2013. Project Description Proposed Development of the Lynx Kimberlite Pipe Section 4, Project Description. September 2013.

Dominion Diamond. 2014a. Developer’s Assessment Report for the Jay Project. Yellowknife, NWT. Canada.

Dominion Diamond. 2014b. Wastewater and Processed Kimberlite Management Plan Version 4.1. May 2014.

Dominion Diamond. 2014c. Ekati Diamond Mine Aquatic Response Framework. February 2014.

BHP Billiton (BHP Billiton Canada Inc.). 2011. Ekati Diamond Mine, Interim Closure and Reclamation Plan. Project 0648-105-01, Report Version 2.4. Report prepared for Wek'èezhìı Land and Water Board. Submitted August 2011.

BHP Billiton. 2012. Ekati Diamond Mine, 2012 Annual Interim Closure and Reclamation Plan Progress Report (pages 35 to 42).

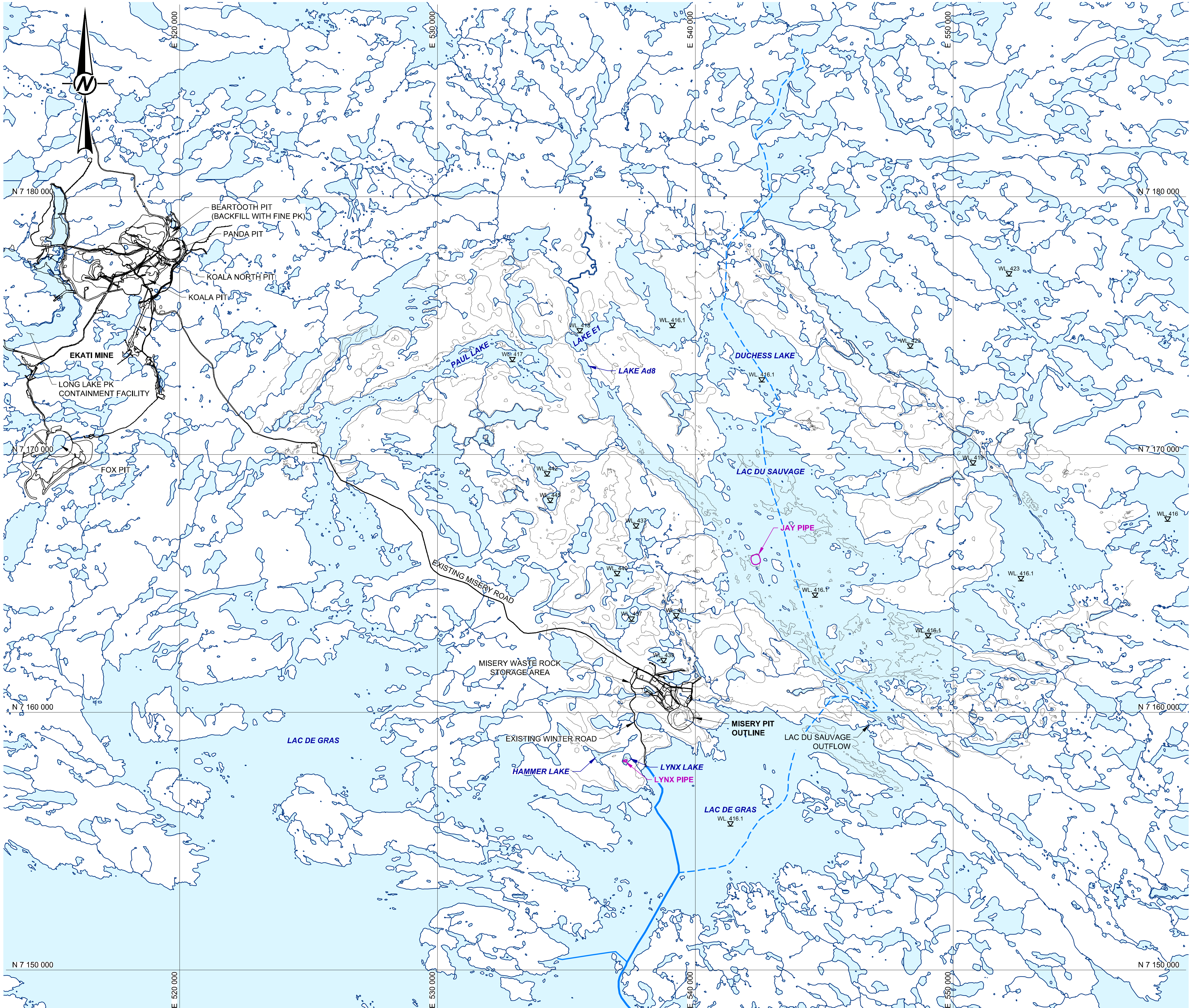
CDA (Canadian Dam Association). 2007. Dam Safety Guidelines.

CDA. 2013. Dam Safety Guidelines (revised 2013).

Doneker RL and Jirka GH. 2007. CORMIX User Manual. U.S. Environmental Protection Agency: EPA-823-K-07-001, Washington, DC, USA.

Esford F, Bonin G, Julien M. 2013. Part 1: Construction of the Dewatering Dikes, Meadowbank Gold Mine, Nunavut. Canadian Dam Association 2013 Annual Conference.

GoldSim (GoldSim Technology Group). 2014. GoldSim User’s Manual Version 11.1, Issaquah, WA, USA. May 2014.



LEGEND

- WATERBODY
- WATERCOURSE
- EXISTING ROAD
- WINTER ROAD - ON DEMAND CONSTRUCTION
- WINTER ROAD - YEARLY CONSTRUCTION
- KIMBERLITE PIPE LOCATION
- WL WATER LEVEL ELEVATION

NOTES

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL (masl).
3. COORDINATES ARE SHOWN IN DATUM: NAD 83, PROJECTION: UTM ZONE 12.

REFERENCES

1. CONTOUR AND BATHYMETRIC DATA PROVIDED BY AURORA GEOSCIENCES LTD., FILE: Final 1m Contours - Priority Area.dxf, DATE RECEIVED: OCTOBER 29, 2013
2. WATER OBTAINED FROM CANVEC NATURAL RESOURCES CANADA, 2012.
3. JAY PIPE LOCATION RECEIVED FROM DOMINION DIAMOND CORPORATION, FILE: jay_kimberlite_pipe_OL.dxf, DATED: JULY 19, 2013.
4. LYNX PIPE LOCATION RECEIVED FROM DOMINION DIAMOND CORPORATION, FILE: lynx_polyline.dxf, DATED: JUNE 25, 2013.

NOT FOR CONSTRUCTION

0 3,000 6,000 9,000

SCALE METRES

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
0	2014-10-09	ISSUED AS FINAL	PC	TAK	PC	JCC

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

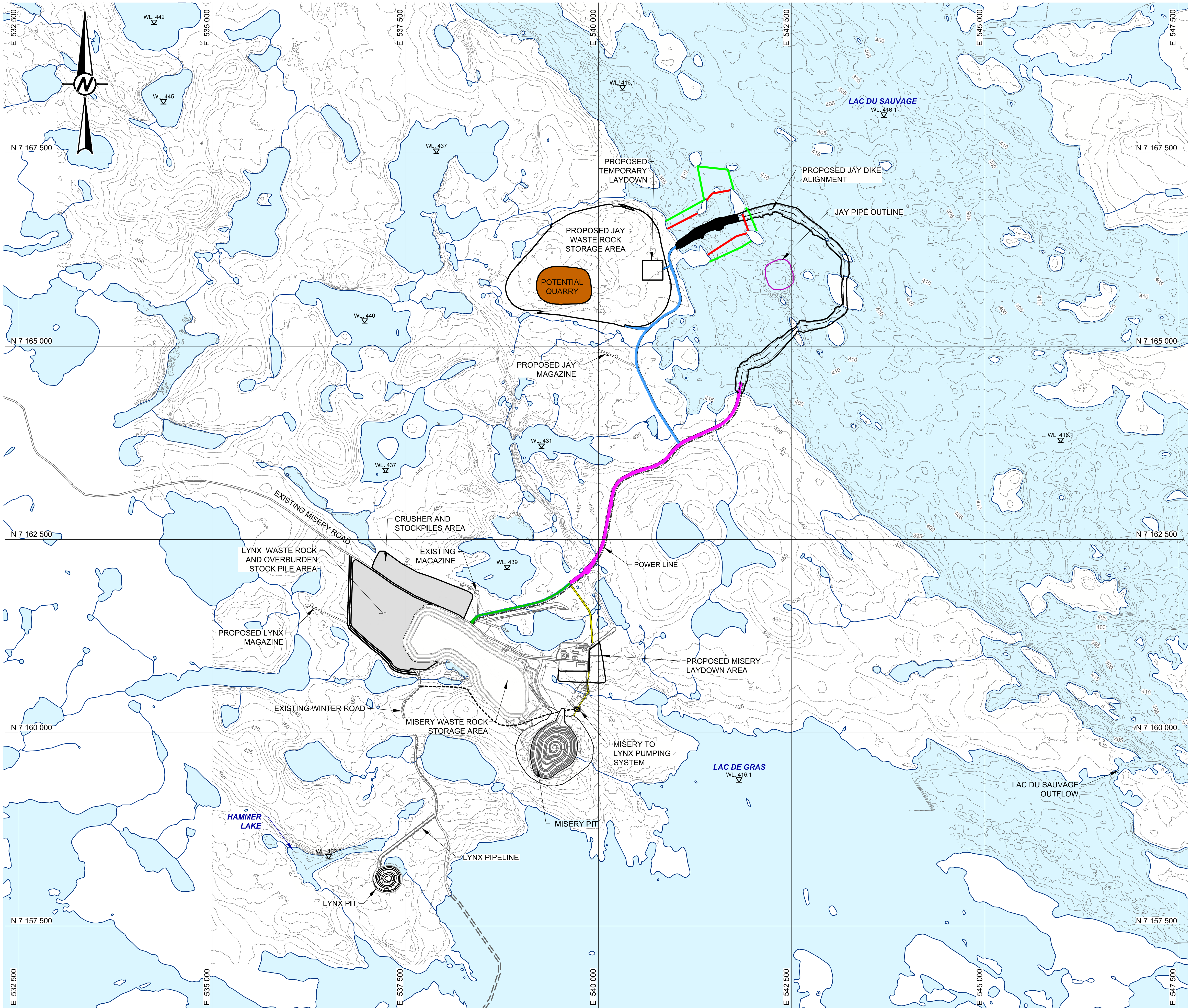
TITLE

GENERAL LOCATION PLAN

Golder Associates

PROJECT No.	13-1328-0041.2020.10		FILE No.	1313280041-2020-10_1-1
DESIGN	PC	2014-09-15	SCALE	AS SHOWN
CADD	TAK	2014-09-15	FIGURE	
CHECK	PC	2014-10-07		1-1
REVIEW	JCC	2014-10-07		

N:\Client\Dominion Diamond\jay-cardinal Project\99_projects\13-1328-0041\02_PRODUCTION\2020\10\Water Management Plan Report\1313280041-2020-10_1-1.dwg | Layout: 1-1 | Modified: jdeol 10/07/2014 9:17 AM | Plotted: jdeol 10/09/2014



LEGEND

- WATERBODY
- WATERCOURSE
- ROAD
- WINTER ROAD - YEARLY CONSTRUCTION
- PROPOSED PUMPING SYSTEM
- WL WATER LEVEL ELEVATION
- PRIMARY TURBIDITY CURTAIN (APPROXIMATE LOCATION)
- SECONDARY TURBIDITY CURTAIN (APPROXIMATE LOCATION)

JAY PROJECT FOOTPRINT

- PROPOSED JAY ROAD NORTH (HAUL ROAD)
- PROPOSED JAY ROAD (HAUL ROAD AND POWER LINE)
- PROPOSED JAY ROAD (HAUL ROAD, PIPELINE AND POWER LINE)
- PROPOSED JAY PIPELINE ROAD (ACCESS ROAD AND PIPELINE)
- POTENTIAL QUARRY
- CONSTRUCTION IN PROGRESS
- NOT YET CONSTRUCTED

LYNX PROJECT FOOTPRINT

- LYNX PROJECT INFRASTRUCTURE

NOTES

1. ELEVATIONS ARE IN METRES ABOVE SEA LEVEL (masl).
2. GROUND SURFACE AND BATHYMETRY CONTOURS ARE SHOWN AT 5 m INTERVALS.
3. COORDINATES ARE SHOWN IN DATUM: NAD 83, PROJECTION: UTM ZONE 12.
4. PIPELINES, AND POWER LINE ARRANGEMENT TO BE DETAILED AS PART OF FURTHER PRE-FEASIBILITY DESIGN. APPROXIMATE CORRIDOR WIDTHS ARE SHOWN.
5. POTENTIAL QUARRY MAYBE REQUIRED WITHIN THE FOOTPRINT OF THE PROPOSED JAY WASTE ROCK STORAGE AREA.
6. TURBIDITY CURTAINS ARE INSTALLED IN THE SUMMER FOLLOWING ICE BREAK UP AND THEN REMOVED PRIOR TO FREEZE UP.
7. TURBIDITY CURTAINS SHALL BE IN PLACE PRIOR TO MATERIAL PLACEMENT.
8. THE UPSTREAM, PRIMARY TURBIDITY CURTAINS WILL BE THE PRIMARY LINE OF PROTECTION. THE BOTTOM OF THE TURBIDITY CURTAINS SHALL BE ANCHORED AT SPOT LOCATIONS TO THE LAKEBED.
9. THE SECONDARY TURBIDITY CURTAINS SHALL BE DEPLOYED BEYOND THE PRIMARY CURTAINS, WHERE POSSIBLE. THE SECONDARY BARRIERS WILL SERVE AS A BACKUP IN THE EVENT THAT ONE OF THE PRIMARY BARRIERS IS BROKEN.

REFERENCES

1. CONTOUR AND BATHYMETRIC DATA PROVIDED BY AURORA GEOSCIENCES LTD., FILE: Final 1m Contours - Priority Area.dxf, DATE RECEIVED: OCTOBER 29, 2013
2. WATER OBTAINED FROM CANVEC NATURAL RESOURCES CANADA, 2012.
3. JAY PIPE LOCATION RECEIVED FROM DOMINION DIAMOND CORPORATION, FILE: jay_kimberlite_pipe_OL.dxf, DATED: JULY 19, 2013.

NOT FOR CONSTRUCTION

0 1,000 2,000 3,000
SCALE METRES

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
△	2014-10-09	ISSUED AS FINAL	MP	TAK	PC	JCC

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

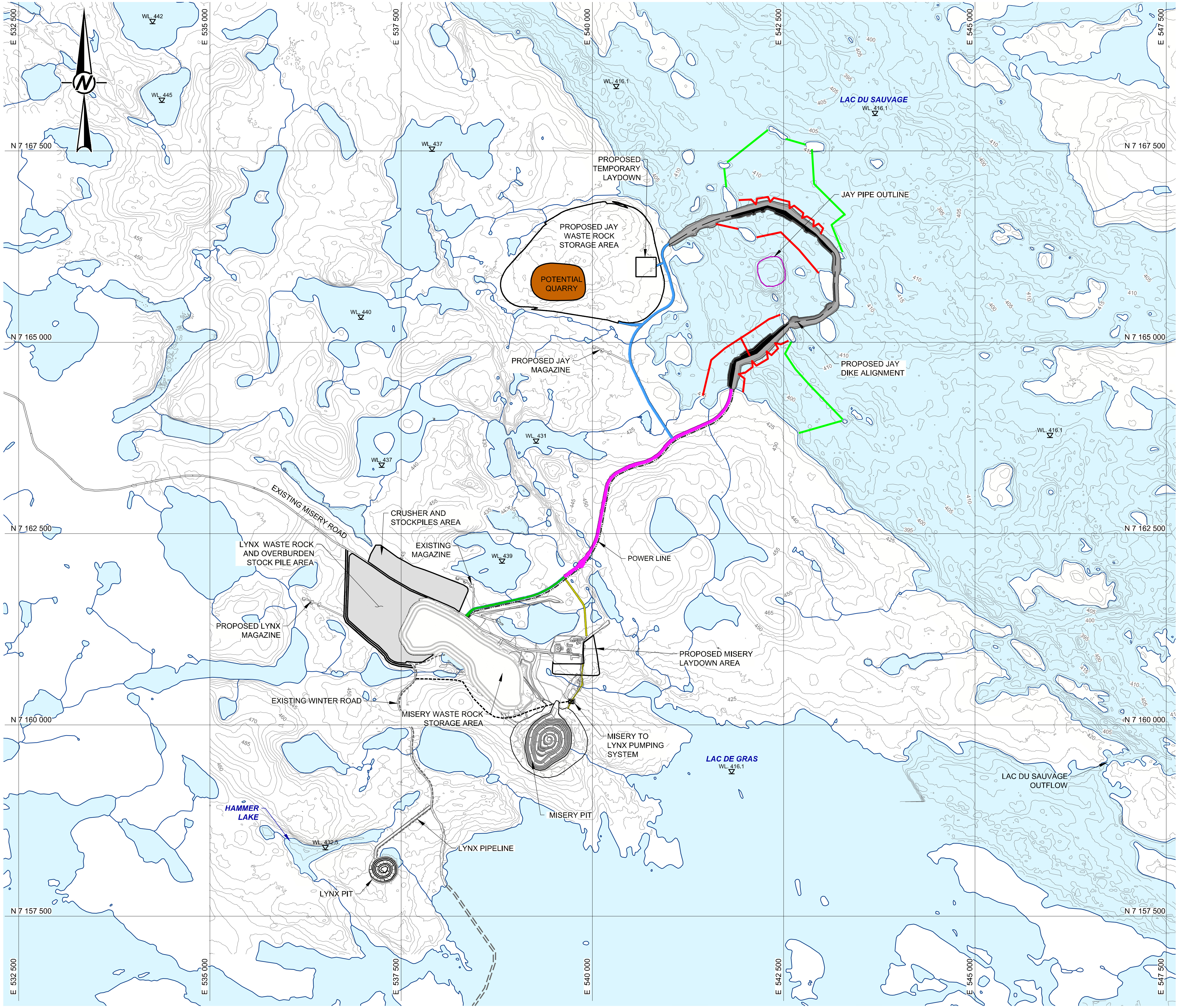
TITLE

CONSTRUCTION SUMMER 2016

PROJECT No.	13-1328-0041.2020.10		FILE No. 1313280041-2020-10_3-1
DESIGN	MP	2014-09-04	SCALE AS SHOWN
CADD	TAK	2014-09-04	FIGURE
CHECK	PC	2014-10-07	
REVIEW	JCC	2014-10-07	3-1

Golder Associates

N:\Client\Dominion Diamond\jay-cardinal Project\99_projects\13-1328-0041\02_PRODUCTION\2020\10\Water Management Plan Report\13-1328-0041-2020-10_3-1.dwg | Layout: 3-1 | Modified: jded 10/07/2014 9:13 AM | Plotted: jded 10/09/2014



LEGEND

- WATERBODY
- WATERCOURSE
- ROAD
- WINTER ROAD - YEARLY CONSTRUCTION
- PROPOSED PUMPING SYSTEM
- WATER LEVEL ELEVATION
- PRIMARY TURBIDITY CURTAIN (APPROXIMATE LOCATION)
- SECONDARY TURBIDITY CURTAIN (APPROXIMATE LOCATION)

JAY PROJECT FOOTPRINT

- PROPOSED JAY ROAD NORTH (HAUL ROAD)
- PROPOSED JAY ROAD (HAUL ROAD AND POWER LINE)
- PROPOSED JAY ROAD (HAUL ROAD, PIPELINE AND POWER LINE)
- PROPOSED JAY PIPELINE ROAD (ACCESS ROAD AND PIPELINE)
- POTENTIAL QUARRY
- PREVIOUSLY CONSTRUCTED (INCLUDES WINTER 2016/2017 CONSTRUCTION)
- CONSTRUCTION IN PROGRESS

LYNX PROJECT FOOTPRINT

- LYNX PROJECT INFRASTRUCTURE

NOTES

1. ELEVATIONS ARE IN METRES ABOVE SEA LEVEL (masl).
2. GROUND SURFACE AND BATHYMETRY CONTOURS ARE SHOWN AT 5 m INTERVALS.
3. COORDINATES ARE SHOWN IN DATUM: NAD 83, PROJECTION: UTM ZONE 12.
4. PIPELINES, AND POWER LINE ARRANGEMENT TO BE DETAILED AS PART OF FURTHER PRE-FEASIBILITY DESIGN. APPROXIMATE CORRIDOR WIDTHS ARE SHOWN.
5. POTENTIAL QUARRY MAYBE REQUIRED WITHIN THE FOOTPRINT OF THE PROPOSED JAY WASTE ROCK STORAGE AREA.
6. TURBIDITY CURTAINS ARE INSTALLED IN THE SUMMER FOLLOWING ICE BREAK UP AND THEN REMOVED PRIOR TO FREEZE UP.
7. TURBIDITY CURTAINS SHALL BE IN PLACE PRIOR TO MATERIAL PLACEMENT.
8. THE UPSTREAM, PRIMARY TURBIDITY CURTAINS WILL BE THE PRIMARY LINE OF PROTECTION. THE BOTTOM OF THE TURBIDITY CURTAINS SHALL BE ANCHORED AT SPOT LOCATIONS TO THE LAKEBED.
9. THE SECONDARY TURBIDITY CURTAINS SHALL BE DEPLOYED BEYOND THE PRIMARY CURTAINS, WHERE POSSIBLE. THE SECONDARY BARRIERS WILL SERVE AS A BACKUP IN THE EVENT THAT ONE OF THE PRIMARY BARRIERS IS BROKEN.

REFERENCES

1. CONTOUR AND BATHYMETRIC DATA PROVIDED BY AURORA GEOSCIENCES LTD., FILE: Final 1m Contours - Priority Area.dxf, DATE RECEIVED: OCTOBER 29, 2013
2. WATER OBTAINED FROM CANVEC NATURAL RESOURCES CANADA, 2012.
3. JAY PIPE LOCATION RECEIVED FROM DOMINION DIAMOND CORPORATION, FILE: jay_kimberlite_pipe_OL.dxf, DATED: JULY 19, 2013.

NOT FOR CONSTRUCTION

0 1,000 2,000 3,000
SCALE METRES

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
	2014-10-09	ISSUED AS FINAL	MP	TAK	PC	JCC

PROJECT

DOMINION DIAMOND

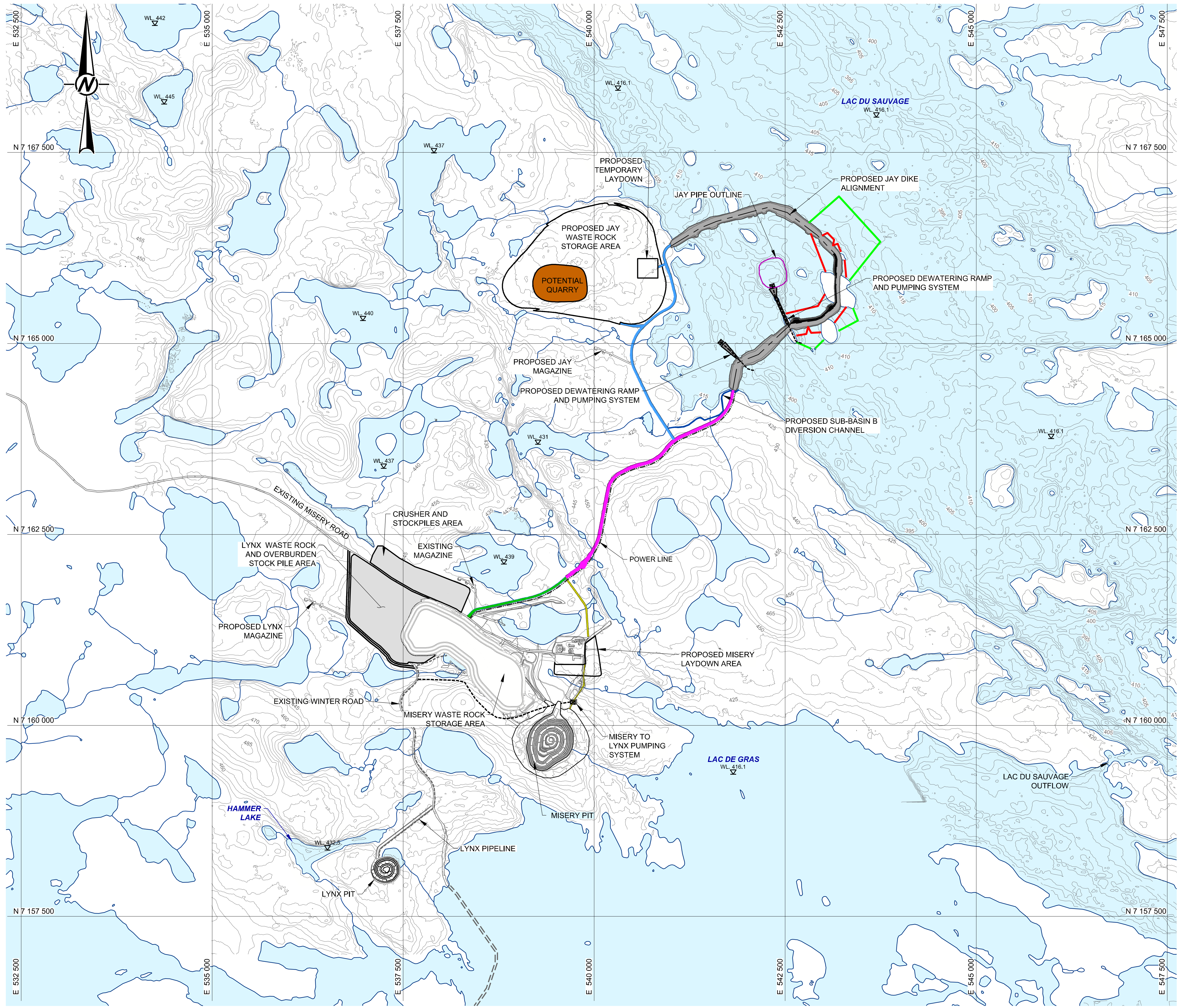
JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

CONSTRUCTION SUMMER 2017

PROJECT No.	13-1328-0041.2020.10		FILE No.	1313280041-2020-10_3-2
DESIGN	MP	2014-09-04	SCALE	AS SHOWN
CADD	TAK	2014-09-04	FIGURE	
CHECK	PC	2014-10-07		3-2
REVIEW	JCC	2014-10-07		

Golder Associates



LEGEND

- WATERBODY
- WATERCOURSE
- ROAD
- WINTER ROAD - YEARLY CONSTRUCTION
- PROPOSED PUMPING SYSTEM
- WATER LEVEL ELEVATION
- PRIMARY TURBIDITY CURTAIN (APPROXIMATE LOCATION)
- SECONDARY TURBIDITY CURTAIN (APPROXIMATE LOCATION)

JAY PROJECT FOOTPRINT

- PROPOSED DIVERSION CHANNEL
- PROPOSED JAY ROAD NORTH (HAUL ROAD)
- PROPOSED JAY ROAD (HAUL ROAD AND POWER LINE)
- PROPOSED JAY ROAD (HAUL ROAD, PIPELINE AND POWER LINE)
- PROPOSED JAY PIPELINE ROAD (ACCESS ROAD AND PIPELINE)
- POTENTIAL QUARRY
- PREVIOUSLY CONSTRUCTED (INCLUDES WINTER 2017/2018 CONSTRUCTION)
- CONSTRUCTION IN PROGRESS

LYNX PROJECT FOOTPRINT

- LYNX PROJECT INFRASTRUCTURE

NOTES

1. ELEVATIONS ARE IN METRES ABOVE SEA LEVEL (masl).
2. GROUND SURFACE AND BATHYMETRY CONTOURS ARE SHOWN AT 5 m INTERVALS.
3. COORDINATES ARE SHOWN IN DATUM: NAD 83, PROJECTION: UTM ZONE 12.
4. PIPELINES, AND POWER LINE ARRANGEMENT TO BE DETAILED AS PART OF FURTHER PRE-FEASIBILITY DESIGN. APPROXIMATE CORRIDOR WIDTHS ARE SHOWN.
5. POTENTIAL QUARRY MAYBE REQUIRED WITHIN THE FOOTPRINT OF THE PROPOSED JAY WASTE ROCK STORAGE AREA.
6. TURBIDITY CURTAINS ARE INSTALLED IN THE SUMMER FOLLOWING ICE BREAK UP AND THEN REMOVED PRIOR TO FREEZE UP.
7. TURBIDITY CURTAINS SHALL BE IN PLACE PRIOR TO MATERIAL PLACEMENT.
8. THE UPSTREAM, PRIMARY TURBIDITY CURTAINS WILL BE THE PRIMARY LINE OF PROTECTION. THE BOTTOM OF THE TURBIDITY CURTAINS SHALL BE ANCHORED AT SPOT LOCATIONS TO THE LAKEBED.
9. THE SECONDARY TURBIDITY CURTAINS SHALL BE DEPLOYED BEYOND THE PRIMARY CURTAINS, WHERE POSSIBLE. THE SECONDARY BARRIERS WILL SERVE AS A BACKUP IN THE EVENT THAT ONE OF THE PRIMARY BARRIERS IS BROKEN.

REFERENCES

1. CONTOUR AND BATHYMETRIC DATA PROVIDED BY AURORA GEOSCIENCES LTD., FILE: Final 1m Contours - Priority Area.dxf, DATE RECEIVED: OCTOBER 29, 2013
2. WATER OBTAINED FROM CANVEC NATURAL RESOURCES CANADA, 2012.
3. JAY PIPE LOCATION RECEIVED FROM DOMINION DIAMOND CORPORATION, FILE: jay_kimberlite_pipe_OL.dxf, DATED: JULY 19, 2013.

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
0	2014-10-09	ISSUED AS FINAL	MP	TAK	PC	JCC

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

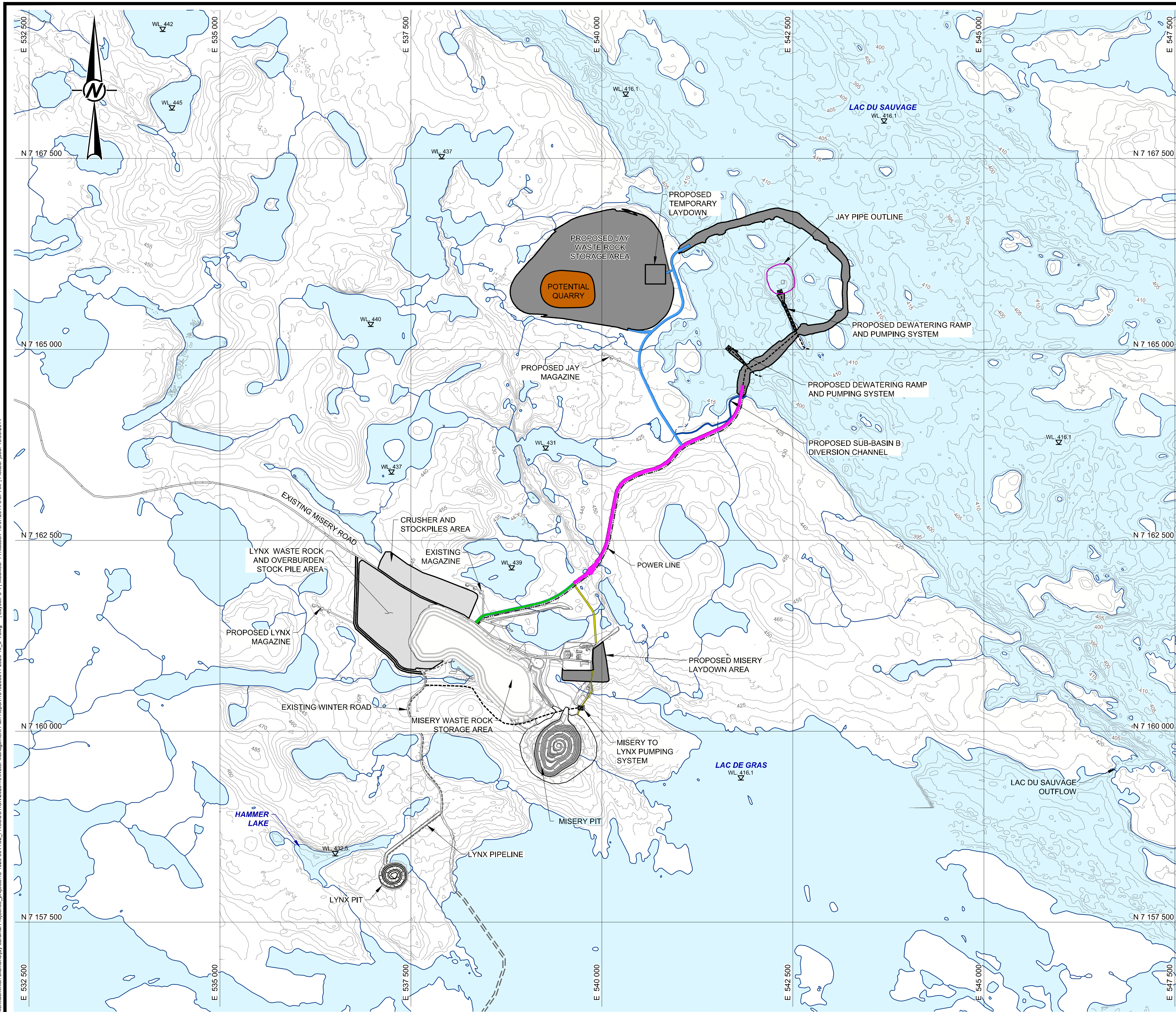
TITLE

CONSTRUCTION SUMMER 2018

PROJECT No.	13-1328-0041.2020.10		FILE No.	1313280041-2020-10_3-3
DESIGN	MP	2014-09-04	SCALE	AS SHOWN
CADD	TAK	2014-09-04	FIGURE	3-3
CHECK	PC	2014-10-07		
REVIEW	JCC	2014-10-07		

Golder Associates

N:\Client\dominion Diamond\jay-cardinal Project\99_projects\13-1328-0041\02_PRODUCTION\2020\10\Water Management Plan Report\1313280041-2020-10_3-3.dwg | Layout: 3-3 | Modified: jded 10/07/2014 9:31 AM | Plotted: jded 10/09/2014



LEGEND

- WATERBODY
- WATERCOURSE
- ROAD
- WINTER ROAD - YEARLY CONSTRUCTION
- PROPOSED PUMPING SYSTEM
- WL WATER LEVEL ELEVATION

JAY PROJECT FOOTPRINT

- PROPOSED DIVERSION CHANNEL
- PROPOSED JAY PROJECT INFRASTRUCTURE
- PROPOSED JAY ROAD NORTH (HAUL ROAD)
- PROPOSED JAY ROAD (HAUL ROAD AND POWER LINE)
- PROPOSED JAY ROAD (HAUL ROAD, PIPELINE AND POWER LINE)
- PROPOSED JAY PIPELINE ROAD (ACCESS ROAD AND PIPELINE)
- POTENTIAL QUARRY

LYNX PROJECT FOOTPRINT

- LYNX PROJECT INFRASTRUCTURE

NOTES

1. ELEVATIONS ARE IN METRES ABOVE SEA LEVEL (masl).
2. GROUND SURFACE AND BATHYMETRY CONTOURS ARE SHOWN AT 5 m INTERVALS.
3. COORDINATES ARE SHOWN IN DATUM: NAD 83, PROJECTION: UTM ZONE 12.
4. PIPELINES, AND POWER LINE ARRANGEMENT TO BE DETAILED AS PART OF FURTHER PRE-FEASIBILITY DESIGN. APPROXIMATE CORRIDOR WIDTHS ARE SHOWN.
5. POTENTIAL QUARRY MAYBE REQUIRED WITHIN THE FOOTPRINT OF THE PROPOSED JAY WASTE ROCK STORAGE AREA.

REFERENCES

1. CONTOUR AND BATHYMETRIC DATA PROVIDED BY AURORA GEOSCIENCES LTD., FILE: Final 1m Contours - Priority Area.dxf, DATE RECEIVED: OCTOBER 29, 2013
2. WATER OBTAINED FROM CANVEC NATURAL RESOURCES CANADA, 2012.
3. JAY PIPE LOCATION RECEIVED FROM DOMINION DIAMOND CORPORATION, FILE: jay_kimberlite_pipe_OL.dxf, DATED: JULY 19, 2013.

NOT FOR CONSTRUCTION

0 1,000 2,000 3,000
SCALE METRES

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
A	2014-10-09	ISSUED AS FINAL	MP	TAK	PC	JCC

PROJECT

DOMINION DIAMOND

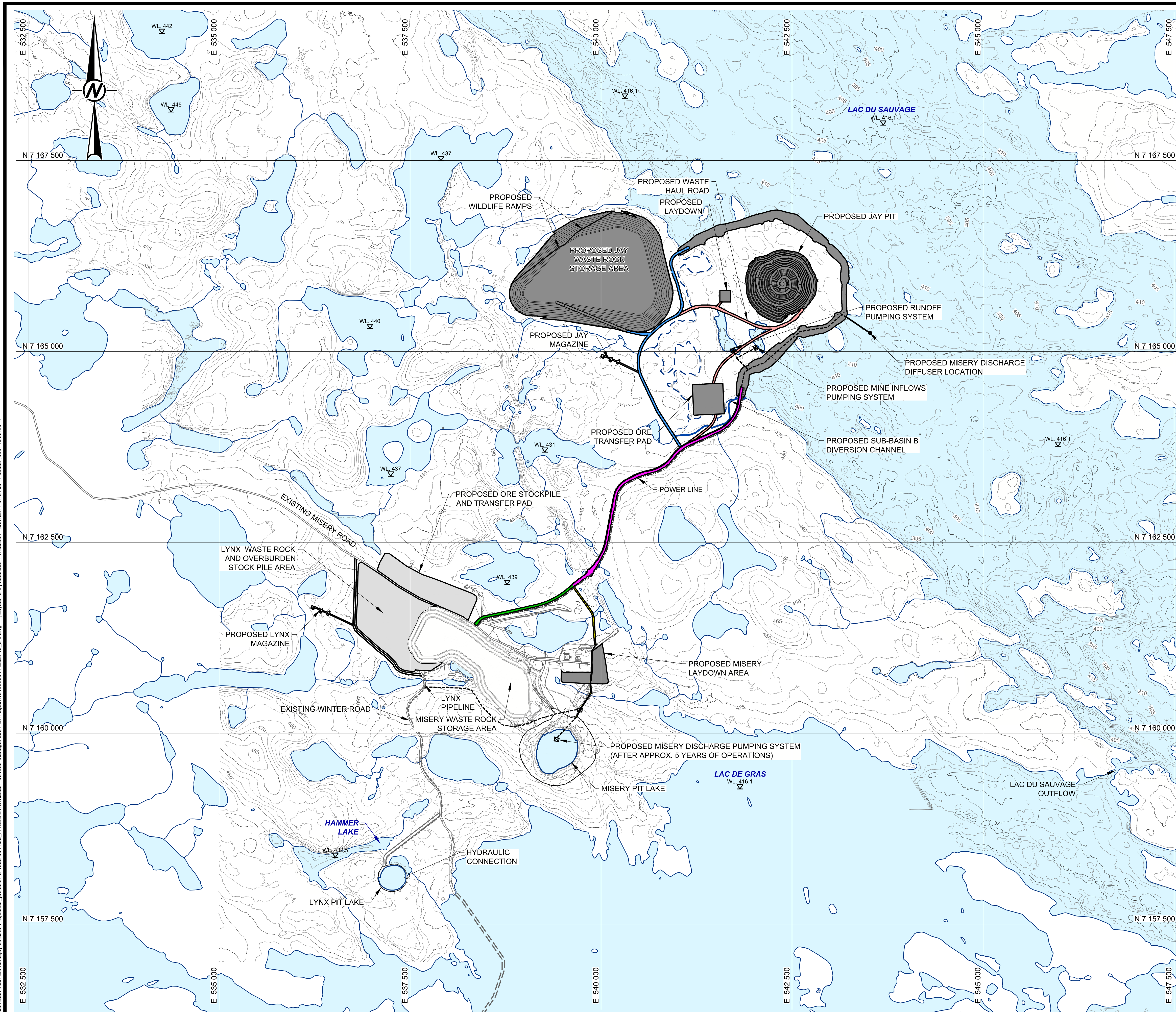
JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

DEWATERING PHASE

Golder Associates

PROJECT No.	13-1328-0041.2020.10		FILE No.	1313280041-2020-10_3-4
DESIGN	MP	2014-07-25	SCALE	AS SHOWN
CADD	JD	2014-07-28	FIGURE	
CHECK	PC	2014-10-07		3-4
REVIEW	JCC	2014-10-07		



LEGEND

- WATERBODY
- WATERCOURSE
- EXISTING SHORELINE OF DEWATERED AREA
- ROAD
- WINTER ROAD - YEARLY CONSTRUCTION
- PROPOSED PUMPING SYSTEM
- WATER LEVEL ELEVATION

JAY PROJECT FOOTPRINT

- PROPOSED DIVERSION CHANNEL
- PROPOSED MISERY DISCHARGE
- PROPOSED JAY PROJECT INFRASTRUCTURE
- PROPOSED JAY ROAD NORTH (HAUL ROAD)
- PROPOSED JAY ROAD (HAUL ROAD AND POWER LINE)
- PROPOSED JAY ROAD (HAUL ROAD, PIPELINE AND POWER LINE)
- PROPOSED JAY PIPELINE ROAD (ACCESS ROAD AND PIPELINE)
- PROPOSED WASTE AND ORE HAUL ROAD

LYNX PROJECT FOOTPRINT

- LYNX PROJECT INFRASTRUCTURE

NOTES

1. ELEVATIONS ARE IN METRES ABOVE SEA LEVEL (masl).
2. GROUND SURFACE AND BATHYMETRY CONTOURS ARE SHOWN AT 5 m INTERVALS.
3. COORDINATES ARE SHOWN IN DATUM: NAD 83, PROJECTION: UTM ZONE 12.
4. PIPELINES, AND POWER LINE ARRANGEMENT TO BE DETAILED AS PART OF FURTHER PRE-FEASIBILITY DESIGN. APPROXIMATE CORRIDOR WIDTHS ARE SHOWN.

REFERENCES

1. CONTOUR AND BATHYMETRIC DATA PROVIDED BY AURORA GEOSCIENCES LTD., FILE: Final 1m Contours - Priority Area.dxf, DATE RECEIVED: OCTOBER 29, 2013
2. WATER OBTAINED FROM CANVEC NATURAL RESOURCES CANADA, 2012.

NOT FOR CONSTRUCTION

0 1,000 2,000 3,000
SCALE METRES

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
A	2014-10-09	ISSUED AS FINAL	MP	TAK	PC	JCC

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

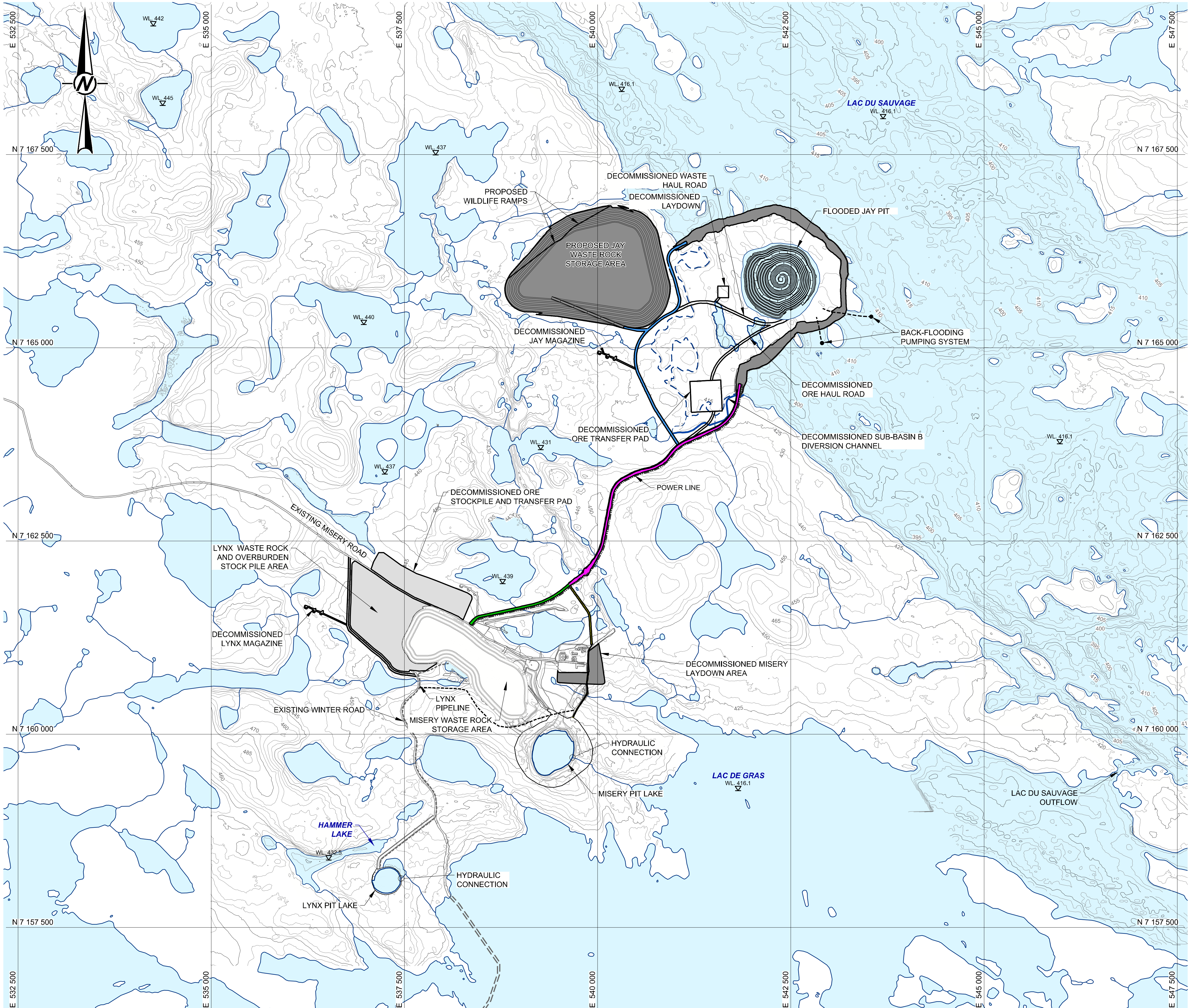
TITLE

OPERATIONS PHASE

PROJECT No.	13-1328-0041.2020.10	FILE No.	1313280041-2020-10_3-5
DESIGN	MP	2014-07-25	SCALE AS SHOWN
CADD	JD	2014-07-28	FIGURE
CHECK	PC	2014-10-07	
REVIEW	JCC	2014-10-07	3-5

Golder Associates

N:\Client\Dominion Diamond\jay-cardinal Project\99_projects\13-1328-0041\02_PRODUCTION\2020\10\Water Management Plan Report\1313280041-2020-10_3-5.dwg | Layout: 3-5 | Modified: TYKlassen 10/07/2014 9:48 AM | Plotted: jdeol 10/09/2014



LEGEND

- WATERBODY
- WATERCOURSE
- EXISTING SHORELINE OF DEWATERED AREA
- ROAD
- WINTER ROAD - YEARLY CONSTRUCTION
- PROPOSED PUMPING SYSTEM
- WATER LEVEL ELEVATION

JAY PROJECT FOOTPRINT

- PROPOSED DIVERSION CHANNEL
- PROPOSED JAY PROJECT INFRASTRUCTURE
- PROPOSED JAY ROAD NORTH (HAUL ROAD)
- PROPOSED JAY ROAD (HAUL ROAD AND POWER LINE)
- PROPOSED JAY ROAD (HAUL ROAD, PIPELINE AND POWER LINE)
- PROPOSED JAY PIPELINE ROAD (ACCESS ROAD AND PIPELINE)
- PROPOSED WASTE AND ORE HAUL ROAD

LYNX PROJECT FOOTPRINT

- LYNX PROJECT INFRASTRUCTURE

NOTES

1. ELEVATIONS ARE IN METRES ABOVE SEA LEVEL (masl).
2. GROUND SURFACE AND BATHYMETRY CONTOURS ARE SHOWN AT 5 m INTERVALS.
3. COORDINATES ARE SHOWN IN DATUM: NAD 83, PROJECTION: UTM ZONE 12.
4. FOR ILLUSTRATIVE PURPOSES ONLY. TIMING OF COMPLETION OF CLOSURE ACTIVITIES DEPENDS ON WATER QUALITY MONITORING RESULTS.

REFERENCES

1. CONTOUR AND BATHYMETRIC DATA PROVIDED BY AURORA GEOSCIENCES LTD., FILE: Final 1m Contours - Priority Area.dxf, DATE RECEIVED: OCTOBER 29, 2013
2. WATER OBTAINED FROM CANVEC NATURAL RESOURCES CANADA, 2012.

NOT FOR CONSTRUCTION

SCALE 0 1,000 2,000 3,000 METRES

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
A	2014-10-09	ISSUED AS FINAL	MP	TAK	PC	JCC

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

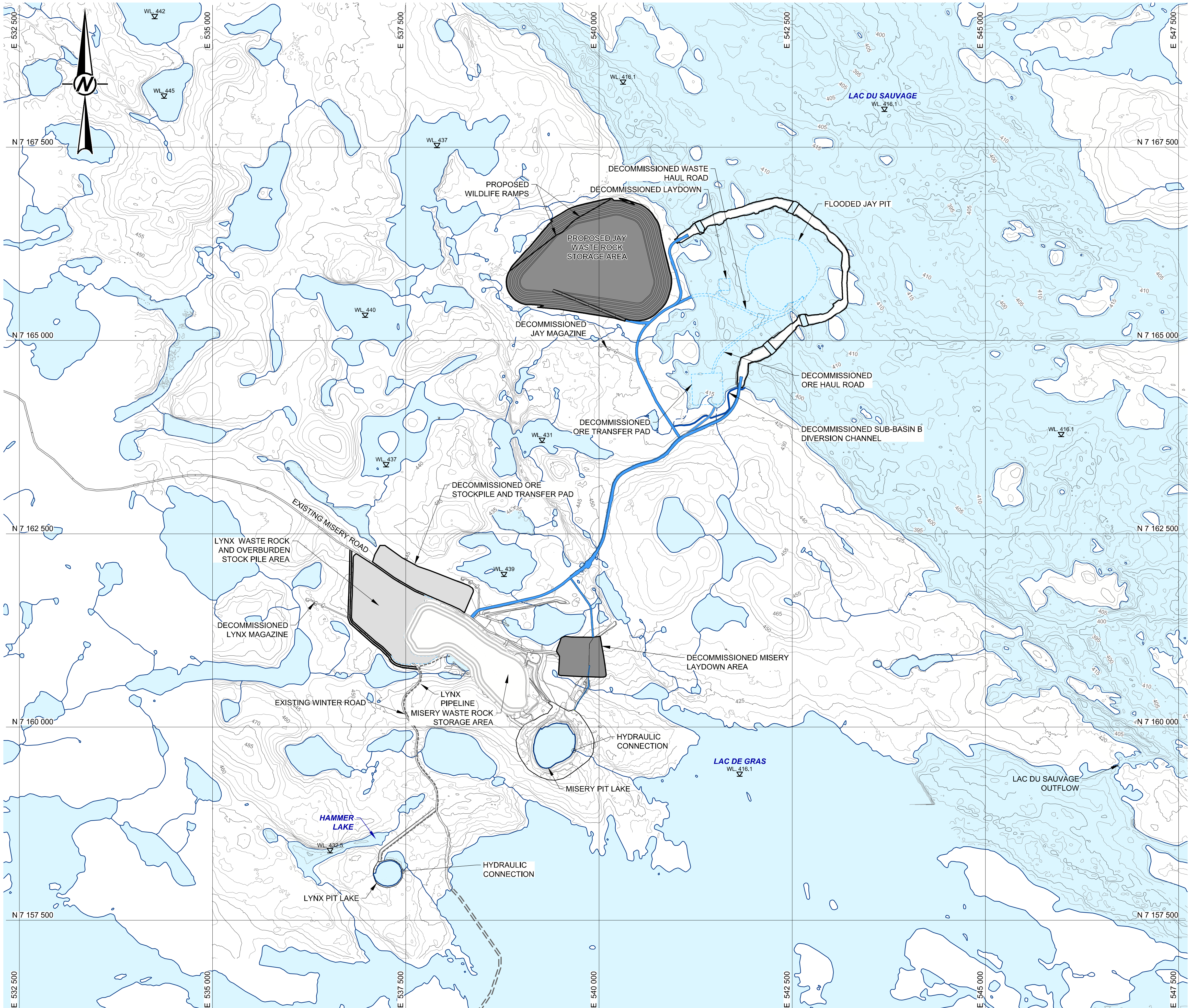
TITLE

CONCEPTUAL CLOSURE PLAN

Golder Associates

PROJECT No.	13-1328-0041.2020.10		FILE No.	1313280041-2020-10_3-6
DESIGN	MP	2014-09-05	SCALE	AS SHOWN
CADD	TAK	2014-09-05	FIGURE	3-6
CHECK	PC	2014-10-07		
REVIEW	JCC	2014-10-07		

N:\Client\Dominion Diamond\Jay-cardinal Project\99_projects\13-1328-0041\02_PRODUCTION\2020\10\Water Management Plan Report\1313280041-2020-10_3-6.dwg | Layout: 3-6 | Modified: TYKlassen 10/07/2014 9:57 AM | Plotted: jdesl 10/09/2014



LEGEND

- WATERBODY
- WATERCOURSE
- ROAD
- WINTER ROAD - YEARLY CONSTRUCTION
- WATER LEVEL ELEVATION
- PROPOSED DIKE BREACH LOCATION

JAY PROJECT FOOTPRINT

- DECOMMISSIONED DIVERSION CHANNEL
- DECOMMISSIONED JAY PROJECT INFRASTRUCTURE
- DECOMMISSIONED JAY ROADS
- JAY ROADS / PIT OUTLINE UNDER WATER

LYNX PROJECT FOOTPRINT

- LYNX PROJECT INFRASTRUCTURE

NOTES

1. ELEVATIONS ARE IN METRES ABOVE SEA LEVEL (masl).
2. GROUND SURFACE AND BATHYMETRY CONTOURS ARE SHOWN AT 5 m INTERVALS.
3. COORDINATES ARE SHOWN IN DATUM: NAD 83, PROJECTION: UTM ZONE 12.
4. FINAL LOCATION OF DIKE BREACHES TO BE DETERMINED IN DETAILED DESIGN.

REFERENCES

1. CONTOUR AND BATHYMETRIC DATA PROVIDED BY AURORA GEOSCIENCES LTD., FILE: Final 1m Contours - Priority Area.dxf, DATE RECEIVED: OCTOBER 29, 2013
2. WATER OBTAINED FROM CANVEC NATURAL RESOURCES CANADA, 2012.

NOT FOR CONSTRUCTION

0 1,000 2,000 3,000
SCALE METRES

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
A	2014-10-09	ISSUED AS FINAL	MP	TAK	PC	JCC

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

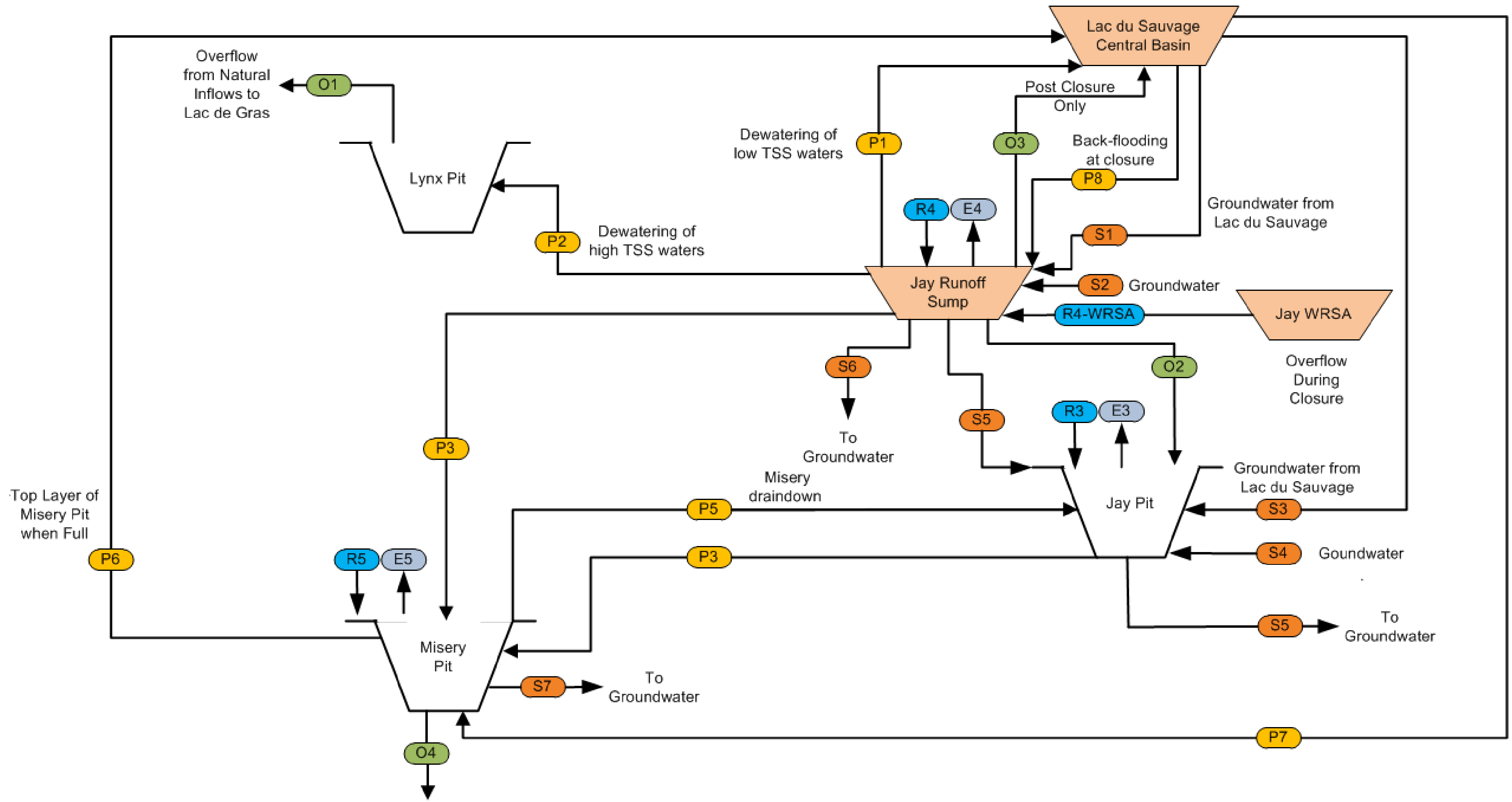
TITLE

CONCEPTUAL POST-CLOSURE PLAN

Golder Associates

PROJECT No.	13-1328-0041.2020.10		FILE No.	1313280041-2020-10_3-7
DESIGN	MP	2014-09-05	SCALE	AS SHOWN
CADD	TAK	2014-09-05	FIGURE	
CHECK	PC	2014-10-07		3-7
REVIEW	JCC	2014-10-07		

O:\Active_2013\1328\13-1328-0041 2000 DD Eng\2020 Pre-Feasibility\10 Lake Drawdown\Water Balance\Flow Diagram



LEGEND:

- Pumped Flows (P)
- Evaporation (E)
- Runoff (R)
- Seepage Flows (S)
- Overflows (O)

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

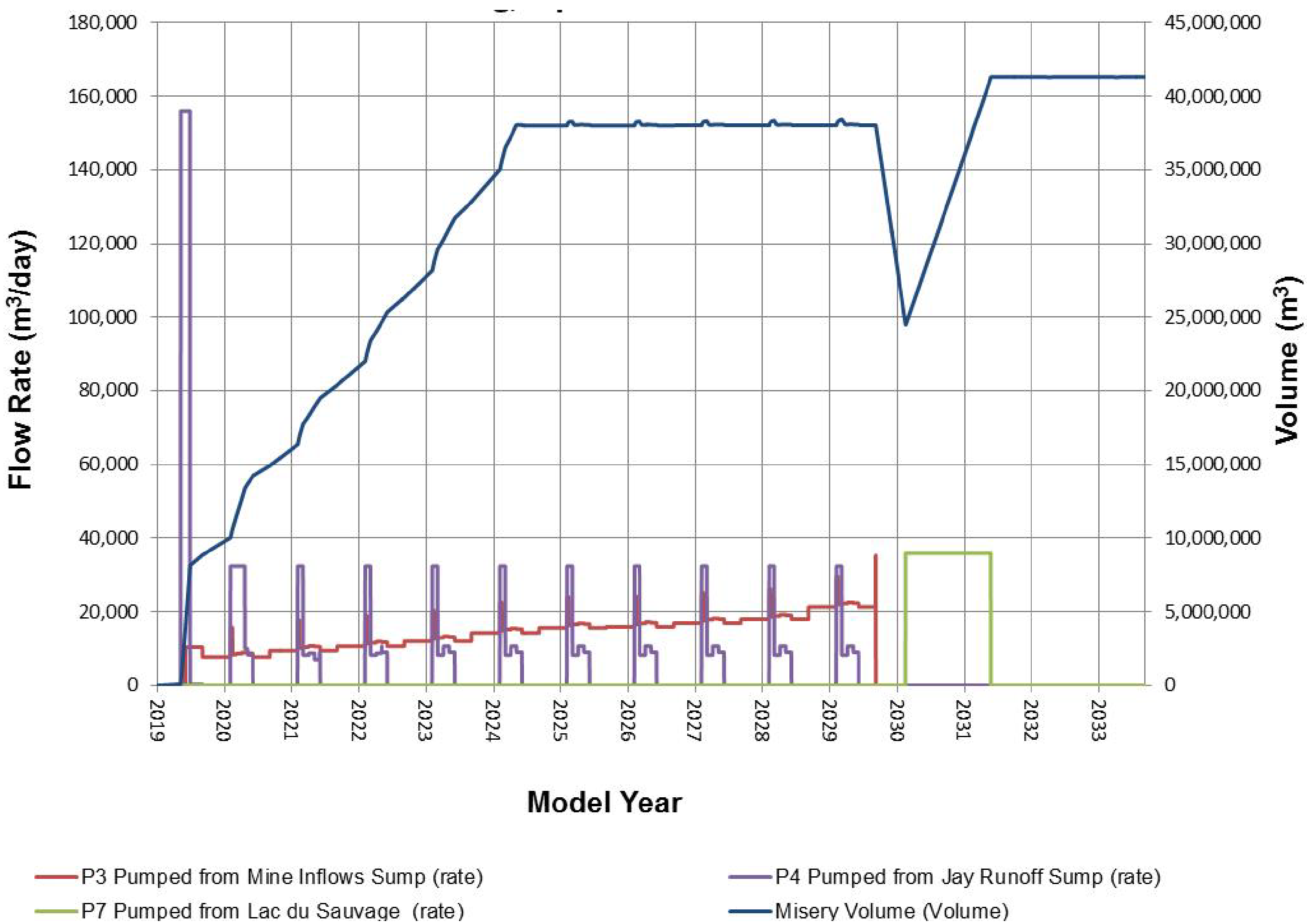
TITLE

Water Balance Flow Chart

Golder Associates

PROJECT No. 13-1328-0041			PHASE No. 2020	
DESIGN	APB	6MAY14	SCALE NTS	REV. 0
CADD	APB	6MAY14	FIGURE	
CHECK	MLP	11JUN14		6-1
REVIEW	DRW	30SEP14		

O:\Active_2013\1328\13-1328-0041 2000 DD Eng\2020 Pre-Feasibility\10 Lake Drawdown\Water Balance\Flow Diagram



PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

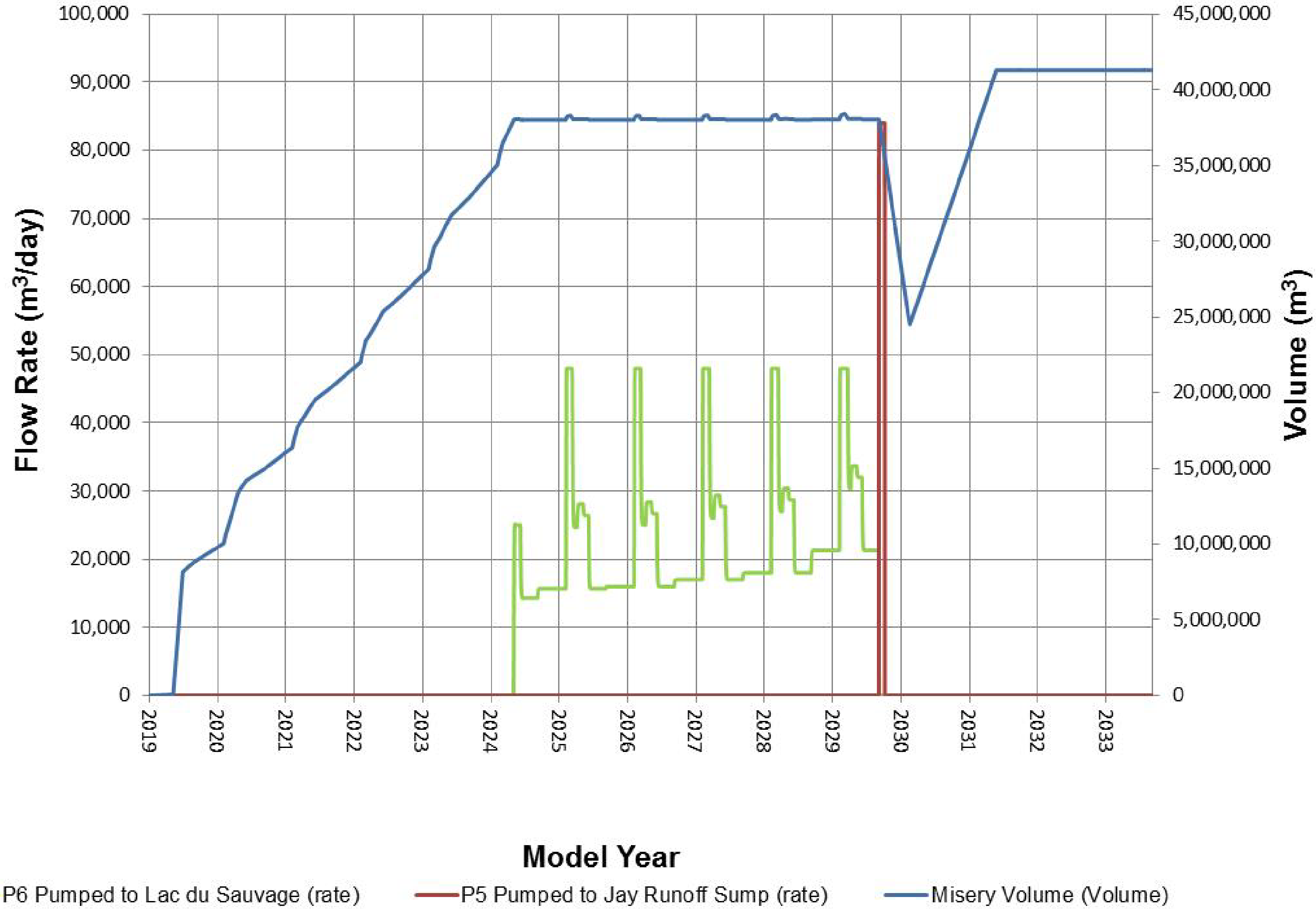
TITLE

Misery Pit Inflows
Dewatering, Operations and Closure

Golder Associates

PROJECT No. 13-1328-0041			PHASE No. 2020	
DESIGN	APB	6MAY14	SCALE NTS	REV. 0
CADD	APB	6MAY14	FIGURE	
CHECK	MLP	11JUN14		**6-2**
REVIEW	DRW	30SEP14		

O:\Active_2013\1328\13-1328-0041 2000 DD Eng\2020 Pre-Feasibility\10 Lake Drawdown\Water Balance\Flow Diagram



PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

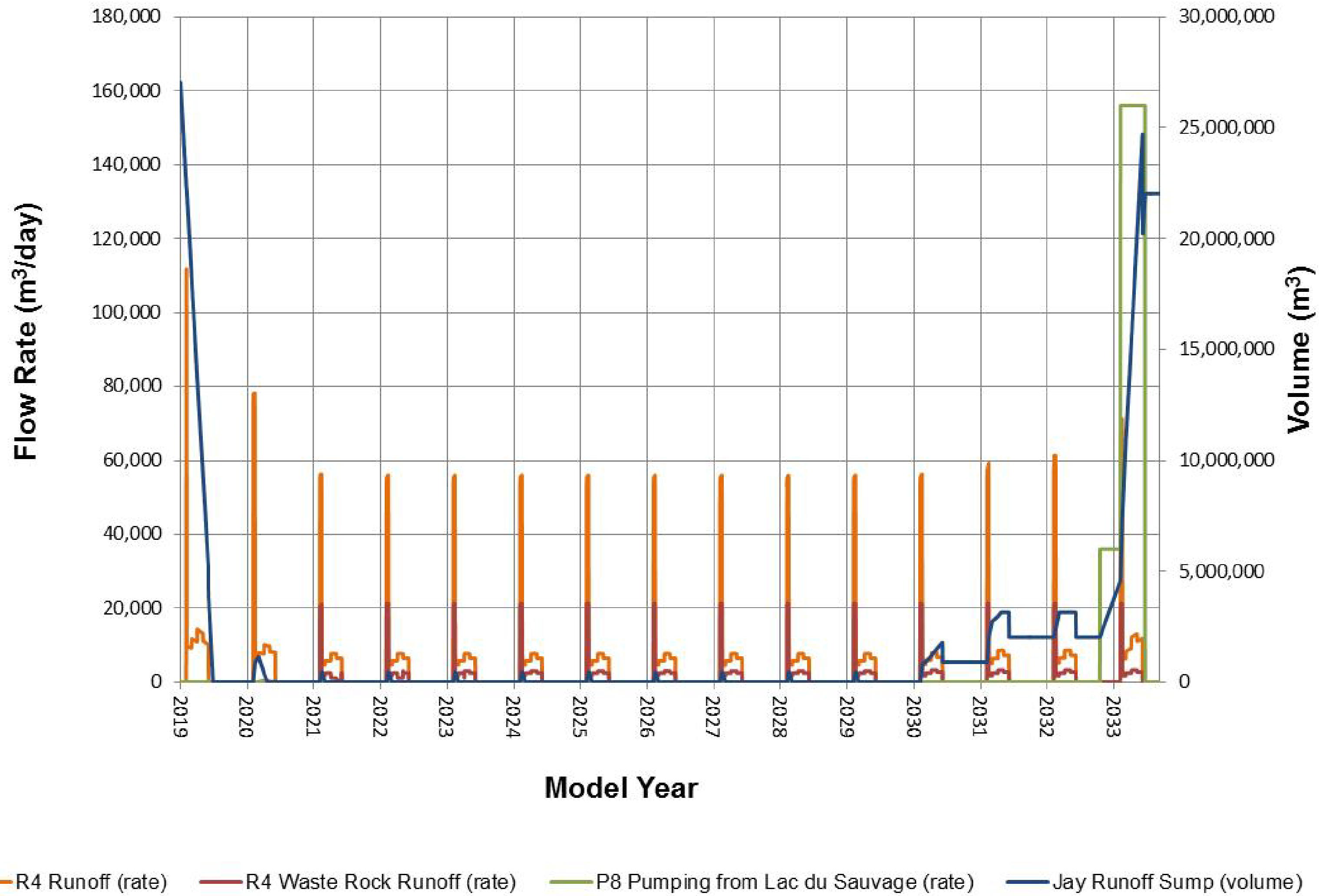
TITLE

Misery Pit Outflows
Dewatering, Operations and Closure

Golder Associates

PROJECT No. 13-1328-0041			PHASE No. 2020	
DESIGN	APB	6MAY14	SCALE NTS	REV. 0
CADD	APB	6MAY14	FIGURE	6-3
CHECK	MLP	11JUN14		
REVIEW	DRW	30SEP14		

O:\Active_2013\1328\13-1328-0041 2000 DD Eng\2020 Pre-Feasibility\10 Lake Drawdown\Water Balance\Flow Diagram



PROJECT

DOMINION DIAMOND

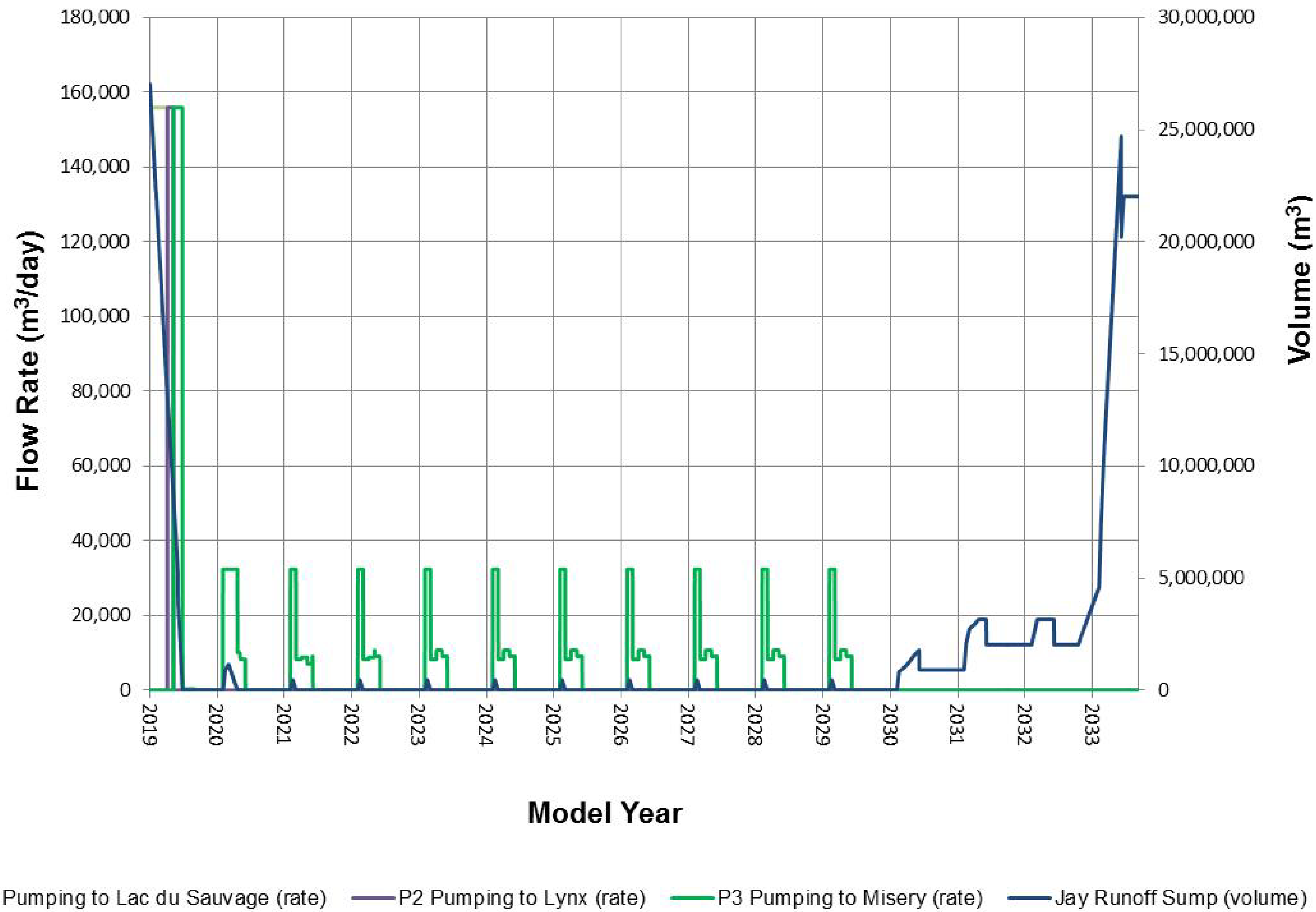
JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

Diked Area Inflows
Dewatering, Operations and Closure

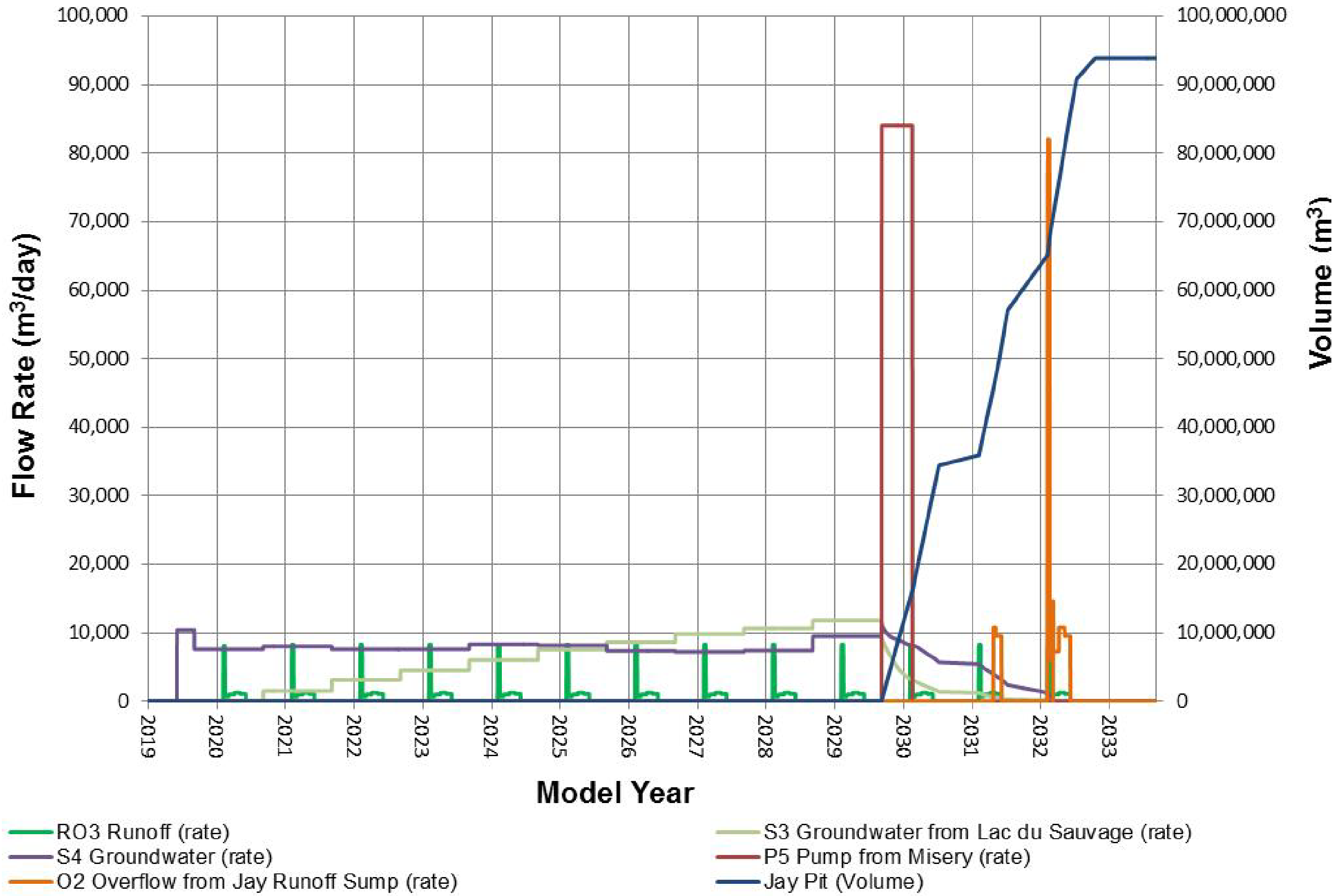
Golder Associates

PROJECT No. 13-1328-0041			PHASE No. 2020	
DESIGN	APB	6MAY14	SCALE NTS	REV. 0
CADD	APB	6MAY14	FIGURE	6-4
CHECK	MLP	11JUN14		
REVIEW	DRW	30SEP14		



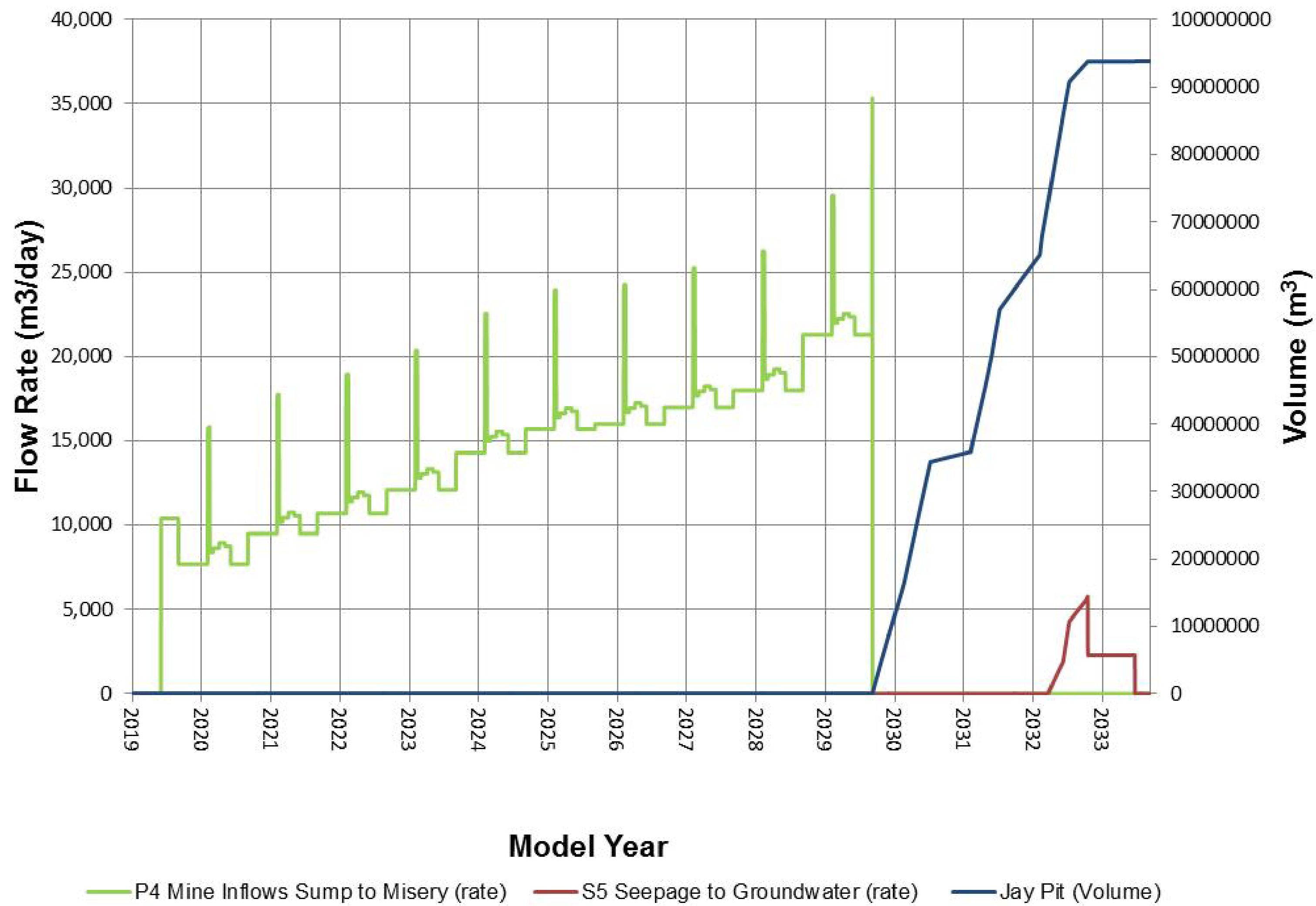
PROJECT	DOMINION DIAMOND	JAY PROJECT NORTHWEST TERRITORIES, CANADA		
TITLE	**Diked Area Outflows Dewatering, Operations and Closure**			
Golder Associates	PROJECT No. 13-1328-0041		PHASE No. 2020	
	DESIGN	APB	6MAY14	SCALE NTS	REV. 0
	CADD	APB	6MAY14	FIGURE 6-5
	CHECK	MLP	11JUN14	
	REVIEW	DRW	30SEP14	

O:\Active_2013\1328\13-1328-0041 2000 DD Eng\2020 Pre-Feasibility\10 Lake Drawdown\Water Balance\Flow Diagram



PROJECT	DOMINION DIAMOND	JAY PROJECT NORTHWEST TERRITORIES, CANADA		
TITLE	**Jay Pit Inflows Dewatering, Operations and Closure**			
Golder Associates	PROJECT No. 13-1328-0041		PHASE No. 2020	
	DESIGN	APB	6MAY14	SCALE NTS	REV. 0
	CADD	APB	6MAY14	FIGURE 6-6
	CHECK	MLP	11JUN14	
	REVIEW	DRW	30SEP14	

O:\Active_2013\1328\13-1328-0041 2000 DD Eng\2020 Pre-Feasibility\10 Lake Drawdown\Water Balance\Flow Diagram



PROJECT

DOMINION DIAMOND

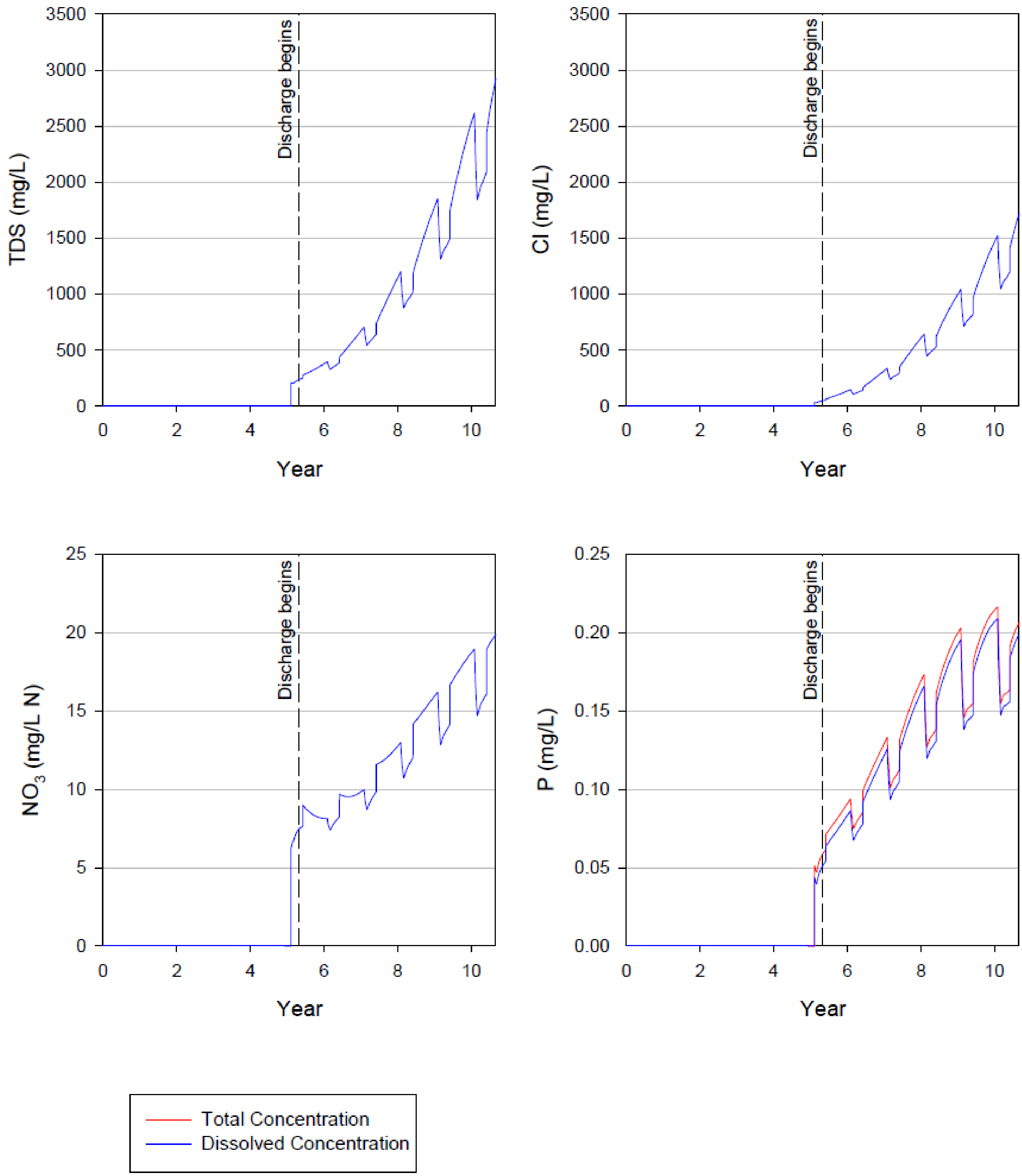
JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

Jay Pit Outflows
Dewatering, Operations and Closure

Golder Associates

PROJECT No. 13-1328-0041			PHASE No. 2020	
DESIGN	APB	6MAY14	SCALE NTS	REV. 0
CADD	APB	6MAY14	FIGURE	
CHECK	MLP	11JUN14		6-7
REVIEW	DRW	30SEP14		



PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

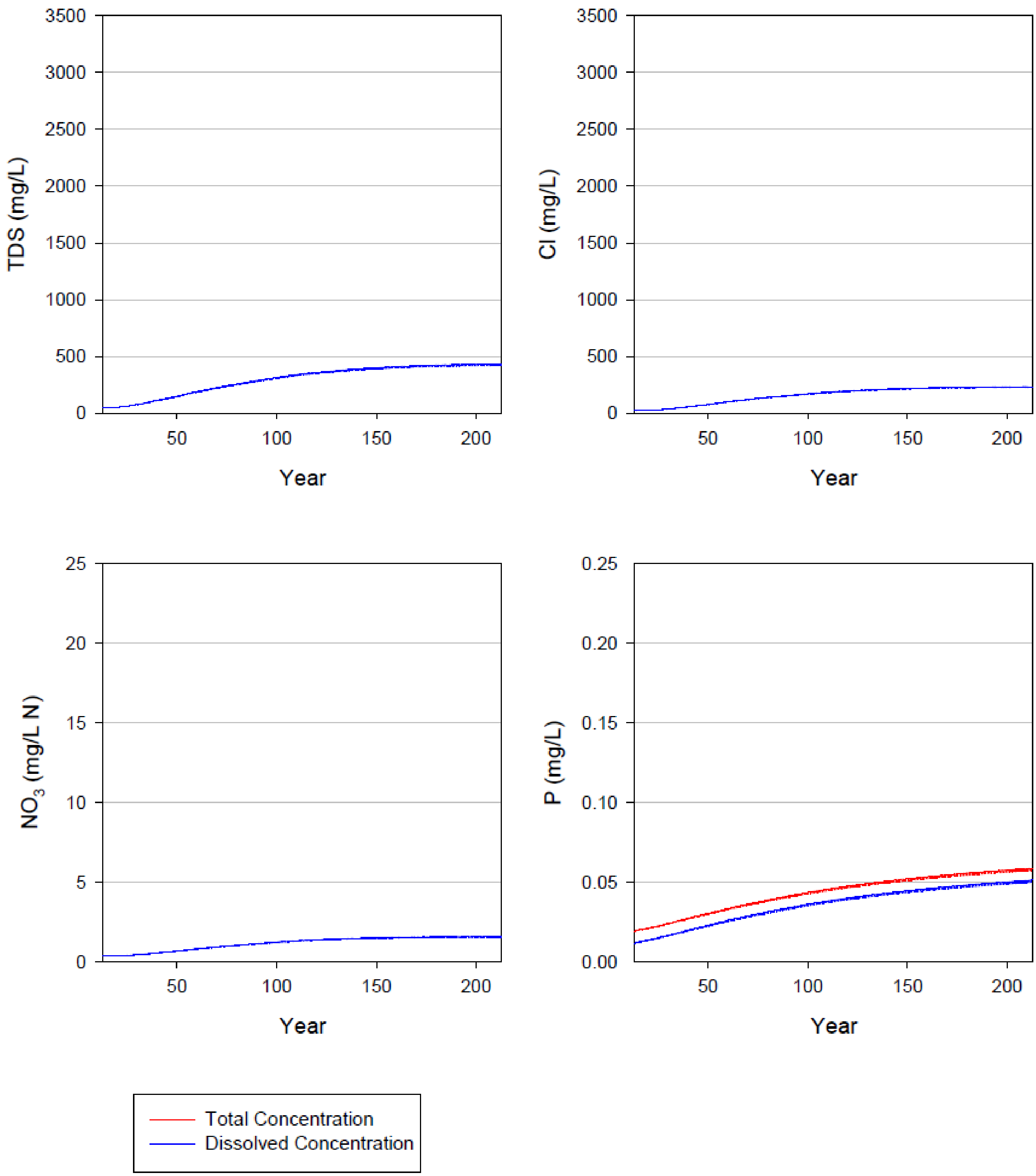
TITLE

Projected Misery Discharge
Water Quality - Operations

Golder Associates

PROJECT No.	13-1328-0041		PHASE No. 2020	
DESIGN	KS	11SEP14	SCALE NTS	REV. 0
CADD	PC	15SEP14	FIGURE	
CHECK	MH	15SEP14		7-1
REVIEW	DRW	30SEP14		

Q:\13-1328-0041 Dominion\FEFLOW_Misery_2DFEFLOW_Misery_2D_Figures.pptx



PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

Projected Misery Discharge
Water Quality – Post-Closure

Golder Associates

PROJECT No.	13-1328-0041	PHASE No.	2020
DESIGN	KS	11SEP14	SCALE NTS / REV. 0
CADD	PC	15SEP14	FIGURE
CHECK	MH	15SEP14	7-2
REVIEW	DRW	30SEP14	

APPENDIX A

Back-Flooding Recommendations for Closure

DATE September 2, 2014 **REFERENCE No.** 1313280041-E14049-TM-Rev0-2020

TO Mats Heimersson
Dominion Diamond Ekati Corporation

FROM John Cunning and Ermanno Rambelli **EMAIL** jcunning@golder.com; erambelli@golder.com

DOMINION DIAMOND JAY PROJECT
LAC DU SAUVAGE BACK-FLOODING RECOMMENDATIONS FOR CLOSURE

1.0 INTRODUCTION

Dominion Diamond Ekati Corporation (Dominion Diamond) has retained Golder Associates Ltd. (Golder) to conduct a pre-feasibility design for mining the Jay kimberlite pipe deposit (Jay Project) at its Ekati Diamond Mine in the Northwest Territories (NWT).

The Jay Project involves the development of the Jay kimberlite pipe, which is located beneath Lac du Sauvage, northeast of the existing Misery Pit operations. Dewatering of part of Lac du Sauvage and diversion of headwater flows are required before commencing mining activities. The dewatered water level will be maintained through the life of the mining operations by pumping. After the mining is completed, the dewatered part of Lac du Sauvage will be back-flooded.

This memorandum summarizes the preliminary recommendations for back-flooding the Lac du Sauvage dewatered area at the end of the Jay Project. The back-flooding will include filling the Jay Pit and the dewatered portion of Lac du Sauvage (Diked Area).

The procedure for back-flooding the dewatered area will be developed as part of the pre-feasibility design of the Jay Project and will be included in the proposed closure and reclamation plan for the Jay Project, which is currently being prepared by Golder.

The layout of the Jay Project at the end of mining operations is provided in Attachment 1.

2.0 RECLAMATION GOAL AND OBJECTIVES FOR LAC DU SAUVAGE DEWATERED AREA

The reclamation goal for the Ekati Mine, as approved by the Water Board through the Interim Closure and Reclamation Plan (ICRP) report (BHP Billiton 2011 and BHP Billiton 2012), is “to return the Ekati Mine site to viable, and wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment, human activities, and the surrounding environment”. The reclamation goal is supported by specific objectives and completion criteria for each type of development (open pits, underground workings, roads, etc.). Reclamation of the Jay Project developments will be designed to fit into this established framework.

The objectives for reclamation of the Lac du Sauvage dewatered area, used for the development of the recommended back-flooding procedure, include the following:

- Natural lake water levels will be re-established; the dewatered area will be re-established to approximately 416.1 m above sea level (m a.s.l.) (natural water level in Lac du Sauvage);
- Water quality within the back-flooded diked area will meet closure criteria prior to permanent breaching of the dike or return of other natural inflows;
- Natural flow paths that have been disturbed for the Jay Project will be re-established where practicable;
- Sub-basin B diversion channel (Christine Lake outflow channel in the Terms of Reference for the Jay Project) will be re-graded to promote natural drainage once the water quality in the back-flooded area will meet closure criteria for discharge;
- Lac du Sauvage will be the primary source for back-flooding the dewatered area;
- Back-flooding of the dewatered area will be carried out in a manner that provides a controlled flow of water in order to protect source water and downstream areas against negative impacts, specifically:
  - local fish habitat disturbance during back-flooding, along with turbidity; and
  - impacts on Lac de Gras and Lac de Sauvage in terms of water level and local hydrological regime.
- Back-flooding time will be reduced based on a reasonable balancing of time/costs with environmental protection;
- Local fish will be able to naturally re-enter the back-flooded area of Lac du Sauvage after the dike has been breached; and
- Local navigation will be re-established as required to meet Transport Canada requirements in the back-flooded area of Lac du Sauvage.

3.0 CLOSURE BACK-FLOODING DESCRIPTION AND RESULTS

3.1 Back-Flooding Volume Requirement

The total volume of water required to back-flood the dewatered area, based on the information available to date is summarized in Table 1.

Table 1: Total Jay Project Back-Flooding Volume Requirement

Area	Volume at Completion (M-m^3)	Total Volume at Completion (M-m^3)	Start Back-Flooding
Jay Pit	93.84	120.48	Year 2030[1]
Diked Area	26.64		

Note: 1. Back-flooding assumed to start in the winter of 2030 at the start of closure.
M-m^3= Million cubic metres.

3.2 Water Management and Back-flooding Summary

The layout of the Jay Project at the end of mining operations is provided in Attachment 1.

At completion of mining the Jay pipe, and as part of the closure measure for Misery Pit, the water level in Misery Pit will be lowered to approximately 60 m below the final overflow elevation. This water is expected to have high concentrations of TDS (total dissolved solids) and it will be pumped into the mined out Jay Pit, where it will occupy the lower half (based on elevation). Once this has been completed, the remaining volume will be back-flooded with water to facilitate creation of a freshwater cap. Water will come from a combination of runoff, precipitation and from Lac du Sauvage. Water from Lac du Sauvage will be pumped over the dike in a controlled manner to control the generation of TSS (total suspended solids). Once water quality within the back-flooded area is demonstrated to be suitable for discharge, then the dike will be locally breached and the Sub-basin B diversion channel will be re-graded to promote natural drainage.

A 60 m cap of fresh water will be created above the high TDS water in the Misery Pit, using runoff, direct precipitation and water pumped from Lac du Sauvage. The remaining high TDS laden water will remain in the lower part of the Misery Pit following the creation of the freshwater cap due to density stratification. Consideration may be given during future stages of design to pumping freshwater from Lac de Gras instead. Once the freshwater cap is created and water quality has been demonstrated to be suitable for discharge, a hydraulic connection to the natural channel to Lac de Gras will be re-established to allow for discharge of water overflows from the surface of the Misery Pit lake to the environment.

3.3 Modelling

The proposed closure back-flooding procedure was modelled with GoldSim to establish flooding rates and the expected time for back-flooding. The existing “Regional Water Balance Model” and “Local Water Balance Model” developed for the Jay Project were used to model the recommended closure procedure. It is assumed that, during the back-flooding period, the Sub-basin B diversion channel will remain in place and will discharge into Lac du Sauvage; therefore water from Sub-basin B will not be used for back-flooding. It has also been assumed that back-flooding can occur year round (to be confirmed during future stages of design).

Meteorological data used for the proposed closure back-flooding modelling were generated from average monthly values from existing local data for the period 1959 to 2013, with the exception of temperature records, which used a daily average from the existing data to provide temperature variations within months. As part of the Environmental Assessment (EA) process for the Jay Project, a hydrology baseline report is being completed which presents these data.

As the meteorological data used for the proposed closure back-flooding modelling are based on averages from the 1959 to 2013 historical records, the estimated effects of closure back-flooding to regional hydrology are for average conditions and do not reflect effects expected to be observed during wet or dry years. Furthermore, results from winter hydrology field programs indicate that the regional hydrology baseline model may slightly over-predict winter flows from the Lac du Sauvage outlet; therefore causing an under-estimate of impacts due to winter withdrawals. Nonetheless, the model is adequate for current purposes (Environmental Assessment and Pre-Feasibility Design). In practice, flow rates into the diked area (and/or the Misery pit) could be varied to accommodate actual conditions in the field and to avoid significant negative effects in the source lakes.

3.4 Results

Modelling results for the proposed closure back-flooding procedure are presented in Attachment 2.

The results for the proposed back-flooding procedure are summarized in Table 2 and in Table 3. The times for back-flooding the dewatered area presented in Table 2 and the estimated regional hydrological effects presented in Table 3 have been estimated using the following pumping assumptions:

- 3,500 m^3/hr will be pumped from the top 60 m of Misery Pit to Jay Pit until the Misery Pit water level is lowered to 60 m below the final overflow elevation. The volume of the top 60 m of Misery Pit is approximately 16.75 million m^3;
- 1,500 m^3/hr will be pumped from Lac du Sauvage to the Misery Pit until it is close to being full, but without external discharge. (Discharge from Misery Pit to the environment will be deferred until acceptable water quality has been demonstrated);
- While Misery Pit is being back-flooded, 5,000 m^3/hr will be pumped from Lac du Sauvage to the Jay Pit and the Diked Area during the June to October period only;
- Once Misery Pit is full, 1,500 m^3/hr will be pumped from Lac du Sauvage to the Jay Pit and the Diked Area during the November to May period, and 6,500 m^3/hr will be pumped during June to October period;
- A maximum pumping rate of 1,500 m^3/hr from Lac du Sauvage during the November to May period has been considered throughout the back-flooding period; and
- Pumping rates are based on pumping capacity available during mining operations; no additional pumping capacity is proposed for closure back-flooding.

The regional hydrological effects of the closure back-flooding procedure were considered for both the Lac du Sauvage and Lac de Gras lakes and outlets. Specific percent reductions were provided for annual cumulative discharges and both the high and low discharges expected under the average meteorological conditions.

Table 2: Proposed Closure Back-flooding Summary

Area	Estimated Time for Back-Flooding [(a)]	Back-Flooding Volume (M-m^3)	Pumped Volume (M-m^3)	Other Inflows (M-m^3) [(b)]
Jay Pit	1,135 Days (Approx. 3 years, 1 month)	93.84	85.17	8.67
Diked Area	247 Days (Approx. 8 months)	26.64	25.02	1.62
Total	1,382 Days (Approx. 3 Years, 9 months)	120.48	110.20	10.28

Note:
a) Based on pumping rates described above with closure commencing on January 1, 2030.
b) Other Inflows include local precipitation, seepage, and local runoff.
c) The volume for the top 60 m of Misery Pit (to be filled with fresh water) is approximately 16.75 M-m^3, it is expected that this volume will be pumped from Lac du Sauvage in 443 days.
m^3/s = cubic metres per second; M-m^3 = Million cubic metres.

Table 3: Regional Hydrological Effects Summary for Proposed Closure Back-flooding

Area of Estimated Effect	Annual Water Discharge Reduction at Lake Outlet (%)	Reduction in average high flows (%)	Reduction in average low flows (%)	Reduction in average high lake levels (m)	Reduction in average low lake levels (m)
Lac du Sauvage	15	14	24	0.05	0.05
Lac de Gras[a]	5	5	7	0.05	0.03

Note:
a) Lac de Gras is recharged by a catchment area of approximately 4,130 km^2. Average annual recharge of 620 $M\text{-}m^3$ (GoldSim Model 2009-2040).

4.0 CONCLUSIONS AND PATH FORWARD

Based on the modelling results available to date, back-flooding would be achieved in about four years (assuming average conditions) and is expected to have acceptable minimal impacts to the level and local hydrological regime in Lac du Sauvage and Lac de Gras. At this stage, it is expected that four years would be an adequate back-flooding time; however studies are currently being carried out to confirm this.

During next stages of the development of the Project, additional modelling will be carried out for the proposed closure back-flooding procedure to better define the water transfer rates. In particular, the modelling will indicate the possibility that there will be times when reduced transfer rates will be required to limit impacts on the downstream hydrological regime during low flow periods, and also the likelihood that increased transfer rates are possible during freshet periods or during high flow periods. The modeling will be conducted with support from fish and fish habitat specialists to identify strategies that could be implemented to reduce impacts of the closure back-flooding to key components, such maintenance of fish passage, rate of change in water depths from late summer to winter and changes to extension of lake surface area (due to changes in water level).

Potential implications to dike design and performance of varying water and ice levels in Lac du Sauvage during the back-flooding stages will also be considered.

Replacing the proposed pumping system from Lac du Sauvage by controlled weirs, to be constructed in the dike at selected locations, will also be evaluated as an alternative option for back-flooding the dewatered area.

5.0 CLOSURE

The reader is referred to the Study Limitations which follows the text and forms an integral part of this technical memorandum.

We trust the above information is sufficient for your present needs. Should you have any questions or require additional information, please do not hesitate to contact us.

GOLDER ASSOCIATES LTD.

Ingrid Martinez, P.Eng. (ON)
Geotechnical Engineer

Ken Bocking, P.Eng.
Principal, Senior Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
J.C. CUNNING
LICENSEE
NWT/NU

Sept 2/14

John Cunning, P.Eng.
Principal, Senior Geotechnical Engineer

Ermanno Rambelli, P.Geo. (BC)
Associate, Senior Engineering Geologist
Project Manager

IM/KAB/JCC/ER/km/jc/ls

Attachments: Study Limitations
Attachment 1: Figure 1 – Operations Footprint
Attachment 2: Model Results (Selected Charts)

\\golder.gds\gal\burnaby\final\2013\1328\13-1328-0041\1313280041-e14049-tm-rev0-2020\1313280041-e14049-tm-rev0-2020-jay-lds backflooding 02sep_14.docx

THE ASSOCIATION OF PROFESSIONAL ENGINEERS, GEOLOGISTS and GEOPHYSICISTS OF THE NORTHWEST TERRITORIES
PERMIT NUMBER
P 049
02/09/2014
GOLDER ASSOCIATES LTD.

REFERENCES

BHP Billiton (BHP Billiton Canada Inc.). 2011. Ekati Diamond Mine, Interim Closure and Reclamation Plan. Project 0648-105-01, Report Version 2.4. Report prepared for Wek'eezhii Land and Water Board. Submitted August 2011.

BHP Billiton. 2012. Ekati Diamond Mine, 2012 Annual Interim Closure and Reclamation Plan Progress Report (pages 35 to 42).

STUDY LIMITATIONS

Golder Associates Ltd. (Golder) has prepared this document in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this document. No warranty, express or implied, is made.

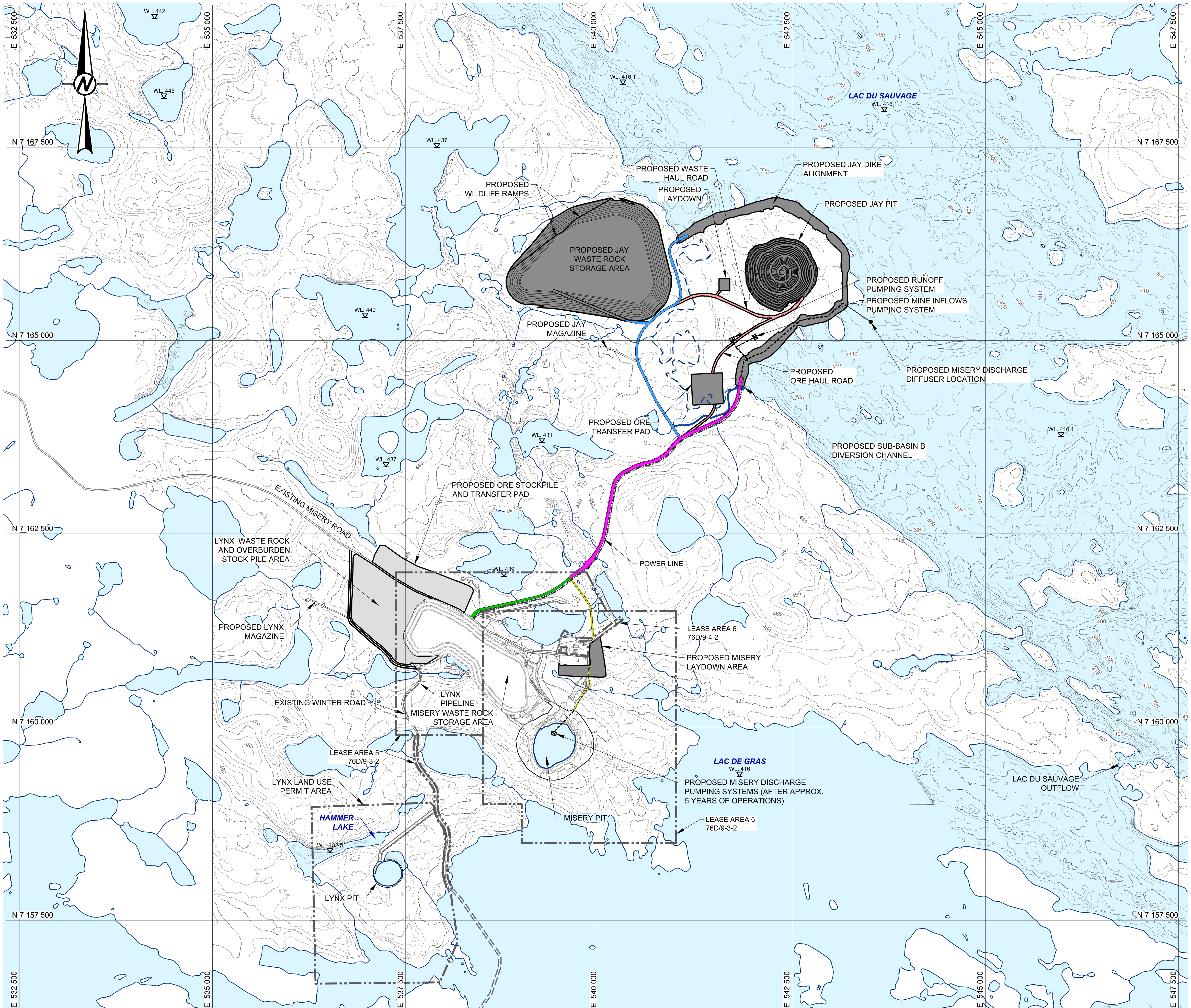
This document, including all text, data, tables, plans, figures, drawings and other documents contained herein, has been prepared by Golder for the sole benefit of Dominion Diamond Ekati Corporation. It represents Golder's professional judgement based on the knowledge and information available at the time of completion. Golder is not responsible for any unauthorized use or modification of this document. All third parties relying on this document do so at their own risk.

The factual data, interpretations, suggestions, recommendations and opinions expressed in this document pertain to the specific project, site conditions, design objective, development and purpose described to Golder by Dominion Diamond Ekati Corporation, and are not applicable to any other project or site location. In order to properly understand the factual data, interpretations, suggestions, recommendations and opinions expressed in this document, reference must be made to the entire document.

This document, including all text, data, tables, plans, figures, drawings and other documents contained herein, as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder. Dominion Diamond Ekati Corporation may make copies of the document in such quantities as are reasonably necessary for those parties conducting business specifically related to the subject of this document or in support of or in response to regulatory inquiries and proceedings. Electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore no party can rely solely on the electronic media versions of this document.

ATTACHMENT 1

Figure 1 – Operations Footprint



N:\Client\Dominion Diamond\Jay-Cardinal Project\99_PROJECTS\13-1328-0041\02_PRODUCTION\2020\55\MEMO\1313280041-2020-55_01.dwg | Layout: 1 | Modified: jdhaliwal 08/29/2014 4:00 PM | Plotted: jdhaliwal 08/29/2014

LEGEND

- WATER BODY
- WATER COURSE
- EXISTING SHORELINE IN DEWATERED AREA
- ROAD
- WINTER ROAD - YEARLY CONSTRUCTION
- PROPOSED PUMPING SYSTEM
- WL WATER LEVEL ELEVATION
- SURFACE LEASE BOUNDARY

JAY PROJECT FOOTPRINT

- PROPOSED DIVERSION CHANNEL
- PROPOSED JAY PROJECT INFRASTRUCTURE
- PROPOSED JAY ROAD NORTH (HAUL ROAD)
- PROPOSED JAY ROAD (HAUL ROAD AND POWER LINE)
- PROPOSED JAY ROAD (HAUL ROAD, PIPELINE AND POWER LINE)
- PROPOSED JAY PIPELINE ROAD (ACCESS ROAD AND PIPELINE)
- PROPOSED OPERATION ROADS

LYNX PROJECT FOOTPRINT

- LYNX PROJECT INFRASTRUCTURE

NOTES

1. ELEVATIONS ARE IN METERS ABOVE SEA LEVEL (masl).
2. GROUND SURFACE AND BATHYMETRY CONTOURS ARE SHOWN AT 5 m INTERVALS.
3. COORDINATES ARE SHOWN IN DATUM: NAD 83, PROJECTION: UTM ZONE 12.
4. PIPELINES, AND POWER LINE ARRANGEMENT TO BE DETAILED AS PART OF FURTHER PRE-FEASIBILITY DESIGN. APPROXIMATE CORRIDOR WIDTHS ARE SHOWN.
5. DRAWING TO BE READ IN CONJUNCTION WITH TECHNICAL MEMORANDUM E14049-TM-REV-0.

REFERENCE

1. CONTOUR AND BATHYMETRY DATA PROVIDED BY AURORA GEOSCIENCES LTD., FILE: Final 1m Contours - Priority Area.dxf, DATE RECEIVED: OCTOBER 29, 2013.
2. WATER OBTAINED FROM CANVEC © NATURAL RESOURCES CANADA, 2012.

NOT FOR CONSTRUCTION

0 1,000 2,000 3,000
SCALE METRES

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
A	2014-08-29	ISSUED FOR PFS DESIGN	IM	JD	KB	JCC

PROJECT

DOMINION DIAMOND

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

GENERAL ARRANGEMENT AT THE END OF JAY MINING

Golder Associates

PROJECT No.	13-1328-0041.2020.55	FILE No.	1313280041-2020-55_01
DESIGN	IM	2014-08-12	SCALE AS SHOWN
CADD	JD	2014-08-13	FIGURE
CHECK	KB	2014-08-29	1
REVIEW	JCC	2014-08-29	

ATTACHMENT 2

Model Results (Selected Charts)

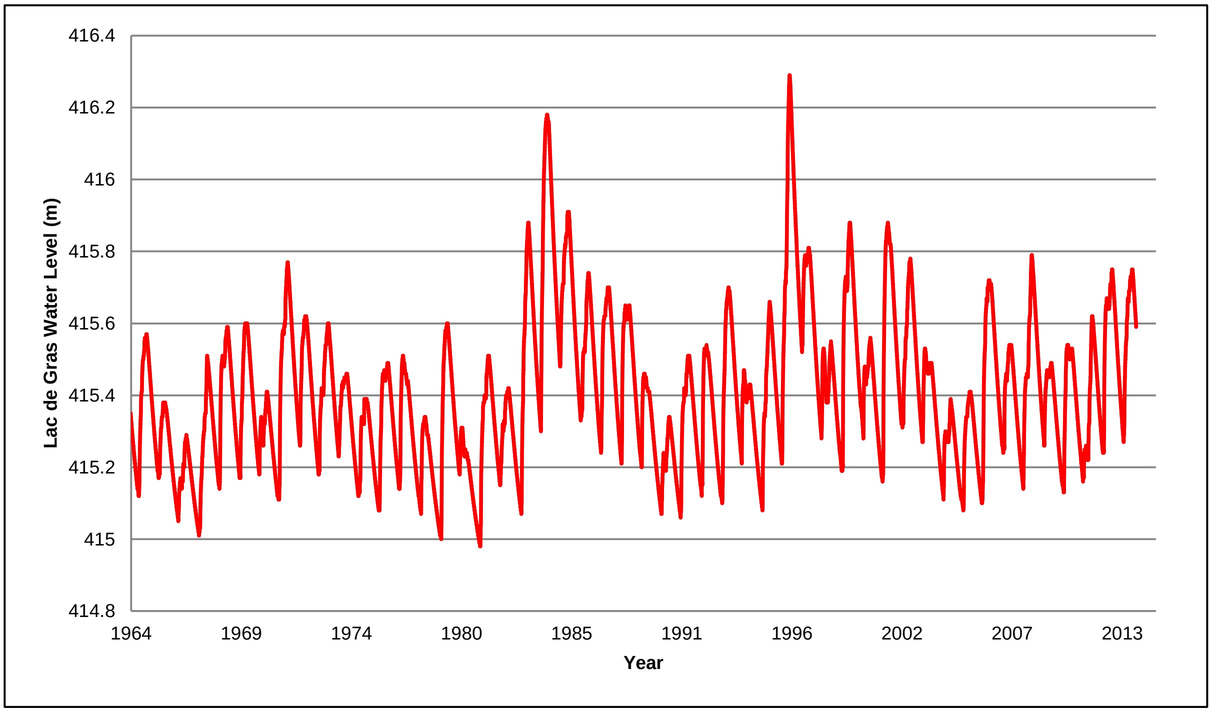


Chart 1 - Lac de Gras Water Level: Natural Variability

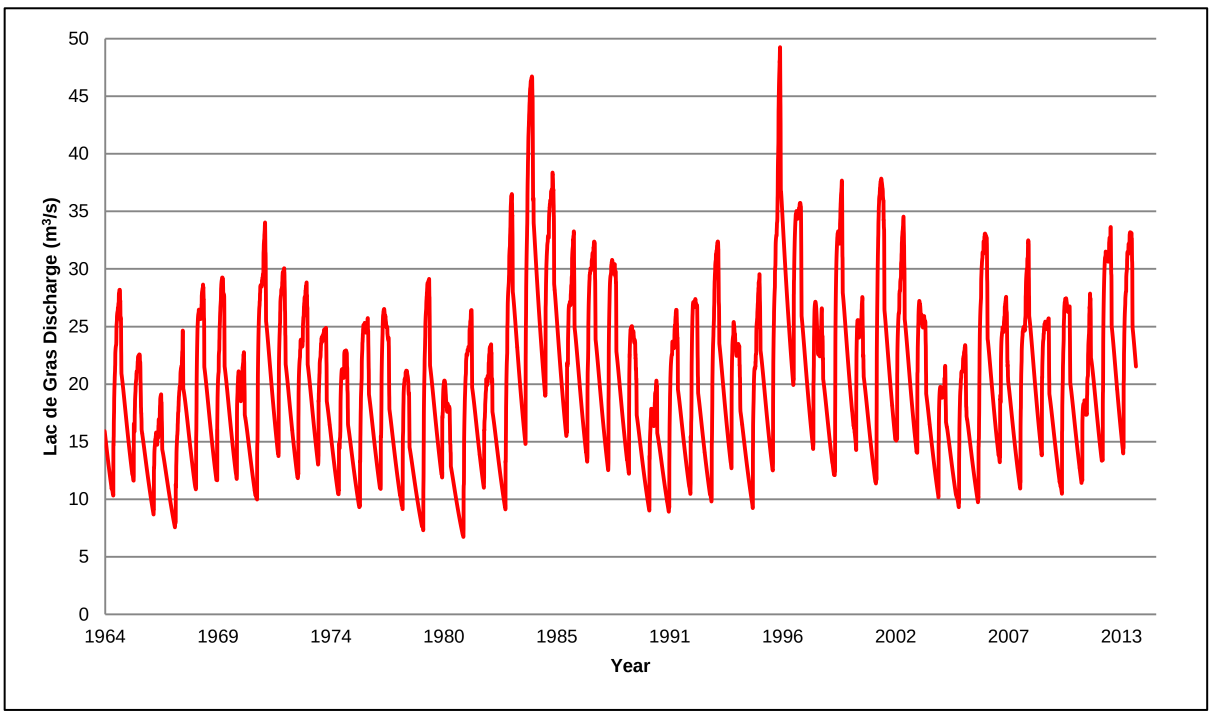


Chart 2 - Lac de Gras Discharge: Natural Variability

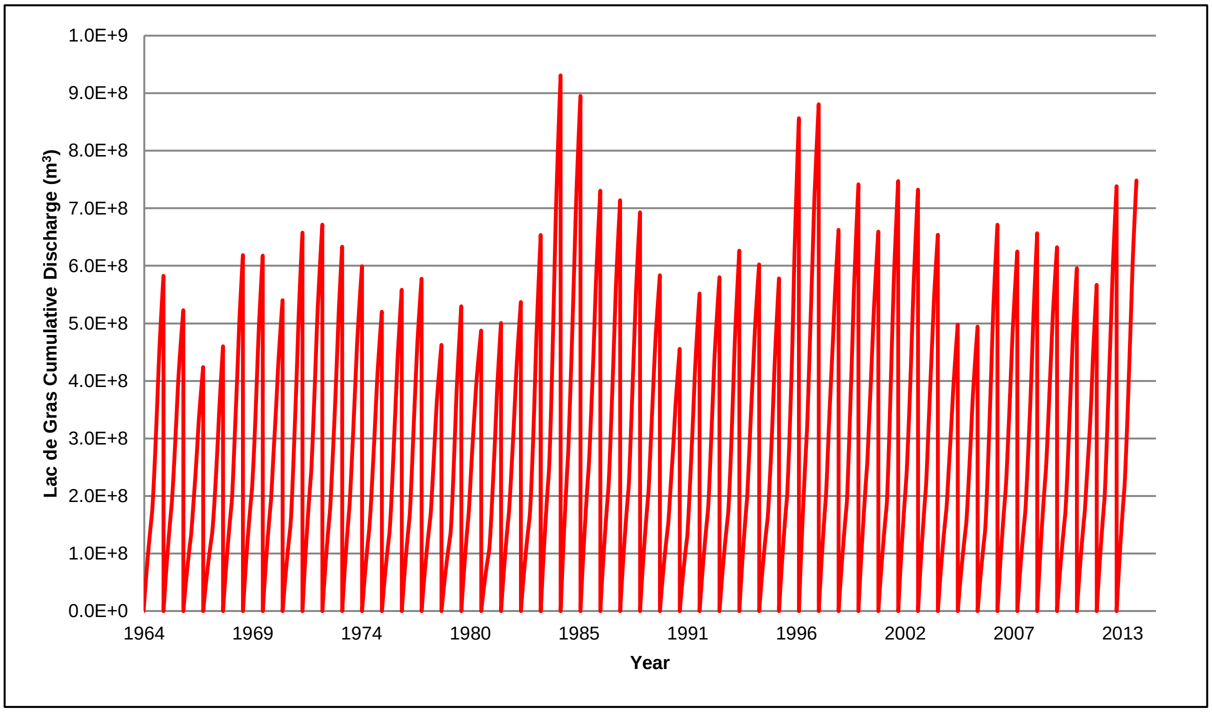


Chart 3 - Lac de Gras Annual Cumulative Discharge: Natural Variability

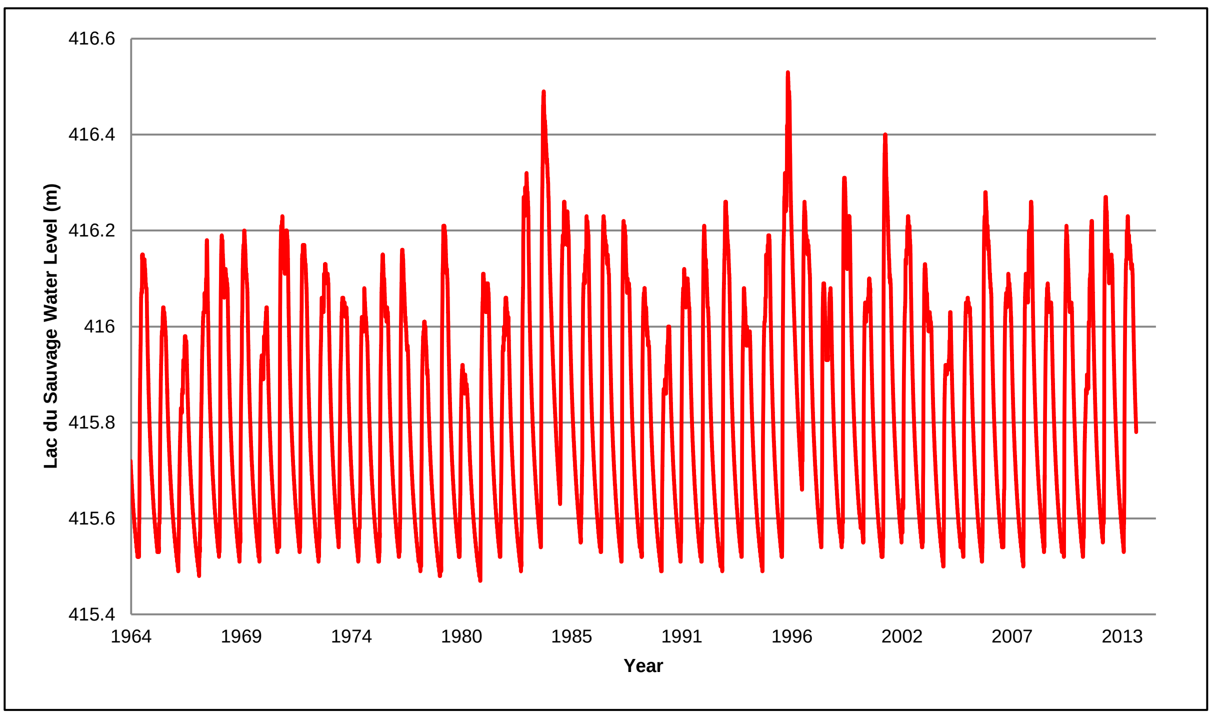


Chart 4 - Lac du Sauvage Water Level: Natural Variability

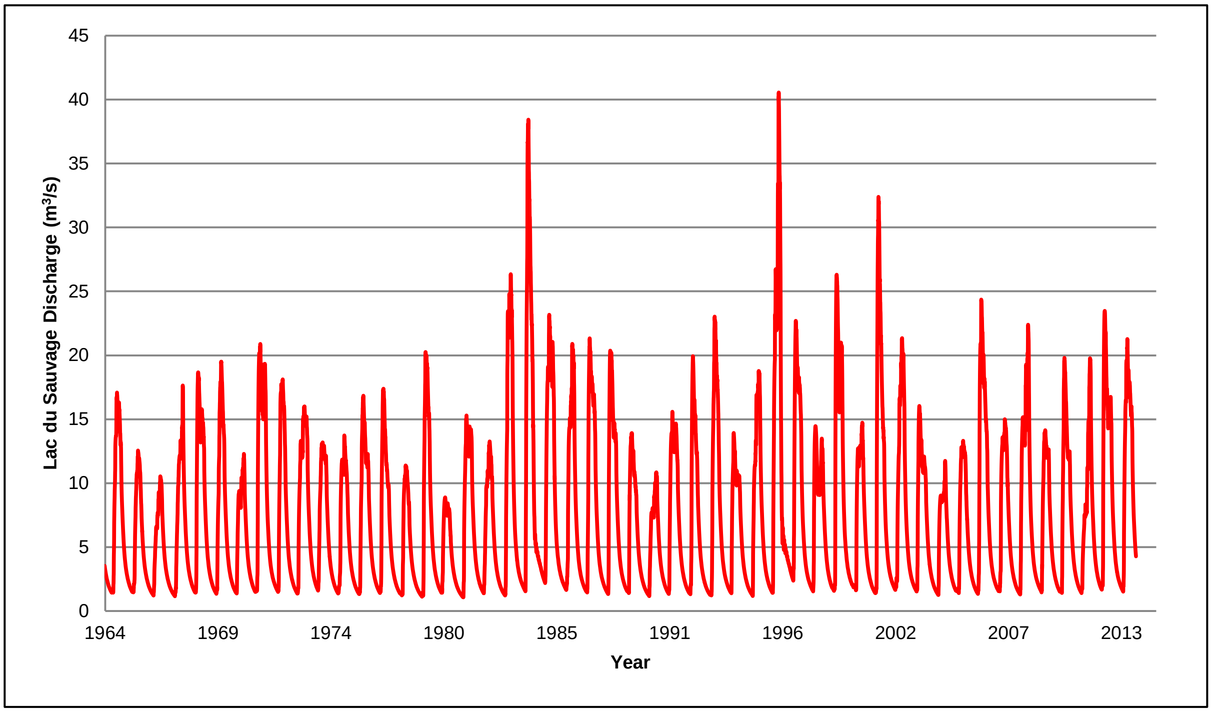


Chart 5 - Lac du Sauvage Discharge: Natural Variability

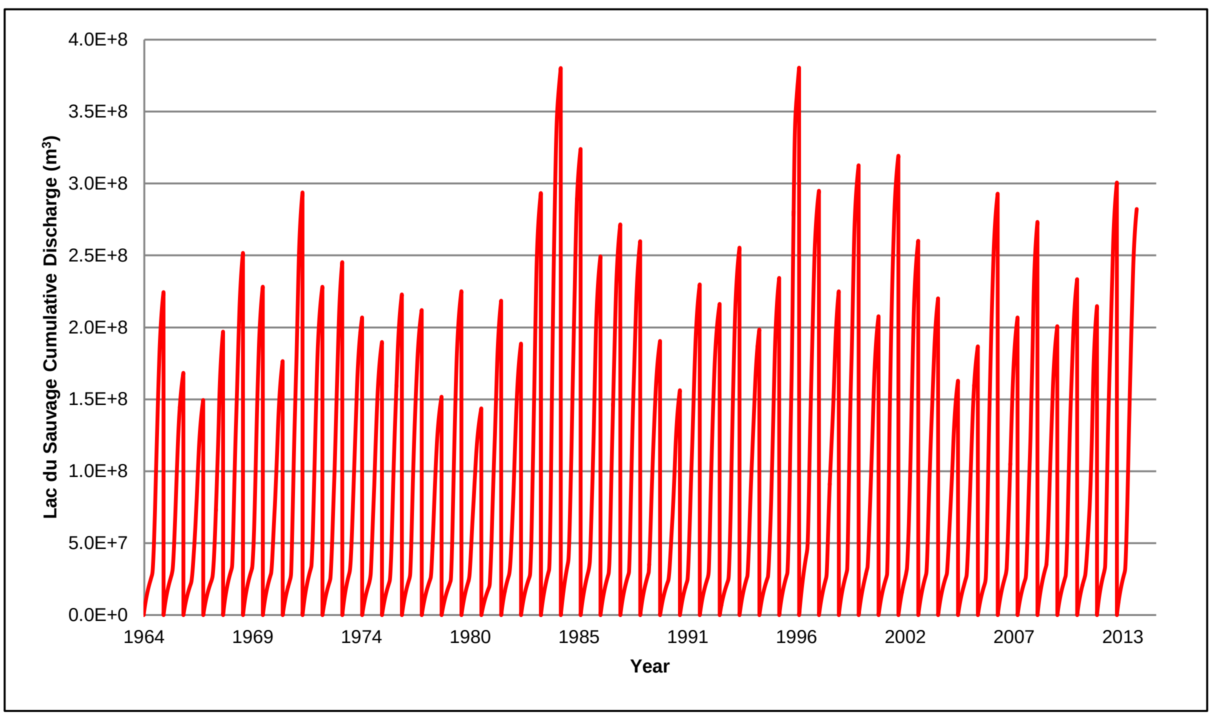


Chart 6 - Lac du Sauvage Annual Cumulative Discharge: Natural Variability

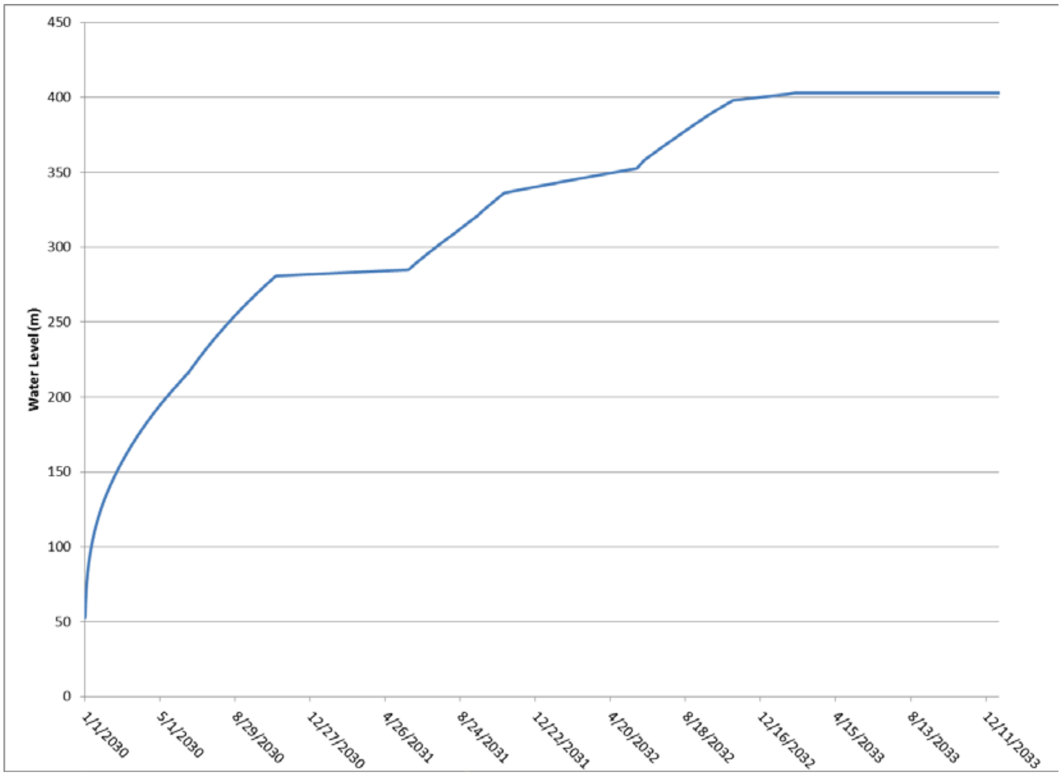


Chart 7 – Jay Open Pit Back-flooding at Closure

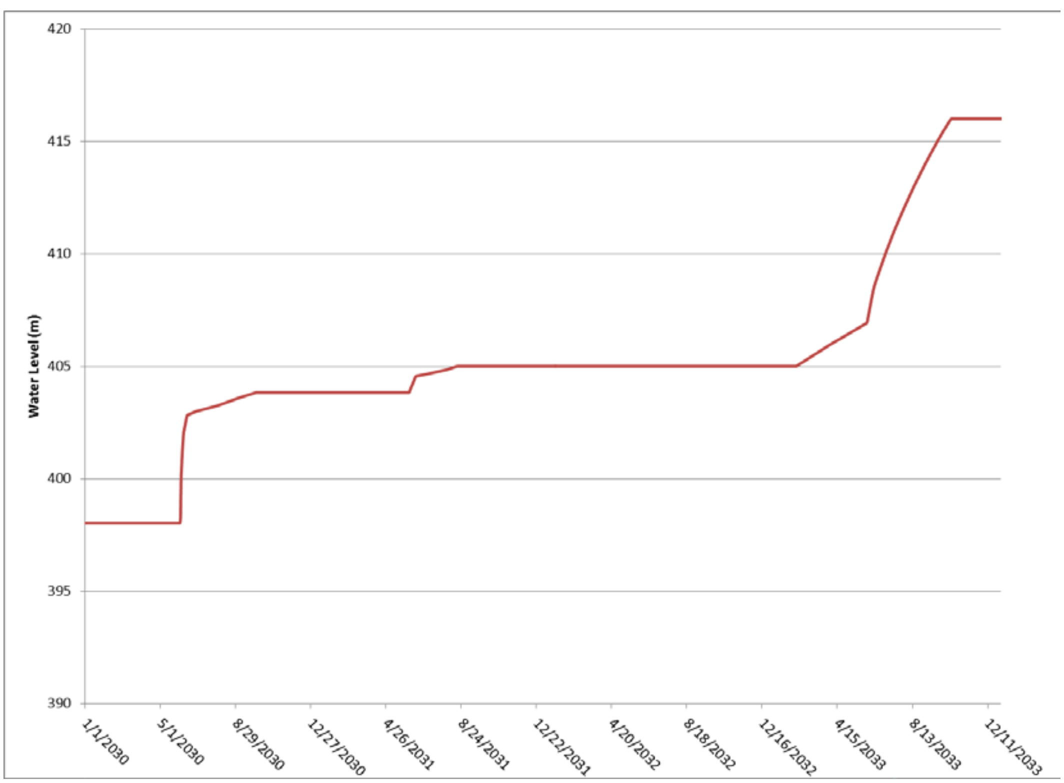


Chart 8 – Diked Area Back-flooding at Closure

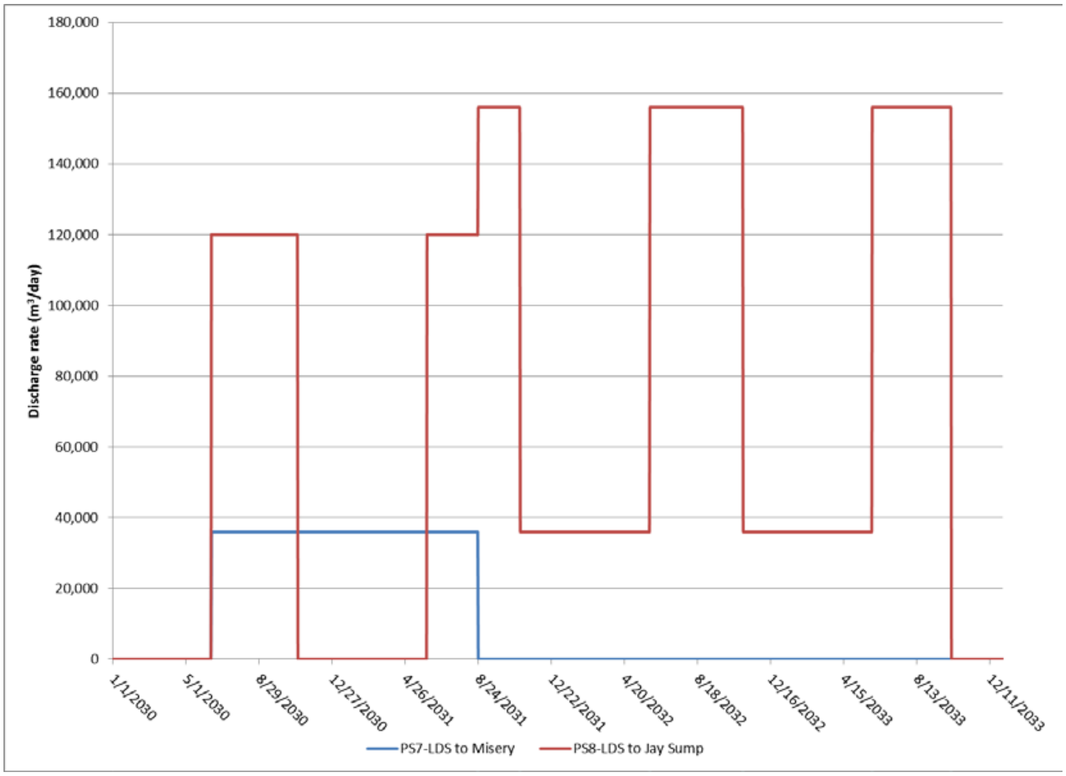


Chart 9 – Back-flooding Pumping at Closure

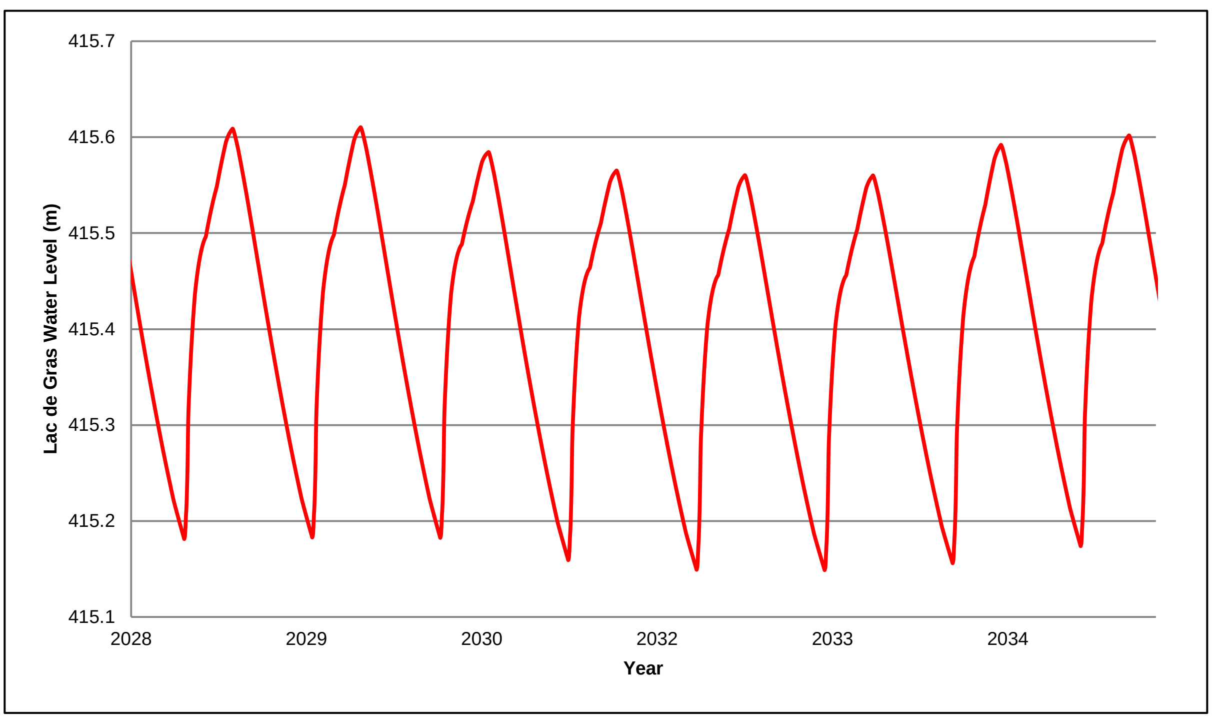


Chart 10 – Predicted Lac de Gras Water Level during Back-Flooding under Average Conditions

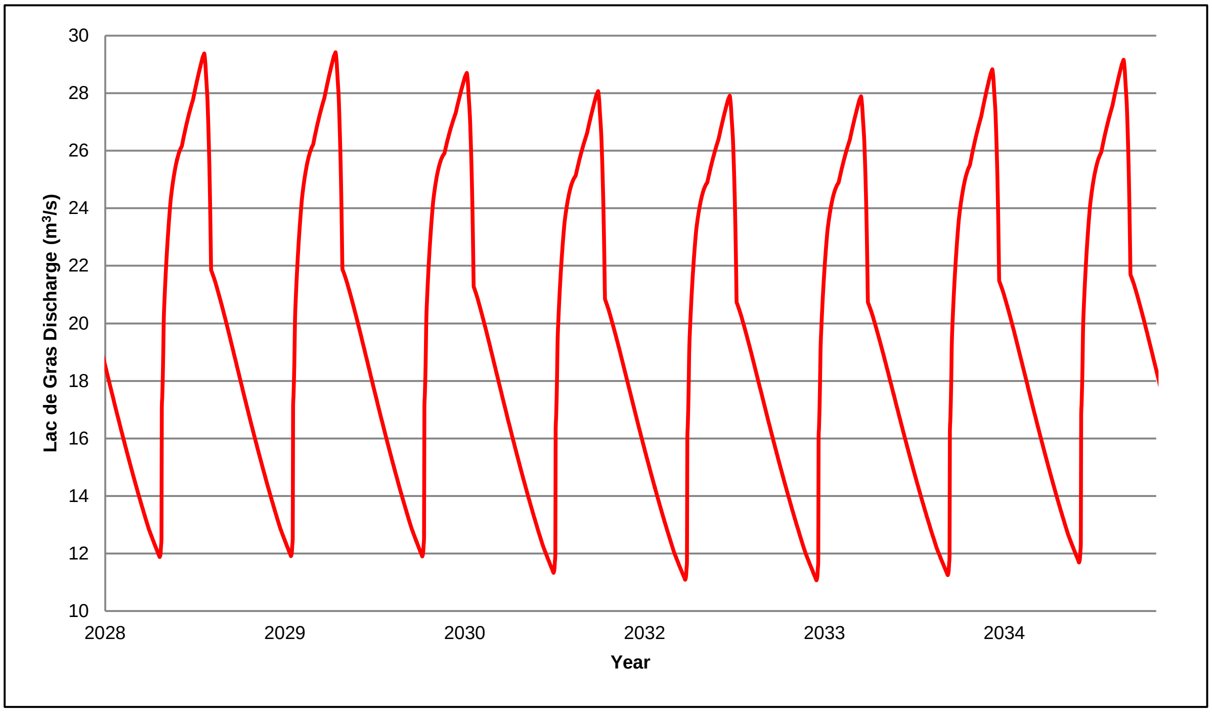


Chart 11 – Predicted Lac de Gras Discharge during Back-Flooding under Average Conditions

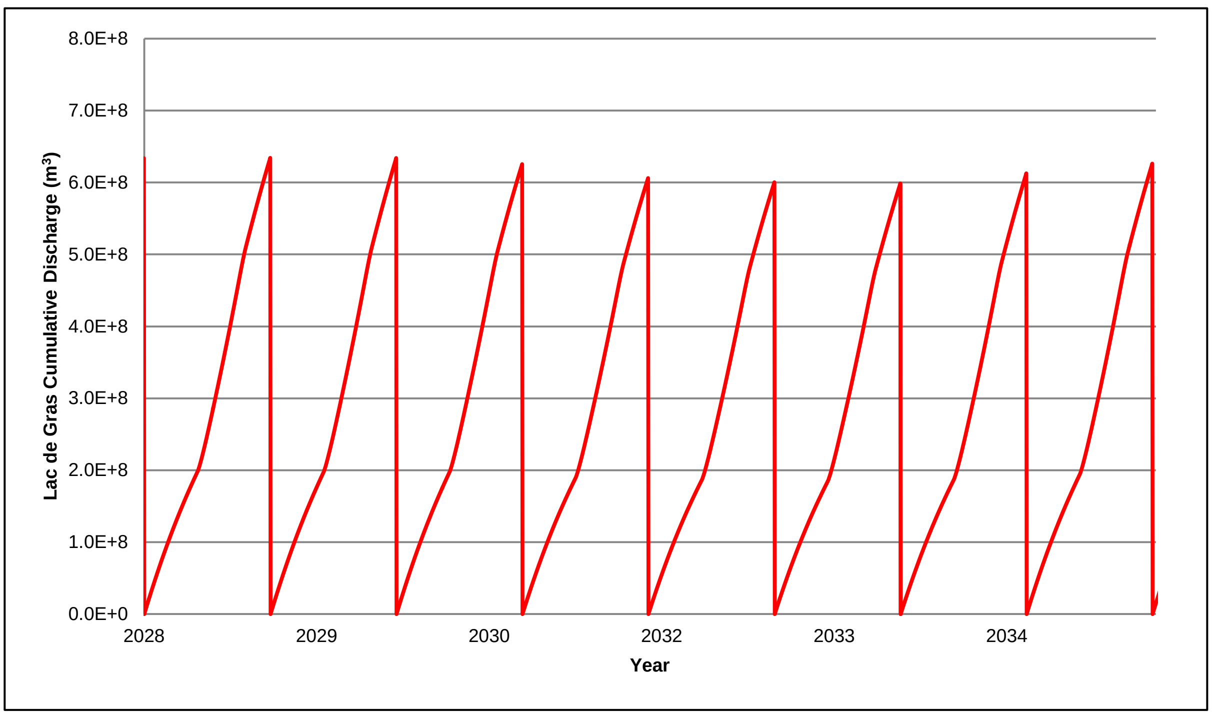


Chart 12 – Predicted Lac de Gras Cumulative Discharge during Back-Flooding under Average Conditions

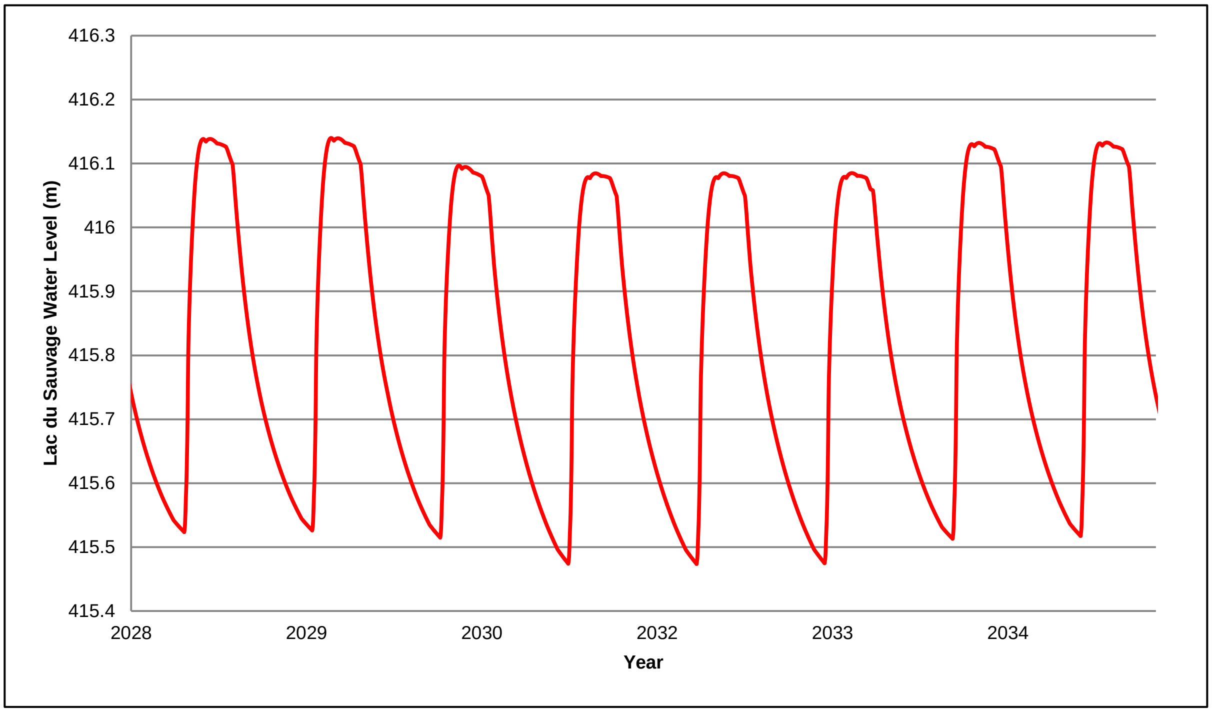


Chart 13 – Predicted Lac du Sauvage Water Level during Back-Flooding under Average Conditions

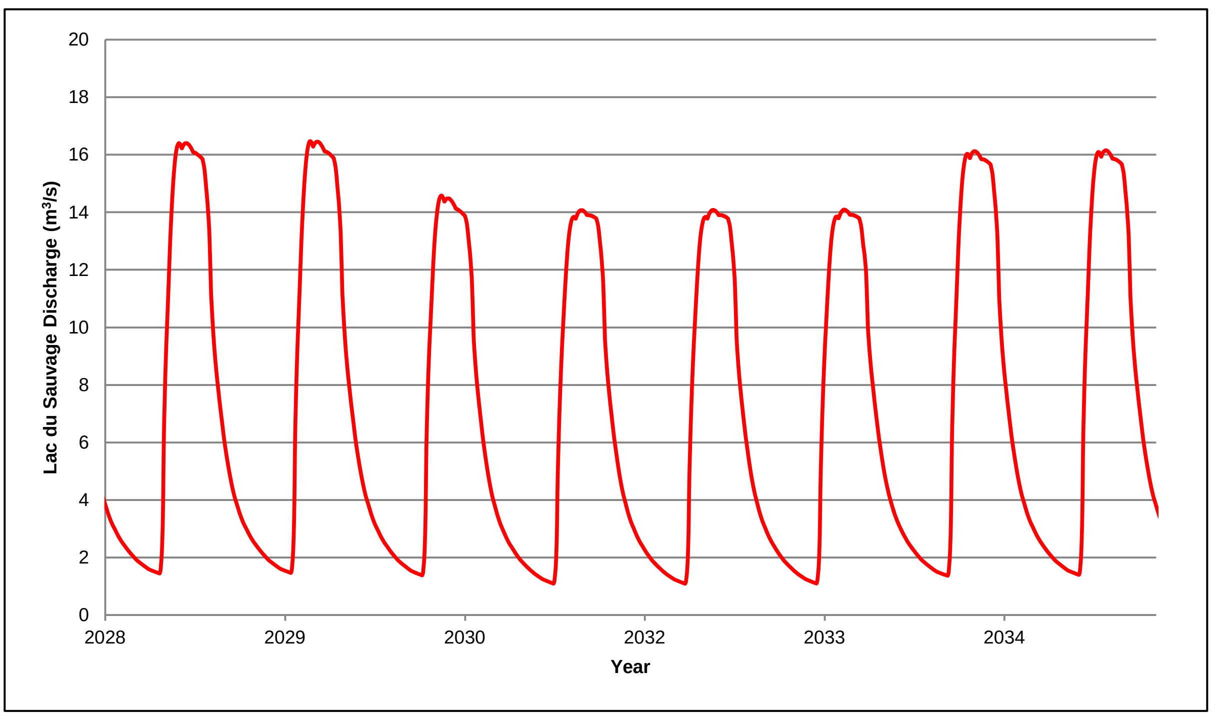


Chart 14 – Predicted Lac du Sauvage Discharge during Back-Flooding under Average Conditions

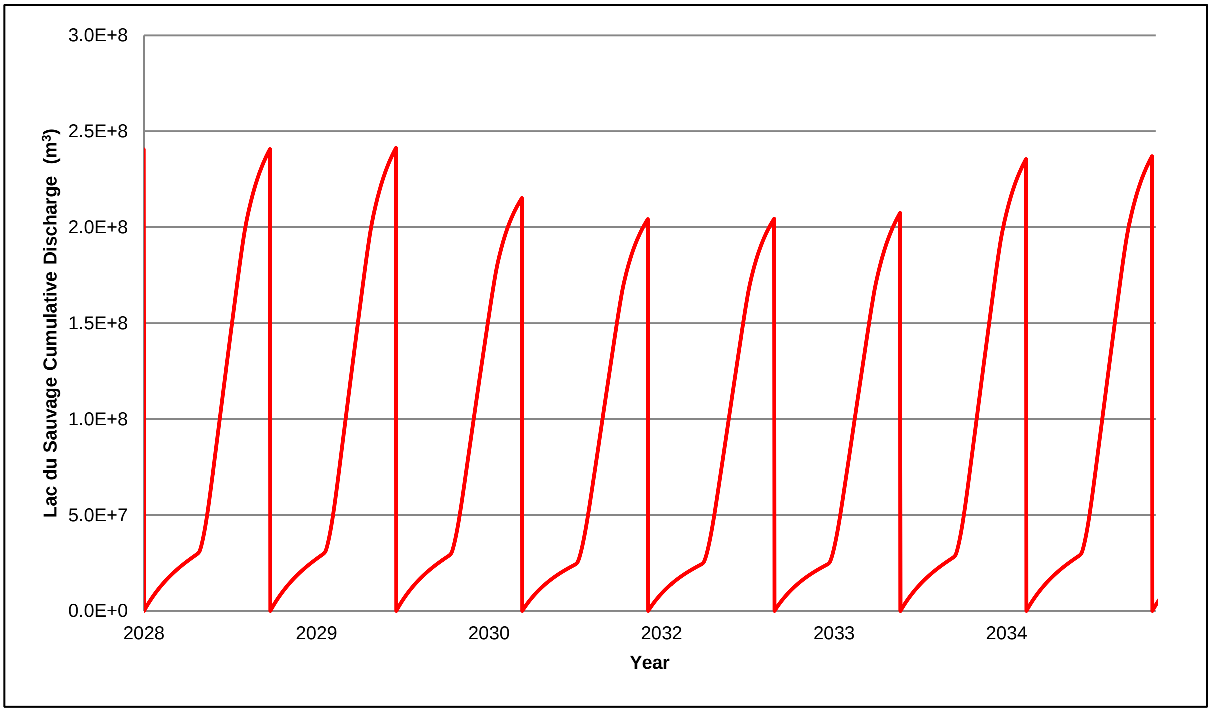


Chart 15 – Predicted Lac du Sauvage Annual Cumulative Discharge during Back-Flooding under Average Conditions

APPENDIX B

Water Balance Inputs

Table B.1: Water Balance Assumptions - General

Property	Value	Source	Comment/Assumptions
Time Step	1 Day	Golder	Runoff generation based on daily precipitation totals. Water quality regulations are generally based on mean monthly water quality.
Simulation Start	May 1, 2019	Golder	Model results are presented based on a Calendar year with the exception of the first year which is presented based on Dewatering and Stripping phases.

Table B.2: Water Balance Model Assumptions – Model Dates

Mine Phase	Start	End	Period Length
Dewatering	May 1, 2019	October 31, 2019	6 months
Open Pit Mining & Stripping	October 1, 2020 [a]	December 31 ,2029	10 year + 3 months
Closure	January 1, 2030	December 31, 2034	4 years

Notes:

a) During the first month of stripping there is an overlap of both Stripping and Dewatering

Table B.3: Water Balance Model Input Parameters and Assumptions - Runoff Generation

Property	Value	Source [a]	Comment/Assumptions
Precipitation	344.6 mm	Golder 2014a	Precipitation from October to May stored and released in June over a period of one month. Equivalent to a 33% runoff coefficient under average conditions. Seepage to/from groundwater assumed negligible due to permafrost.
Sublimation and Redistribution	30%	Golder 2014a	Applied over a 9 month period. Assumed 30% of the annual snowfall of 177.8 mm.
Lake Evaporation	272 mm	Golder 2014a	Annual value. Based on 4 years of collected site data.
Ice Thickness	1.5 m	Golder 2014a	Ice-cover season typically spanning from mid-October to late June and featuring a mean peak ice thickness of 1.5 m. Model assumes ice volume is instantaneously removed on October 1, and is melted at a constant rate through the month of June.
Runoff Coefficient for Undisturbed Area	0.7 June, 0.57 from July September	Golder 2014a	Monthly runoff coefficients applied to the natural ground and undisturbed areas. Accounts for losses due to evaporation, storage etc.
Runoff Coefficient for WRSA	0.7	Assumed	Monthly runoff coefficients applied to waste rock storage areas. Accounts for losses due to evaporation, storage etc.
Runoff Coefficient for Water Surface	1	Assumed	Average annual runoff coefficient applied to the pond surface (direct precipitation).
Runoff Coefficient for Pits	0.9	Assumed	Average annual runoff coefficient applied to the open pit areas. Accounts for losses due to evaporation, storage, etc.
Runoff Coefficient for Drained Down Area	0.7	Assumed	Average annual runoff coefficient applied to the dewatered areas. Accounts for losses due to evaporation, storage, etc.

Notes:

a) See “references” section of the report.

Table B.4: Water Balance Model Assumptions – Waste Rock Storage Areas

Property	Value	Source [a]	Comment/Assumptions
Infiltration (shallow)	0, 65 & 80% of Total Runoff	Assumed	Infiltration 0% (winter), 65% (June freshet) or 80% (summer) of total available runoff. Assumed shallow infiltration which reports to base of pile in same month. Surface runoff = total runoff less infiltration.
Surface Runoff	Total Less Infiltration	Assumed	Surface runoff = total runoff less infiltration
Water Retention	1%	Assumed	Assumed percentage of infiltrated water by volume retained in rock piles.
WRSA Final Area	250.7 ha	Golder 2014e	Footprint area.
WRSA Active Life	October 1, 2019 to December 31, 2030	Assumed	Pile starts being active at the start of stripping and ends at the start of closure.

Notes:

a) See "references" section of the report.

Table B.5: Water Balance Model Assumptions – Open Pit

Property	Value	Source	Comment/Assumptions
Misery Pit Seepage	$0 m^3$/day	Assumed	Assumed zero seepage into the open pits due to the surrounding permafrost
Growth Rate of Pit Footprints	Linear	Assumed	Pits are assumed to reach their final footprint over the first winter and the full footprint is assumed for the following freshet
Jay Pit Seepage	Lookup	Assumed	Based on Groundwater inflows (Section 4.1 of the report)
Runoff Volume	Computed	Assumed	Computed based on pit footprint (in plan)

o:\final\2013\1328\13-1328-0041\1313280041-e14056-r-rev0-2020\appendices\appendix b water balance inputs-sep15.docx

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

For more information, visit golder.com

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
500 - 4260 Still Creek Drive
Burnaby, British Columbia, V5C 6C6
Canada
T: +1 (604) 296 4200

Golder Associates